ISSN 2334-8496 (Online)

IJCR SEE

INTERNATIONAL JOURNAL OF COGNITIVE RESEARCH IN SCIENCE, ENGINEERING AND EDUCATION

IJCRSEE

Volume 12, Issue 2, August 2024.

www.ijcrsee.com

ISSN 2334-8496 (Online)

INTERNATIONAL JOURNAL OF COGNITIVE RESEARCH IN SCIENCE, ENGINEERING AND EDUCATION

IJCRSEE

Volume 12, Issue 2, August 2024.

www.ijcrsee.com

IMPRESSUM

International Journal of Cognitive Research in Science, Engineering and Education (IJCRSEE)
Volume 12, Issue 2, August 2024.

Editor in chief:
Dr. Lazar Stošić

Publisher:
The Association for the development of science, engineering and education
Address: Prvi maj 18, 17500 Vranje, Serbia
Phone: +381 17 400 165, + 381 63 700 4281
https://urnio.org.rs/
E-mail: predsednik@urnio.org.rs

Co-publisher:
University Business Academy, Faculty of Economics and Engineering Management in Novi Sad, Serbia
Address: Cvećarska 2, 21107 Novi Sad, Vojvodina, Srbija
https://www.fimek.edu.rs/en/

Don State Technical University
Address: Gagarin Square 1, Rostov-on-Don, Russia, 344000
https://donstu.ru/

For publisher:
Dr. Lazar Stošić
Dr. Marko Carić
Dr. Alla Belousova

Indexed & Abstracted:
Web of Science (Clarivate Analytics) – Emerging Sources Citation Index (ESCI), SCOPUS, SJR - Scimago Journal, DOAJ - Directory of Open Access Journals (DOAJ Seal), ProQuest, EBSCO (Academic Search Ultimate Magazines and Journal), DOI Serbia, Central and Eastern European Online Library (CEEOL), Dimensions, CyberLeninka, e-Library RU, COBISS.SR, MIAR, Sherpa/Romeo, CNKI, Turkish Education Index, ROAD, GoogleScholar, Dialnet, Index Copernicus, Harvard University Library, WorldCat, PUBDB DESY Publication Database, Journals Index (OAJI), J-Gate, Cabell's Directory, JOUR Informatics, Academic Journals Database, WorldWideScience Sources, UlrichsWeb, TIB-German National Library of Science and Technology, Science Central, Electronic Journals Library, Academic Keys, ETH-Bibliothek, BASE, PBN, OAJ, JournalTOCs...

International Journal of Cognitive Research in Science, Engineering and Education

(IJCRSEE)

EDITORIAL

International Journal of Cognitive Research in Science, Engineering and Education (IJCRSEE) is an open access international peer-reviewed, open-access journal, which provides a platform for highlighting and discussing various cognitive science issues dealing with the problems of cognition (and its evolution) within some specific subject field - philosophical, psychological, linguistic, mathematical, psychogenetic, pedagogical, ergonomic. Editorial Board strives to provide a possibility for the scientists of different fields to publish the results of their research, technical and theoretical studies. IJCRSEE is multidisciplinary in approach, and will publish a great range of papers: reports of qualitative case studies, quantitative experiments and surveys, mixed method studies, action researches, meta-analyses, discussions of conceptual and methodological issues, etc. IJCRSEE publisher is The Association for the Development of Science, Engineering and Education, Vranje, Serbia. Co-publishers are: University Business Academy, Faculty of Economics and Engineering Management in Novi Sad, Serbia and Don State Technical University, Rostov on Don, Russian Federation.

IJCRSEE particularly welcomes articles on the results of scientific research in various fields of cognitive science (psychology, artificial intelligence, linguistics, philosophy and neuroscience) catering for international and multidisciplinary audience. Readers include those in cognitive psychology, special education, education, adult education, educational psychology, school psychology, speech and language, and public policy.IJCRSEE has regular sections: Original Research, Review Articles, Studies and articles, Book Reviews, Case Studies, and is published three times a year. This journal provides an immediate open access to its contents, which makes research results available to the public based on the global exchange of knowledge. The journal also offers access to uncorrected and corrected proofs of articles before they are published.

The main aim of the Journal is to discuss global prospects and innovations concerning major issues of cognitive science, to publish new scientific results of cognitive science research, including the studies of cognitive processes, emotions, perception, memory, thinking, problem solving, planning, education and teaching, language and consciousness study, the results of studying man's cognitive development and the formation of basic cognitive skills in everyday life. The Journal seeks to stimulate the initiation of new research and ideas in cognitive science for the purpose of integration and interaction of international specialists in the development of cognitive science as interdisciplinary knowledge.

All articles are published in English and undergo a peer-review process.

The scope of IJCRSEE is focused on cognitive research both in topics covered as well as disciplinary perspective:

- Cognitive Research in Education
- Cognitive Pedagogics
- Cognitive Psychology
- Forensic Psychology
- Psycholinguistics
- Cognitive Linguistics
- Cognitive Culture Studies
- Cognitive Neurophysiology
- Cognitive Aspects: Sport Culture
- Cognitive Aspects: Methodology of Knowledge
- Text Processing and Cognitive Technologies

- Curriculum Development
- Development of Learning Environment
- Education Administration
- Educational Psychology
- Educational Technology
- Elementary Education
- Innovative Pedagogical Models
- Learning Systems Platforms
- Media Education
- Science Education
- Teaching and Learning Technologies
- Artificial intelligence and education

JCRSEE has an international editorial board of eminent experts in their field from Russia, USA, Republic of Macedonia, Germany, Hong Kong, Greece, Serbia, Australia, United Kingdom, USA, Turkey, Nigeria, Bulgaria, Romania, Spain, Italy, Republic of Srpska, Croatia, Kingdom of Saudi Arabia (KSA), India, China, Thailand, Israel, Malaysia, Morocco, Jordan,, Iran... We are confident that IJCRSEE will attract a great number of editors, eminent scientists in the field. The selection will be based on the activities of the editors and their desire to contribute to the development of the journal.

IJCRSEE provides a platform for academics and scientists professionals to refer and discuss recent progress in the fields of their interests. Authors are encouraged to contribute articles which are not published or not under review in any other journal.

Each submitted manuscript is evaluated on the following basis: the originality of its contribution to the field of scholarly publishing, the soundness of its theory and methodology, the coherence of its analysis, its availability to readers (grammar and style). Normal turn-around time for the evaluation of manuscripts is one to two months from the date of receipt.

Submission of an original manuscript to the journal will be taken to mean that it represents original work not previously published, that is not being considered elsewhere for publication; that the author is willing to assign the copyright to the journal as per a contract that will be sent to the author just prior to the publication and, if accepted, it will be published in print and online and it will not be published elsewhere in the same form, for commercial purposes, in any language, without the consent of the publisher.

The names and email addresses entered in this journal site will be used exclusively for the stated purposes of this journal and will not be made available for any other purpose or to any other party.

The requirement for the submission of a paper implies that it has not been published before; that it is not under consideration for publication anywhere else; that its publication has been approved by all co-authors.

When considering submitting an article, the Editors have provided the following criteria to assist authors with preparing their submissions:

Originality – The author should ensure that the manuscript has not been previously published nor is being considered by another journal.

Plagiarism - Content should be properly referenced. Be sure to check the paper for possible accidental plagiarism. Some plagiarism checker websites include: http://www.ithenticate.com/, www.antiplagiat.ru, www.grammarly.com, www.plagtracker.com or www.duplichecker.com

Writing – Please write in good English (American or British usage is accepted, but not a mixture of these). For non-native English speakers, and perhaps even for some native English speakers, grammar, spelling, usage, and punctuation of the texts are very important for an effective presentation. Hence, manuscripts are expected to be written in a clear, cogent, and readily understandable by an international readership.

Manuscripts must be submitted online. Electronic submission reduces the editorial processing and reviewing time. As part of the submission process, authors are required to check off their submission compliance with all of the following items, and submissions may be returned to authors who do not adhere to the following guidelines:

The submission has not been previously published or presented to another journal for consideration (or an explanation has been provided in Comments to the Editor).

The submission file is in OpenOffice, Microsoft Word, RTF, or WordPerfect document file format.

Where available, DOIs and URLs for the references have been provided.

The text is single-spaced; uses a 12-point font; employs italics, rather than underlining (except with URL addresses); and all illustrations, figures, and tables are placed within the text at the appropriate

points, rather than at the end.

The text adheres to the stylistic and bibliographic requirements outlined in the Author Guidelines.

If submitting to a peer-reviewed section of the journal, the instructions in Ensuring a Double Blind Review have been followed.

A manuscript goes through the peer review process. Authors submit manuscripts to Editorial office via the online system. The acknowledgement letter should be sent to the author to confirm the receipt of the manuscript. The Chief Editor first reviews manuscripts. Chief Editor is assisted by Section Editors (could also be Co- or Associated Editors). The Editor assigns a Section Editor to see the manuscript through the complete review process and return it with a recommendation or decision. The manuscript is checked to see if it meets the scope of the Journal and its formal requirements. If it is incorrect or unsuitable, the author should be informed and the manuscript filed (or returned if requested) – direct rejection. Manuscripts that are not suitable for publication in the Journal are rejected. A Rejection letter is sent to the author stating the reason for rejection. If the manuscript conforms to the aims and scope of the Journal, and formally abides by the Instructions to Authors it is sent out for review. Depending on the type of paper, it could be accepted immediately for publication (invited Editorial, Book review etc) by the Chief Editor.

Check that the manuscript has been written and styled in accordance with the Journal style; that it carries an abstract (if applicable), keywords, correct reference system etc. and check that the correct blinding system has been used. If anything is missing ask the author to complete it before the manuscript is sent out for review.

The manuscript is sent out for review. The reviewer reads and evaluates the manuscript and eventually sends a review report to the Chief Editor. The time for review can be set to 2-6 weeks depending on the discipline (more time is usually given to papers in the humanities and social sciences). Make sure to provide the reviewer with clear instructions for the work, e.g. outlined in the form of a Review report or a number of questions to be considered.

Based on the reviewers' comments the Chief Editor makes a decision to:

- Accept the manuscript without further revision
- Accept after revision
- Ask authors to resubmit
- Reject

An acceptance letter is sent to the author and the final manuscript is forwarded to production. Sometimes, the authors are requested to revise in accordance with reviewers' comments and submit the updated version or their manuscript to the Chief Editor. The time for review can be set to 2-6 weeks depending on the discipline and type of additional data, information or argument required. The authors are requested to make substantial revisions to their manuscripts and resubmit for a new evaluation. A rejection letter is sent to the author and the manuscript is archived. Reviewers might be informed about the decision.

After review a manuscript goes to the Copy Editor who will correct the manuscript concerning the correct referencing system, confirmation with the journal style and layout. When Copy Editor finishes his/her work they send manuscripts to the Layout editor.

Layout Editor is responsible for structuring the original manuscript, including figures and tables, into an article, activating necessary links and preparing the manuscript in the various formats, in our case PDF and HTML format. When Layout Editor finishes his/her job they send manuscripts to Proof Editor.

Proof Editor confirms that the manuscript has gone through all the stages and can be published.

This issue has 21 articles (19 Original researches and 2 Review articles). Our future plan is to increase the number of quality research papers from all fields of science, engineering and education. The editors seek to publish articles from a wide variety of academic disciplines and substantive fields; they are looking forward to substantial improvement of educational processes and outcomes.

Editor in Chief
Assoc. prof. Dr. Lazar Stošić, Research Associate

International Journal of Cognitive Research in Science, Engineering and Education (IJCRSEE)
Address: Prvi maj 18, 17500 Vranje, Serbia
Phone: +381 17 400 165, + 381 63 700 4281
Web: www.ijcrsee.com
E-mail: editor@ijcrsee.com

CONTENTS

Original scientific paper

Received: May 05, 2024.
Revised: August 02, 2024.
Accepted: August 08, 2024.

UDC:
373.3.091:005.336.3
378:006.015.5(497.11)
10.23947/2334-8496-2024-12-2-251-257

Using a Longitudinal Trajectory of Pre-Service Elementary School Teachers' Metacognition as a Quality Indicator of Higher Education

Branka Radulović[1*], *Milanka Džinović*[2], *Gordana Miščević*[2]

[1] University of Novi Sad, Faculty of Sciences, Department of Physics, Novi Sad, e-mail: branka.radulovic@df.uns.ac.rs
[2] University of Belgrade, Faculty of Education, Belgrade, e-mail: milanka.dzinovic@uf.bg.ac.rs; gordana.miscevic@uf.bg.ac.rs

Abstract: Quality of education is comprised in the quality of pre-service teacher education. However, to assess the quality of a teacher training program it is necessary to track some of the non-cognitive parameters. Metacognition is one of these parameters. The present study aimed at the longitudinal trajectory of the development of metacognition in pre-service teachers as an indicator of the quality of the applied teacher training program. The study included 160 pre-service elementary school teachers studying at Teacher Education Faculty at University of Belgrade. The participants' metacognitive development was measured by Metacognitive Awareness Inventory at three points of time (the beginning of studying, the academic year 2021/22 – T1, the end of the first year – T2, and the end of the second year, 2022/23-T3). The elementary school teacher training program is based on a combination of science and pedagogy related courses that together with school teaching practice start from the first semester. The courses based on problem solving and inquiry-based approach encourage students' search for adequate strategies and the assessment of their effectiveness. The findings point to a significant increase in total metacognition score between T1 and T2 and somewhat less intense increase between T2 and T3. The findings also point to a significant increase in all metacognitive subcomponents, with Conditional knowledge and Debugging strategies showing a significant increase only between T2 and T3. Between T1 and T2 the largest differences were detected in Declarative knowledge, Comprehension monitoring, and Planning. The results suggest that the teacher training program is metacognitively stimulating.

Keywords: *metacognition; pre-service elementary school teachers; study program; indicator of quality in higher education*

Introduction

Since the late 1970s when it was introduced, the concept of metacognition has constantly attracted the attention of researchers and educators due to its (in)direct effect on students' performance. According to Kuhn (2000; see Sendurur 2011, p. 102), metacognition is viewed as one of the goals in education or one of the most important aspects of problem solving (Wider and Wider, 2023, p. 359), i.e. factors that affect individuals' problem solving skills (Memnun and Akkaya, 2009, p. 1919). As an awareness of our own cognitive processes, metacognition is considered useful for raising students' awareness and responsibility for their own knowledge and ideas, as well as for applying different learning strategies to better understand the learning material (Anderson and Krathwohl, 2001; see Palennari, 2016). Metacognition has two components (Kankaraš, 2004), one related to knowledge that can be used to control cognitive processes (Palennari, 2016), and one related to the regulation of cognition that can be used to plan, monitor and assess cognitive processes (Feyzioğlu et al, 2018). Both components are further divided into several subcomponents. Thus, metacognitive knowledge consists of three subcomponents: (1) declarative knowledge related to knowledge and sources necessary for solving the task, (2) procedural knowledge related to how to recognize necessary skills and strategies, and (3) conditional knowledge related to knowing how and when to apply specific procedures and strategies. Metacognitive regulation consists of five subcomponents: (1) planning, which is related to setting goals and allocating existing resources, (2) comprehension monitoring, related to monitoring one's own process of learning, (3) information man-

*Corresponding author: branka.radulovic@df.uns.ac.rs

agement strategies, related to using skills and strategies for more efficient information processing, (4) debugging strategies, related to applying strategies for eliminating mistakes in the learning process, and (5) evaluation, related to the final stage, evaluation of strategy effectiveness after learning (Schraw and Moshman, 1995, Tuononen et al., 2023). Through the development of these subcomponents, students are equipped with strategies for solving a specific problem and see the learning benefits of the applied strategies (Vosniadou et al., 2024). However, in order to create a learning environment stimulative for the development of students' metacognition, it is necessary to have teachers who are familiar with the concept of metacognition and how it can be raised (Parlan, 2024). As teacher training is initiated at higher education institutions, the development of metacognition among pre-service teachers may be taken as one of the quality indicators of higher education programs (Stojanović and Gojkov, 2016). It is therefore important to track the metacognitive development of pre-service teachers as it can be a way of assessing the quality of teacher education. With this in mind, the current study is set around the following research tasks:

1. To determine how students' metacognition changes over time.
2. To determine how metacognitive subcomponents change over time.

Materials and Methods

Research Design

The research used a method of systematic non-experimental observation with the assessment scale. Students' achievement was assessed by means of Metacognitive Awareness Inventory developed by Schraw and Dennison (1994) during two consecutive academic years (the beginning of the first year – T1, the end of the first year – T2, and the end of the second year of studying – T3).

In the first semester of undergraduate studies students have a core course entitled Introduction to Science. Within this course, through inquiry-based approach which highlights experiments, students study physical laws related to air and water. At the end of each topic students create their own mental maps as a form of recapitulation of the content. Although quite complex, the course Introduction to Science is taught in the first semester so that though inquiry-based learning and problem solving students develop learning strategies and raise their metacognitive levels. In addition to this course, students attend pedagogy- and psychology-related courses and Educational Technology course in which they also learn through solving problems and evaluating the learning strategies they apply. According to Kramarski and Michalsky (2010; see Feyzioğlu et al. 2018), combination of computer-based learning with metacognitive instruction causes increasing pre-service teachers' ability to reflect on the learning process. This curriculum concept of combining science and pedagogy is also applied in the second year of studying. Thus, within the course Introduction to Social Sciences, inquiry-based learning is applied in the segment related to geography, while the history-related topics imply causal interpretation of the learning content. Students also have some teaching practice hours in the first year of studying and this concept eliminates Thomas' statement that metacognition is not present in "everyday practice of classroom teachers or the mindset and/or curricula of teacher educators and their teacher education programs" (Jahangard et al., 2016, p. 341). This is how "successful learning predominantly based on metacognitive activities performed and monitored during the learning process" is achieved (Feyzioğlu et al. 2018, p. 46).

Sample

The study sample included 160 undergraduates of the Faculty of Education at University of Belgrade. There were three measurements altogether: In October in the academic year 2021/22, i.e. at the beginning of the first year of undergraduate studies (T1), at the end of September in the academic year 2021/22, i.e. at the end of the first year (T2), and at the end of September of the academic year 2022/23, or the end of the second year of undergraduate studies (T3). As the overwhelming majority of students were females, gender differences were excluded from the analysis. The students were informed that the research was anonymous and that their participation was voluntary, as well as that they could withdraw from the research at any time without consequences. No dropouts, however, were recorded. In order to secure

their anonymity, the students created their own codes which they used for signing in the measurements.

Instrument

A Metacognitive Awareness Inventory developed by Schraw and Dennison (1994) was used. The inventory included 52 items. The five-point Likert scale was used for the level of agreeing with the items. The value 1 indicated complete disagreement, while the value 5 indicated complete agreement. Cronbach's Alpha was .847, while Cronbach's Alpha based on Standardized Items was .854. As for the subcomponents, Cronbach's Alpha values were the following: Declarative Knowledge .786; Procedural Knowledge .712; Conditional Knowledge .717; Planning .729; Comprehension Monitoring .771; Information Management Strategies .755; Debugging Strategies .729; Evaluation .708. González Cabañes et al. (2022) reported similar results for Cronbach's Alpha.

Data Analysis

Since the values of skewness and kurtosis were within the range -1 to +1 (Tabachnick and Fidell, 2007), parametric test was used. Descriptive statistics and t-test of paired samples were used to determine differences in metacognition and its subcategories.

All analyses were performed using SPSS 20.0 software.

Results

Figure 1 shows the mean of total sum of students' metacognition over time.

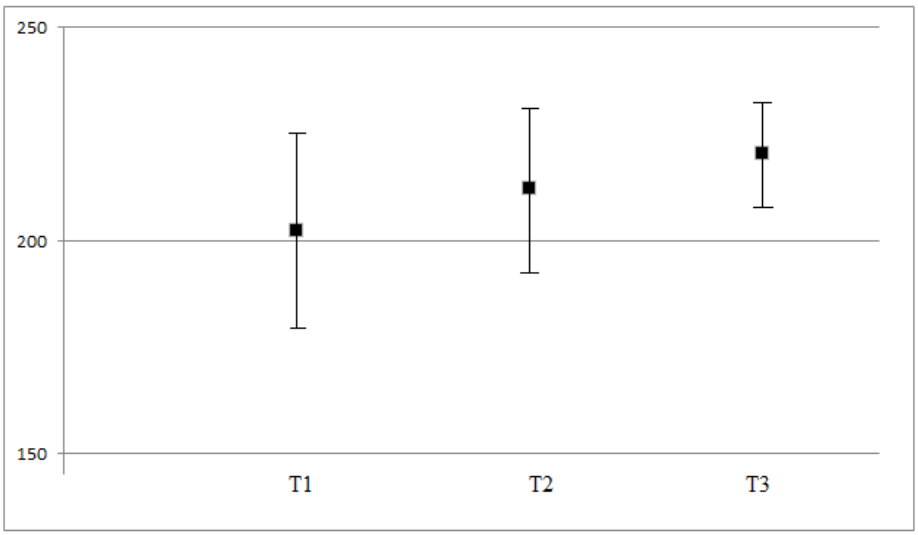

Figure 1. Students' metacognition over time.

Descriptive statistics shows that after the first year of study there is a significant increase in the total score of students' metacognition and that it continues to increase during the second year of study. Spearman's correlation coefficient shows the existence of a correlation between the study year and the total metacognition score (*rho* = 0.359, $p < .001$). Table 1 shows t-test of paired samples.

Table 1. *T-test of paired samples for total metacognition score*

	M	SD	*t*	η^2
T1 - T2	-9.68	29.95	-4.086**	.096
T2 - T3	-8.43	8.53	-12.493**	.497

Note. **p < .01

Since metacognition is a complex construct, in order to better understand the change in metacognition, Figure 2 shows subcomponent changes over time.

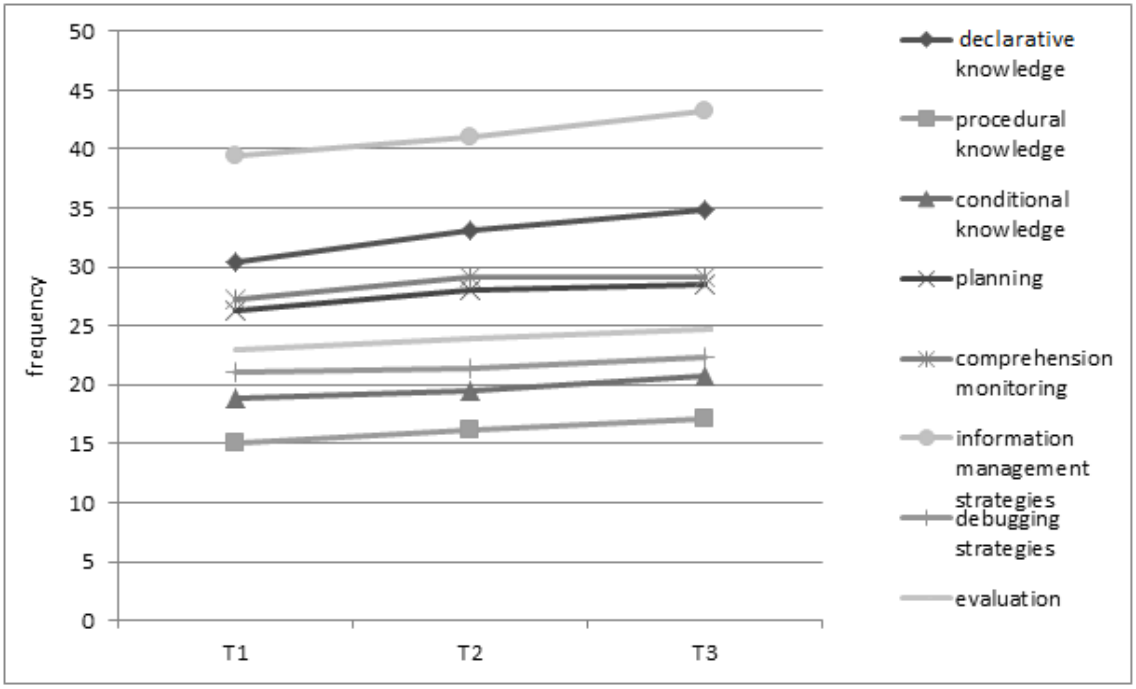

Figure 2. Trajectory of metacognitive subcomponents over time.

As shown in Figure 2, there is an increase in each subcomponent, but the differences in all components are not the same. The largest differences between T1 and T2 are observed in Declarative knowledge, Comprehension monitoring and Planning, while between T2 and T3 the differences are most noticeable in Information management strategies (Table 2). On the other hand, the smallest differences between T1 and T2 are recorded in Conditional knowledge and Debugging strategies, but these competencies increase significantly during the second year of study.

Table 2. *T-test of paired samples for metacognitive subcomponents*

Components	Time	M	SD	*t*	η²
Declarative Knowledge	T1 - T2	-2.65	5.73	-5.853**	.177
	T2 - T3	-1.74	1.81	-12.191**	.483
Procedural Knowledge	T1 - T2	-1.08	3.42	-4.001**	.091
	T2 - T3	-1.04	1.37	-9.590**	.366
Conditional Knowledge	T1 - T2	-0.54	4.05	-1.700	-
	T2 - T3	-1.23	1.94	-8.041**	.289
Planning	T1 - T2	-1.74	5.83	-3.772**	.082
	T2 - T3	-0.56	1.77	-3.970**	.090
Comprehension Monitoring	T1 - T2	-1.91	4.97	-4.869**	.130
	T2 - T3	0.07	2.25	.387	-
Information Management Strategies	T1 - T2	-1.62	7.53	-2.720*	.044
	T2 - T3	-2.16	2.11	-12.983**	.515
Debugging Strategies	T1 - T2	-0.39	4.14	-1.184	-
	T2 - T3	-0.98	1.27	-9.684**	.371
Evaluation	T1 - T2	-1.03	4.47	-2.904*	.050
	T2 - T3	-0.79	1.93	-5.159**	.143

Note. * p < .05; **p < .01

Discussions

The analysis of students' and teachers' metacognitive activities is central for a critical evaluation of study programs and procedures that are in use (Kankaraš, 2004). With this in mind, the current study examined the longitudinal trajectory of pre-teachers' metacognition development in order to assess the quality of their study program. The findings point to a significant increase in the subjects' metacognition from T1 to T2, and to T3.

As for the measured subcomponents, the greatest improvement in the period from the enrolment up to the end of the first year is detected in the components referring to Declarative knowledge, Comprehension monitoring and Planning. When engaged in reflexive activities, such as reflecting on the learning strategies they used, the set goals and the achievements they reached, the students become more aware of their strengths and areas in which they need improvement. It can be assumed that increased metacognition has led to the improvement of comprehension monitoring and planning. This improvement can be reached through practical activities and providing feedback (Rawson and Dunlosky, 2007; see Stanton et al., 2021). More precisely in the case of the current study, inquiry-based learning, which is widely applied at Teacher Education Faculty, puts students in a position to investigate and formulate conclusions based on the results of their experiments and thus multiple feedback is obtained (both from the teacher and by comparing the hypotheses and the experiment results). In this way comprehension monitoring and planning is evaluated as an important predictor of both natural science and language achievement (Hausman et al., 2021, Pesout and Nietfeld, 2021, Stanton et al., 2021).

On the other hand, the subcomponents Conditional knowledge and Debugging strategies showed no significant improvement over the first year. Conditional knowledge and Debugging strategies are metacognitive components that are more complex and require specific guidance and practice in a longer period. Accordingly, the improvement in these segments was observed after the second measurement and the period of one more year. Similar findings are reported in other studies – development of procedural–conditional knowledge mainly occurred during the second year of study" (Schiering et al., 2021, p. 9).

During the period from the first to the second year of studying a significant increase of metacognitive components is detected in all domains except for Comprehension monitoring. A possible explanation may be sought in this preliminary progress detected in the first year of study. Although faced with new challenges and requirements of studying at university, students' further improvement in the use of strategies for monitoring their own learning processes may be less obvious and more demanding for measuring due to the improvement they made.

The study findings comply with recommendations of other researchers that teacher education faculties should invest in the professional development of pre-service teachers, and the curricula should provide added explicit metacognitive scaffolding (Michalsky, 2024). Faculty of Education of the University of Belgrade has recognized the importance of developing metacognition and its components in its students –future teachers. In this way teachers-to-be will become able to support their own students and develop their metacognitive strategies and self-regulated learning once they start their teaching career. Swanson's results (1990; see Wider and Wider, 2023), which indicate that students with a high metacognitive level more effectively solve problems than students with low metacognition, highlight the role of teacher and his/her ability to create a learning environment that stimulates the development of metacognition. The importance of pre-service teacher training in creating metacognitively stimulating learning environment is highlighted by the interaction between metacognition and students' motivation (Palennari, 2016) and better comprehension of science texts, i.e. attractiveness of sciences (Jahangard et al., 2016). Therefore the vision of the Faculty of Education is to create metacognitively stimulating programs that encourage effective learning in all three levels of education and thus contribute to the continuous quality improvement of the study programs.

Conclusions

The aim of the present study is longitudinal trajectory of the development of metacognition in pre-service teachers as an indicator of the quality of higher education. The findings point to a significant increase in the overall metacognition score and in almost all tracked components between the measure-

ments T1 and T2, while the increase is somewhat lower between the measurements T2 and T3. The findings also suggest that all subcomponents of metacognition have substantially increased, with an exception of Conditional knowledge and Debugging strategies which showed a significant incline in T3 measurement. The largest differences between T1 and T2 are detected in Declarative knowledge, Comprehension monitoring, and Planning. The overall results suggest that the first two years of the current teacher education program stimulate metacognitive development.

The main limitation of the study lies in the impossibility of comparing the obtained results with other teacher education faculties since the study programs differ. Also, as almost all students of Faculty of Education of the University of Belgrade participated in this study, there is no possibility of enlarging the research sample. Additional limitation is related to the study length. The participants' metacognitive development was tracked in the first two years of undergraduate studies as these have been reported as the most critical for dropping out (Araque et al., 2009, Bostic 2024, Everaert et al., 2024). Further research, therefore, should encompass a large number of parameters that would serve as additional quality indicators of pre-service teacher education. This would also enable participation of a larger number of teacher education faculties not only in Serbia but in the neighboring countries as well, and these investigations would point to the direction of future educational reforms. Future studies should also focus on reasons for choosing the teaching career and potential changes in these reasons as metacognitive changes occur.

Acknowledgements

The authors gratefully acknowledge the financial support of the Ministry of Science, Technological Development and Innovation of the Republic of Serbia (Grants No. 451-03-66/2024-03/200125 & 451-03-65/2024-03/200125 and Grants No. 451-03-66/2024-03/200138 & 451-03-65/2024-03/200138).

Conflict of interests

The authors declare no conflict of interest.

Author Contributions

Conceptualization, B.R. and M.Dž.; methodology, B.R. and M.Dž.; formal analysis, B.R.; writing—original draft preparation, B.R, M.Dž. and G.M. All authors have read and agreed to the published version of the manuscript.

References

Araque, F., Roldán, C., & Salguero, A. (2009). Factors influencing university drop out rates. *Computers & Education*, *53*(3), 563-574. https://doi.org/10.1016/j.compedu.2009.03.013

Bostic, Tanya Washington, "Strategies for Reducing Dropout Rates of First-Generation College Students" (2024). *Walden Dissertations and Doctoral Studies*. 15424. https://scholarworks.waldenu.edu/dissertations/15424

Everaert, P., Opdecam, E., & van der Heijden, H. (2024). Predicting first-year university progression using early warning signals from accounting education: A machine learning approach. *Accounting Education*, *33*(1), 1-26. https://doi.org/10.1080/09639284.2022.2145570

Feyzioğlu, E. Y., Akpinar, E., & Tatar, N. (2018). Effects of technology-enhanced metacognitive learning platform on students' monitoring accuracy and understanding of electricity. *Journal of Baltic Science Education*, *17*(1), 43-64. https://doi.org/10.33225/jbse/18.17.43

González Cabañes, E., García Fernández, T., Álvarez García, D., Fernández Alba, M. E., & Rodríguez Pérez, C. (2022). Validation of the shortened version of the metacognitive awareness inventory in spanish university student. *Psicothema*, *34*(3), 454-462. https://doi.org/10.7334/psicothema2022.75

Hausman, H., Myers, S. J., & Rhodes, M. G. (2021). Improving metacognition in the classroom. *Zeitschrift für Psychologie*, *229*(2), 89-103. https://doi.org/10.1027/2151-2604/a000440

Jahangard, Z., Soltani, A., & Alinejad, M. (2016). Exploring the relationship between metacognition and attitudes towards science of senior secondary students through a structural equation modeling analysis. *Journal of Baltic Science Education*, *15*(3), 340-349. https://doi.org/10.33225/jbse/16.15.340

Kankaraš, M. (2004). Metacognition: A new cognitive paradigm [The Origin of the Metakognicija□nova kognitivna paradigma]. *Psihologija*, *37*(2), 149-161. https://doi.org/10.2298/PSI0402149K

Memnun, D. S., & Akkaya, R. (2009). The levels of metacognitive awareness of primary teacher trainees. *Procedia-Social and Behavioral Sciences*, *1*(1), 1919-1923. https://doi.org/10.1016/j.sbspro.2009.01.337

Michalsky, T. (2024). Metacognitive scaffolding for preservice teachers' self-regulated design of higher order thinking tasks. *Heliyon*, *10*(2), 1-19. https://doi.org/10.1016/j.heliyon.2024.e24280

Palennari, M. (2016). Exploring the correlation between metacognition and cognitive retention of students using some biology teaching strategies. *Journal of Baltic Science Education*, *15*(5), 617-629. https://doi.org/10.33225/jbse/16.15.617

Parlan, P. (2024). Perspective Chapter: Metacognitive Learning Strategy. In: (Ed. Prof. Murat Tezer) *Metacognition in Learning - New Perspectives*, 1-20. https://doi.org/10.5772/intechopen.113919

Pesout, O., & Nietfeld, J. (2021). The impact of cooperation and competition on metacognitive monitoring in classroom context. *The Journal of Experimental Education*, *89*(2), 237-258. https://doi.org/10.1080/00220973.2020.1751577

Quality assurance strategy (2020), University of Belgrade-Faculty of Education. http://www.uf.bg.ac.rs/wp-content/uploads/2013/05/Prilog-1.1.pdf

Schiering, D., Sorge, S., & Neumann, K. (2021). Promoting progression in higher education teacher training: how does cognitive support enhance student physics teachers' content knowledge development? *Studies in Higher Education*, *46*(10), 1-12. https://doi.org/10.1080/03075079.2021.1953337

Schraw, G., & Dennison, R. S. (1994). Assessing metacognitive awareness. *Contemporary educational psychology*, *19*(4), 460-475. https://doi.org/10.1006/ceps.1994.1033

Schraw, G., & Moshman, D. (1995). Metacognitive theories. *Educational psychology review*, *7*, 351-371. https://doi.org/10.1007/BF02212307

Şendurur, E., Şendurur, P., Mutlu, N., & Baser, V. G. (2011). Metacognitive awareness of pre-service teachers. *International Journal on New Trends in Education and Their Implications*, *2*(4), 102-107.

Stanton, J. D., Sebesta, A. J., & Dunlosky, J. (2021). Fostering metacognition to support student learning and performance. *CBE—Life Sciences Education*, *20*(2), fe3,1-7. https://doi.org/10.1187/cbe.20-12-0289

Stojanović, A., & Gojkov, G. (2016). Creativity and metacognition as indicators of higher education quality. In Editors: Urban Bacher, Dražen Barković et al. *Interdisciplinary Management Research XII* , 773-782.

Tabachnick, B., & Fidell, L. (2007). *Using multivariate statistics* (5th edition). Pearson Education.

Tuononen, T., Hyytinen, H., Räisänen, M., Hailikari, T., & Parpala, A. (2023). Metacognitive awareness in relation to university students' learning profiles. *Metacognition and Learning*, *18*(1), 37-54. https://doi.org/10.1007/s11409-022-09314-x

Vosniadou, S., Bodner, E., Stephenson, H., Jeffries, D., Lawson, M. J., Darmawan, I. N., Kang, S., Graham, L., & Dignath, C. (2024). The promotion of self-regulated learning in the classroom: a theoretical framework and an observation study. *Metacognition and Learning*, *19*(1), 1-39. https://doi.org/10.1007/s11409-024-09374-1

Wider, C., & Wider, W. (2023). Effects of Metacognitive Skills on Physics Problem-Solving Skills among Form Four Secondary School Students. *Journal of Baltic Science Education*, *22*(2), 357-369. https://doi.org/10.33225/jbse/23.22.257

Original scientific paper

UDC: 37.091.39:004.8

Received: April 14, 2024.
Revised: August 02, 2024.
Accepted: August 10, 2024.

10.23947/2334-8496-2024-12-2-259-272

Check for updates

The Application of Artificial Intelligence in Education – The Current State and Trends

Vladimir Milicević[1*], *Limonka Koceva Lazarova*[2], *Miroslava Jordović Pavlović*[1]

[1] The Faculty of Mechanical and Civil Engineering in Kraljevo of the University of Kragujevac, e-mail: milicevic.v@mfkv.kg.ac.rs, jordovicpavlovic.m@mfkv.kg.ac.rs
[2] Goce Delchev University Stip, e-mail: limonka.lazarova@ugd.edu.mk

Abstract: The aim of this paper is to discuss the application of contemporary AI tools and technologies in education. The paper will mainly focus on a close examination of relevant academic literature as well as the current situation and methods of AI implementation in different sectors, finally, in education. Particularly, it was crucial that there were identified the major directions of applying AI in learning with an emphasis on learners and educators being the basic aspects of AI use within modern educational approaches. Secondly, some benefits and drawbacks concerning AI implementations in education supported by experiences from industry leaders and specific satisfaction measures among existing users, are analyzed. The most significant part covers integrating findings that show facts about artificial intelligence being used in education for 2024 like top online learning statistics for 2024, top AI statistics for 2024, and best AI plagiarism checkers for teachers in 2024 respectively. This includes evaluating teacher or instructor preparation skills to employ artificial intelligence (AI) tools and technology as well as ways students can learn how to use them without misuse towards quality education improvement.

Keywords: *artificial intelligence, education, machine learning, personalized learning, adaptive learning*

Introduction

Artificial intelligence (AI) could be defined as a task executed by a program or a machine where otherwise human intelligence is required (Harkut and Kasat, 2019). For learning – concrete facts and knowledge on how the facts are to be used; reasoning, which defines business rules that come close to or equal to definite conclusions; self-adjustment. AI can be thought of as encompassing a multitude of processes and tools such as machine learning, natural language processing, computer vision, robotics, etc.

Simplifying, achieving AI can be defined as copying or mimicking human intelligence, solving complex problems, constructing machines, that can work, that need human intelligence to do it, and creating some system that can learn independently are some of the specific objectives of AI (Ghosh and Thirugnanam, 2021). Some of authors affirm that AI can be employed for very crucial activities including the diagnosis of diseases, treatment recommendations, discovery of drugs, patients' supervision, and healthcare systems (Tajidini and Kheiri, 2022). The application areas of AI include finance fraud, credit risk, algorithmic trading, intelligent customer service, digital financial advisory services as well. The authors pointed out that AI has been developing very fast and is implemented in various industries and processes, financial activity included (Bahoo et al., 2024).

As the amount of research on artificial intelligence (AI) in the educational process rises the authors pointed out that the role of teachers, schools, and education leadership will be different (Gocen and Aydemir, 2020). AI is used for demand forecasting, segmentation of customers, recommendation systems, inventory management, and chatbots for customer service. The authors have stated that different types of retailers can practically implement various AI applications in their organizations and respective undertakings (Jayakrishnan, 2022). AI can be used in L4 or L5 self-driving cars soon, for navigation, traffic

*Corresponding author: milicevic.v@mfkv.kg.ac.rs

control, prognosis, and planning tasks of route optimization. Also, these technologies can help to control the growth of large cities, enhance the economy, cut down energy consumption as well as increase the living conditions of the inhabitants (Bharadiya, 2023). AI and ML can greatly enhance manufacturing efficacy and efficiency, production rates, and sustainability within the near future that is acknowledged by the authors (Plathottam et al., 2023). Towards the near future of the next five to ten years Marketing AI has the possibility to become a very fast-growing field of study, as noted by Asi et al., (2023). Smart virtual assistants and chatbots will define the trends in the so-called customer-oriented companies of the post-COVID epoch. They are applied for commanding customer relations, offers, support issues, and operational processes (De Andrade and Tumelero, 2022). The uses of AI in security include threat identification, outliers, malwares, and security breaches. Thus, it can be concluded that some cybersecurity challenges could only be solved effectively if AI solutions were implemented (Das and Sandhane, 2021). It is and will be commonly applied in language translation, sentiment, and text analysis, speech recognition, and virtual assistance (Mah, 2022). E-government services in education were recognized by the authors too (Spalević, et al., 2023).

These are just some of the examples, but the uses of AI expand with development of the technology.

Thus, the objective of the paper is to substantiate the importance of using AI in the learning process and at the same time to outline possible weaknesses when depending solely on information and conclusions derived from the AI.

The use of artificial intelligence in the learning process can change the traditional learning process for students and the manner of teaching among teachers. Here is some keyways AI is being applied in education:

1. Personalized Learning: Personalization is based on AI techniques in which with the help of analysis of the level of understanding of the learner and preferred modes of learning, suitable contents for each learner are identified (Murtaza et. al 2022). AI will be able to understand the characteristics of each student: learning style, preferences, as well as peculiarities of knowledge acquisition, because of that AI will be able to provide suitable educational material and educational experience for every student. This kind of setting can aid the learning process of the students depending on their capabilities and techniques to achieve enhanced learning and knowledge acquisition.
2. Intelligent Tutoring Systems: Steenbergen-Hu and Cooper (2014) noted that use of AI and IT systems in sustainable education has a bearing on the outcome that makes it possible to present students with special learning styles that suit them. Tutoring systems that incorporate the use of artificial intelligence can offer students a certain level of friendly helpfulness that is comparable to the help of a tutor. These systems allow for monitoring students' progress, the detection of skills need for reinforcement, and the provision of information and support for the weak areas (Lin et al., 2023).
3. Automated Grading and Assessment: Different methods and approaches have been implemented in various studies for formative and summative assessments in the corresponding educational centers today (Aldriye et al., 2019). Teachers can employ the help of AI to mark assignments, quizzes and tests in the shortest time and with the highest efficiency. It thus relieves teachers from some of the routine grading work which in turn gives them more time to devote their attention to more substantive feedback on students' work.
4. Virtual Classrooms and Remote Learning: We are in an era of a highly digital knowledge-based economy and artificial intelligence (AI), that is, machine learning (ML), deep learning (DL) technologies are present in all aspects of people's lives, including learning. (Dogan et al., 2023). Machine learning, natural language processing, and many more technologies create and deliver virtual classes and online learning systems for distance education. Many of these platforms can have tools like videos with lectures and instructions, interactive simulations, as well as collaboration tools to improve the learning process for the students irrespective of their geographical location.
5. Data Analysis and Insights: The objective of big data using AI is to minimize the time and make it more effective and efficient in analyzing the data to provide values for the organizations and give edge over competitors (Gandomi et al., 2023). This system can also evaluate educational data, which comprises students' accomplishment, attendance, and learning results, and employ AI to discover trends. These findings can assist educators in making decisions that will benefit the student such as change of method of teaching, content that is taught and so on.

6. Natural Language Processing (NLP): Natural language processing or NLP is an actual branch of artificial intelligence which deals with natural language processing and computer interpretation. (Sodhar et al., 2020). AI facilities powered by NLP can be helpful to the students in learning languages, reading and writing skills where the students are given real-time feedback on grammatical errors and syntax and the usage of vocabulary. These tools can also enhance the means of communication between a student and a teacher, or a student with an electronic system through voice identification and chat boxes.
7. Adaptive Learning Platforms: There is a huge contribution of AI/ML in enhancing the e-learning platforms for personalization and making the educational process more effective. (GGligorea et al., 2023). Hybrid, intelligent space that enables learning can shift the content's difficulty and rate of delivery according to the learners' level of mastery as well as achievements. This means students are always being stretched appropriately, and the risk of apathy setting in due to the content's difficulty is eliminated.
8. Predictive Analytics for Student Success: In many higher education settings, there is emerging interest in implementing ways of developing models of prediction of course/program failure using the data sources that are available. (Cui et al., 2019). From such characteristics like academic achievement records, absenteeism or even active participation, it is possible for AI algorithms to determine the students' chances of success or their chances of dropping out (Jordovic Pavlovic et al., 2017). If such predictions are made early enough, educators will have an easy time supporting these learners to ensure that they do not drop out within the first few years of schooling.

Overall, it can be stated that education is one of the fields where AI implementation has a possibility to create more interesting, productive, and convenient learning processes for learners of different ages and with different learning background. However, it is crucial to check that these technologies will be ethical to implement and to use in the process of learning to support the teacher instead of replacing his authority and position. The following image illustrates the roles that AI should perform due to the intensification of its application in the education process.

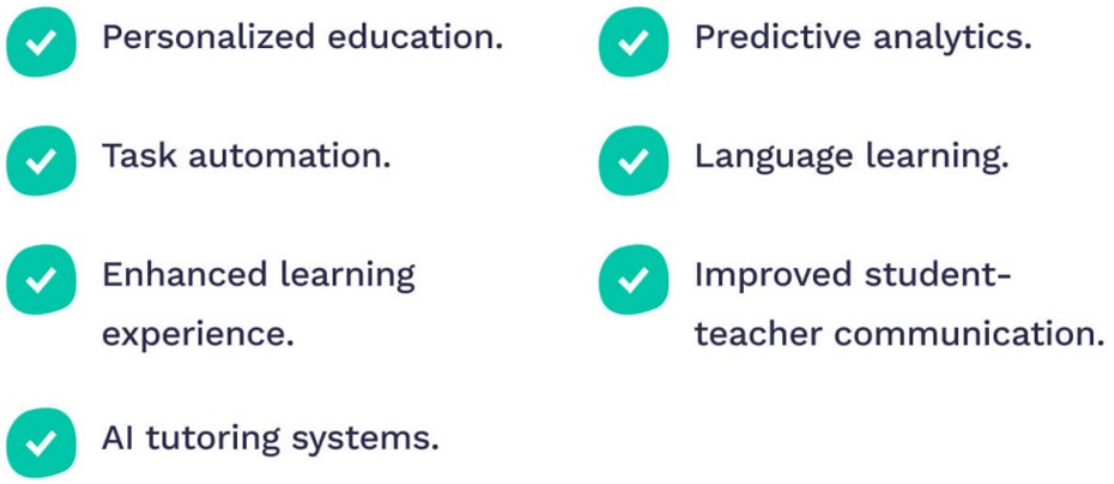

Figure 1. AI tasks in the education process, (https://studycorgi.com/blog/can-ai-change-the-way-we-study-in-the-near-future/, 2023)

As the main motivation, this study shall address four main research questions:

1. What are the key directions of AI applications in the educational process?
2. What are the benefits and drawbacks of AI applications in the educational process?
3. What is the state of AI in education facts in 2024?
4. To what extent can existing AI detectors such as Winston AI successfully detect AI-generated content for essays and projects?

Review Strategy and Design

1) Materials and Methods

The paper addresses the impact of AI on education. A retrospective analysis of data and previous research or studies on the mentioned topic was conducted. A qualitative research approach was chosen to provide in-depth insights and a nuanced understanding of the subject. This approach involved combining quality content analysis and thematic analysis while considering various methodologies to ensure a robust examination of the available literature.

2) Search Strategy

To identify relevant literature, a systematic search strategy was employed. Keywords and search strings were crafted to capture the broad spectrum of AI's impact on education. Databases such as Web of Science and Google Scholar were utilized to perform extensive searches. This approach ensured the inclusion of a wide range of articles from various reputable journals, thus enhancing the comprehensiveness of the review.

The keywords and search strings used included terms like "AI in education," "artificial intelligence and learning," "impact of AI on teaching," and "educational technology." Boolean operators were employed to refine the search results further, ensuring that the selected articles were highly relevant to the research questions.

3) Sampling: Exclusion and Inclusion Criteria

An initial pool of 250 articles published after 2017 was selected based on defined criteria. These criteria included matching search keywords, relevant search strings, and inclusion in peer-reviewed journals. This initial selection aimed to capture a broad range of studies to ensure a comprehensive review.

Each article underwent a thorough review and further analysis to identify those that specifically focused on the nature of AI and its impact on education. Articles were evaluated for their methodological rigor, relevance to the research questions, and contribution to the field. Additionally, the H-Index of the journals in which the articles were published was considered to ensure the selection of high-impact studies.

Thus, the selection was narrowed to thirty articles. This sample size was deemed sufficient to draw well-founded conclusions and inferences about the impact of AI on education from a retrospective perspective. The selected articles provided a balanced mix of theoretical insights, empirical findings, and case studies, thus enriching the overall analysis.

The implementation of artificial intelligence in education

In addition, it is equally important to analyze available information concerning the implementation of artificial intelligence in education derived from various sources and for various purposes.

Personalized learning is generally defined as the process of placing a client centered approach to education that addresses individualization of learning intervention for each learner (Tehseen, 2023). Numerous ways exist in which artificial intelligence techniques can enhance personalized learning:

- adaptive learning;
- interactive experience;
- data analysis and predictive analytics.

As classic examples of artificial intelligence applications for personalized learning, Khan Academy and Duolingo are often mentioned.

As for the Internet resources, Khan Academy is an innovative project which offers free courses in shape of the lessons, exercises, and tests on the given themes and subjects including, but not limited to, mathematics, sciences, history, and art, etc. Artificial intelligence helps Khan Academy in identification of the outcomes, the results of the corresponding exercises and tests, and other input data of the users, to offer program suggestions that may be of interest to the user's abilities and preferences.

Duolingo is an application for learning foreign languages which uses artificial intelligence for giving additional settings in learning according to the level of various users, their results of tests, and their preferences. The responses given by the users to the exercises given are measured and coped with algorithms that measure the levels of knowledge and determine the next lessons and exercises that will be more touching on the topic at hand.

The benefits that companies achieve using artificial intelligence tools and techniques are significant. These examples demonstrate how artificial intelligence can be integrated into educational platforms to provide personalized learning tailored to the needs and learning styles of everyone.

At the time of writing this, Duolingo is the second largest company with fewer than 1,000 employees and 21 million daily active users (blog.duolingo.com, 2024). It covers more than 100 courses in more than 40 different languages (www.washingtonpost.com/ 2024). This is the main reason why we must categorically aim to provide unstoppable educational resources that are high in quality and affordable to the resources allowances in order to gain the best education and make it every-where distributed rationale out. Duolingo asserts: „AI is not to replace the work of human experts but to assist us. It is our tool to boost productivity and efficiency, so we can generate more content and enhance the experience of our course in a shorter period " (www.washingtonpost.com/ 2024)).

AI intelligent tutoring systems are educational systems that are computer-based and apply AI in such a way as to simulate a human who is teaching without a teacher. AutoTutor, invented at the University of Memphis, generates tricky problems and helps students come up with solutions through an interactive dialogue with the computer (crowdmark.com, 2024). This tool is mostly used for math and science, although the focus of computer literacy was there from the beginning. AutoTutor can keep track of the student's mental processes and emotions and to give feedback that helps the student to adapt to a better way (www.memphis.edu, 2024).

Technology enhancements in the education sector benefit teachers in their teaching role as they can dedicate more time to planning lesson activities and giving individual feedback to students. Some efficient representatives for the Automatic Grading and Assessment category are:

- Gradescope;
- Canvas;
- Chat GPT;
- Quizgecko;
- Zipgrade;
- Quizizz, etc.

Automated grading, assessment efficiency, and time savings are obvious.

The trend of this digital environment will continue to grow across various industries. At present, the indication of students' acceptance and use of these schools is more in focus. Here are some online classrooms, which received a lot of positive reviews from the students of the future and their parents. The following list of examples includes (livestorm.co, 2024):

- Livestorm;
- Wooclap;
- Kahoot;
- Google Clasroom;
- Docebo Learn;
- Moodle;
- Adobe Captivate, etc.

With the help of artificial intelligence, it is possible to obtain very precise and useful analytical data that can subsequently be used to improve the education process, provide better access to students, and ensure careful preparation of teaching materials. The most important analytics are:

1. Online learner proficiency;
2. Student satisfaction rating;
3. Course engagement;
4. Learn progress;
5. Session times.

In order to implement the aforementioned, it is necessary to emphasize the use of adaptive learning platforms. Here are seven of the best adaptive learning platforms (whatfix.com, 2024.):

- Whatfix - user rating 4.6 / 5;

- EdApp - user rating 4.7 / 5;
- 360Learning - user rating 4.6 / 5;
- Adaptemy - user rating N.A;
- Knewton - user rating 4.6 / 5;
- Realizeit - user rating N.A;
- Pearson Interactive Labs - user rating N.A.

Numerous significant sources, including Devlin Pack, provide detailed data on the impact of artificial intelligence in the field of education. Online learning has exploded in popularity. It can be done anywhere, at any time, and, most importantly, is just as effective as in-person learning (devlinpeck.com, 2024).

Devlin Pack cites significant data encouraging the intensive application of tools and concepts in the field of contemporary education (devlinpeck.com, 2024), Table 1:

Matleena Salminen, from hostinger.com, discussed the importance of artificial intelligence soon, including its impact on the education process (hostinger.com, 2024), as shown in Table 2.

Table 1. *The top online learning statistics in 2024, (*https://www.devlinpeck.com/content/online-learning-statistics*, 2024)*

The Top Online Learning Statistics in 2024	
1.	Worldwide, 49% of students have completed some sort of online learning
2.	70% of students say online learning is better than traditional classroom learning
3.	The number of online learning users is expected to increase to 57 million by 2027
4.	80% of businesses now offer online learning or training solutions
5.	63% of students in the US engage in online learning activities daily
6.	Online learning can increase student and employee retention to as much as 50%
7.	Online learning can reduce the time needed to learn a subject by 40% to 60%
8.	The online learning industry is projected to be worth more than $370 billion by 2026
9.	Online learning and training can improve employee performance by 15% to 25%

Table 2. *The importance of artificial intelligence in the near future, (*https://www.hostinger.com/tutorials/ai-statistics*, 2024)*

The Top Artificial Intelligence Statistics in 2024	
1.	The Global AI Market Size Is Expected to Grow 37% Every Year From 2023 to 2030
2.	Over 40% Of Business Leaders Report Increased Productivity Through AI Automation
3.	Artificial Intelligence Is Expected to Create 133 Million New Jobs by 2030
4.	AI Will Contribute Over $15 Trillion to the Global Economy by 2030
5.	Interest in AI Website Builders Has Grown 50% in Previous 12 Months
6.	25% Of Companies Have Adopted AI to Address Labor Shortages
7.	33% Of All AI Adoption Cases Focus on the Automation of IT Processes
8.	AI Startup Funding Has Increased on Average by 66% Between 2021 and 2023
9.	The Artificial Intelligence Industry Is Expected to Be Worth $190 Billion by 2030
10.	Increased AI Adoption and Digital Access Will Drive Job Growth in Over 50% Of Surveyed Businesses
11.	50% of Surveyed Companies Plan to Invest in On-The-Job and Internal Training Departments Related to AI Adoption

Further, in educational environments, AI chatbots are acknowledged for serving various functions, which can be grouped into four categories: teaching agents, collaborative agents, learnable agents, and peer agents, each exhibiting varying degrees of efficacy (Kuhail et al., 2023). Numerous studies indicate that AI chatbots motivate students and help in their dedicated engagement by providing quick assistance, especially in online environments. Besides the mentioned benefits in learning, this can also lead to unintended consequences in the educational process:

- Using AI to write seminars, essays, or projects;
- Cheating;
- Misinformation.

Detection of AI-generated content

In the absence of adopted standards and principles by universities and faculties, teachers can address this issue by suggesting (rather than banning) appropriate AI tools available to students and by using suitable tools for detecting cheating. Here is the short list of 5 best AI plagiarism checkers for teachers (www.classpoint.io, 2024), Table 3.

Based on the table, it can be concluded that the proposed tools have satisfactory accuracy, allowing teachers to rely on them to detect the undesired consequences of AI applications in the educational process. The AI tool Detector Pro currently provides slightly poorer results, but it is in a phase of intensive development and improvement (www.scribbr.com,2024). Winston AI scores were obtained by running a dataset of 10,000 texts provided above through a proprietary AI detection model (gowinston.ai, 2024).

Table 3. *The best Ai plagiarism checkers for teachers in 2024, (*https://www.classpoint.io/blog/best-free-ai-detectors-for-teachers*, 2024)*

The best Ai plagiarism checkers for teachers in 2024		
No.	**AI tool**	**Accuracy**
1.	**Copyleaks**	99.12 %
2.	**GPTKit**	98%
3.	**GPTZero**	99%
4.	**AI Detector Pro**	60 - 84%
5.	**Winston AI**	99.98%

The impact of ChatGPT on modern education (Singh Gill et al., 2024) and the development of ethical standards for chatbots in educational settings (Cotton et al., 2024; Tayan et al., 2023) are currently being actively discussed. Each new technological breakthrough compels us to rethink the limits of educational possibilities. ChatGPT marks the latest achievement in this ongoing evolution, but it is far from the final one. The potential implications, possibilities, and concerns about the use of ChatGPT in education are discussed in numerous scientific papers (Ipek et al., 2023; Karakose et al., 2023; Athanassopoulos et al., 2023).

In the context of this discussion and for the purpose of the overall project, the following research question was posed: to what extent can existing AI detectors such as Winston AI successfully detect AI-generated content for essays and projects?

Computer science students who are proficient in AI tools participated in our experiment. Essay assignments were distributed to the students, and they were instructed on how they could use AI tools in completing their tasks. Some of them used ChatGPT to a greater or lesser extent, while others had to rely on their own abilities. The following are the settings of our experiment:

- 60 students from two different faculties, participated,
- 20 students were not allowed to use artificial intelligence for creating the essay content
- 20 students were allowed to use artificial intelligence to create an Introduction section
- 20 students are allowed to use artificial intelligence to create the entire content of the essay.

All students submitted their assignments on time and indicated the extent to which they used ChatGPT for creating the essay content:

- 0%,
- less than 50%,
- more than 50%.

Winston AI was chosen to check the extent of ChatGPT usage in students' essay preparation. The verification was conducted in the following manner:

1. First, students who claimed they did not use ChatGPT at all for essay preparation were checked.
2. Afterward, students who claimed to have partially used ChatGPT were checked. The verification was conducted in two ways: checking the Introduction text and checking the entire document text.

3. Finally, the essays of students who claimed to have fully used ChatGPT for essay creation were verified.

Winston AI is very easy to use and intuitive, both for checking text and for importing entire documents (Figures 3 and 4, respectively).

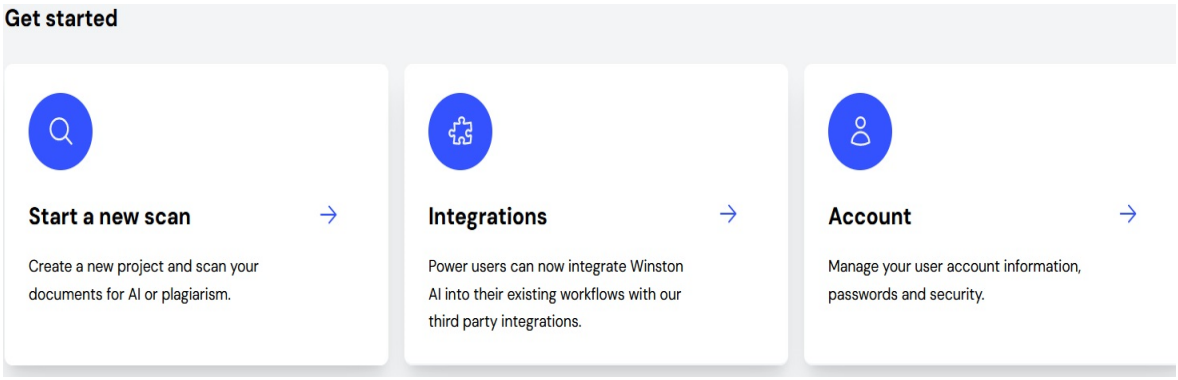

Figure 2. Winston AI, starting a new scan (source: authors)

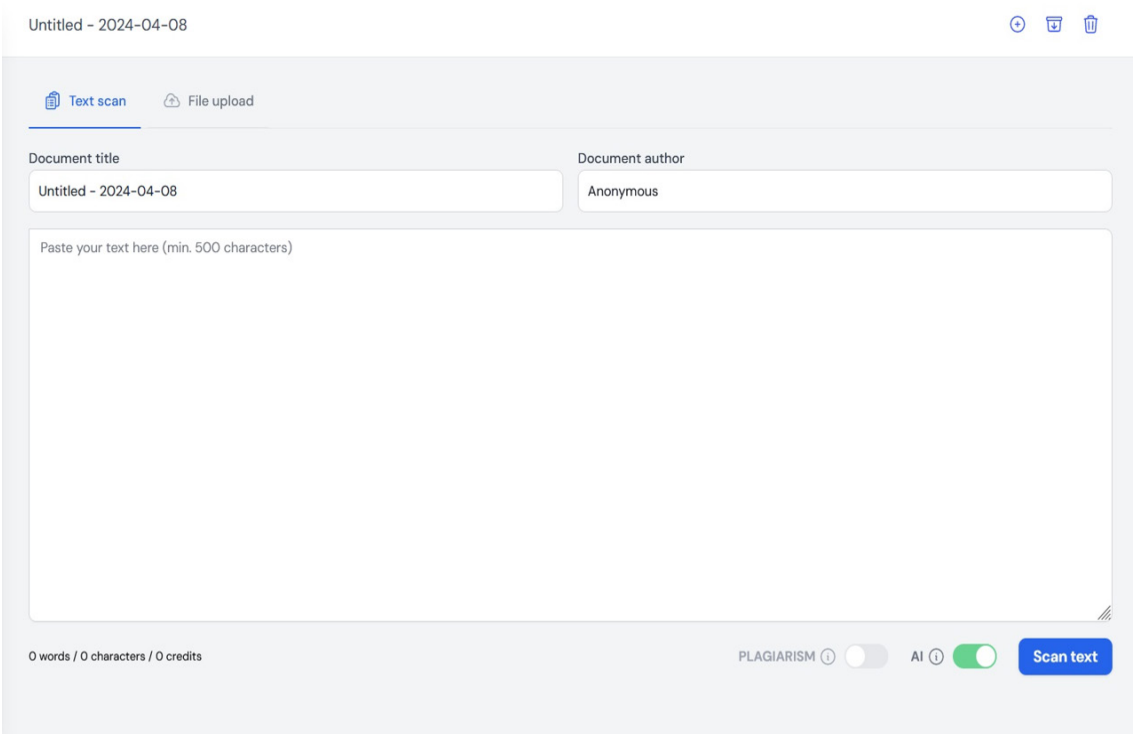

Figure 3. Winston AI, paste the text for the new scan (source: authors)

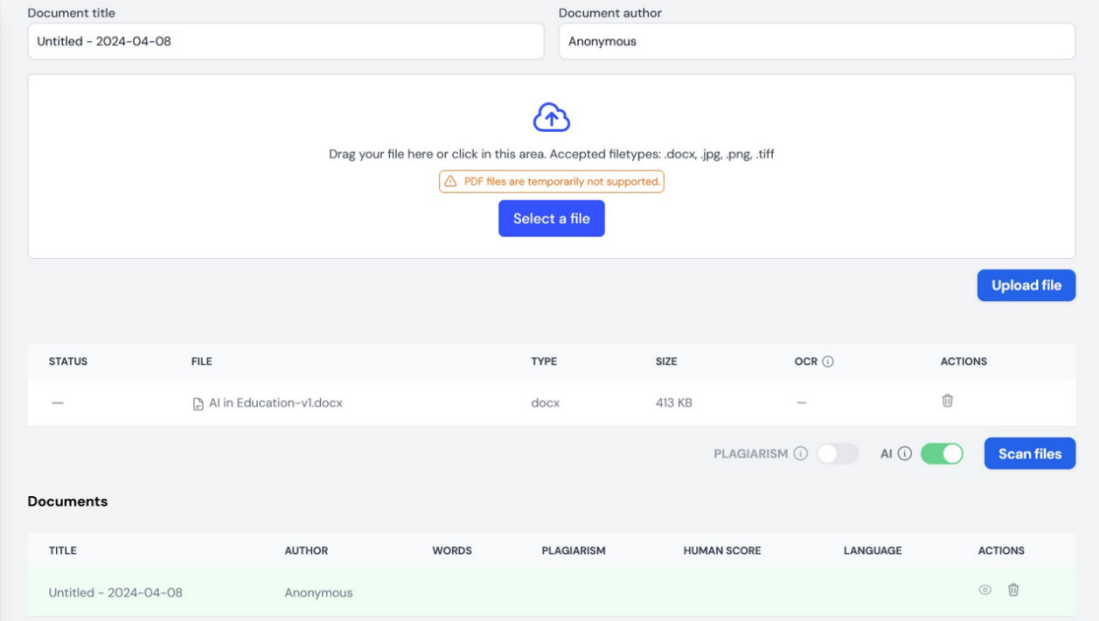

Figure 4. Winston AI, import the text document for the new scan (source: authors)

In the initial phase, essays from students who reliably did not use AI for their creation were reviewed. Winston AI effectively completed the task, confirming that tools like ChatGPT were not utilized in the essay preparation (Figure 5).

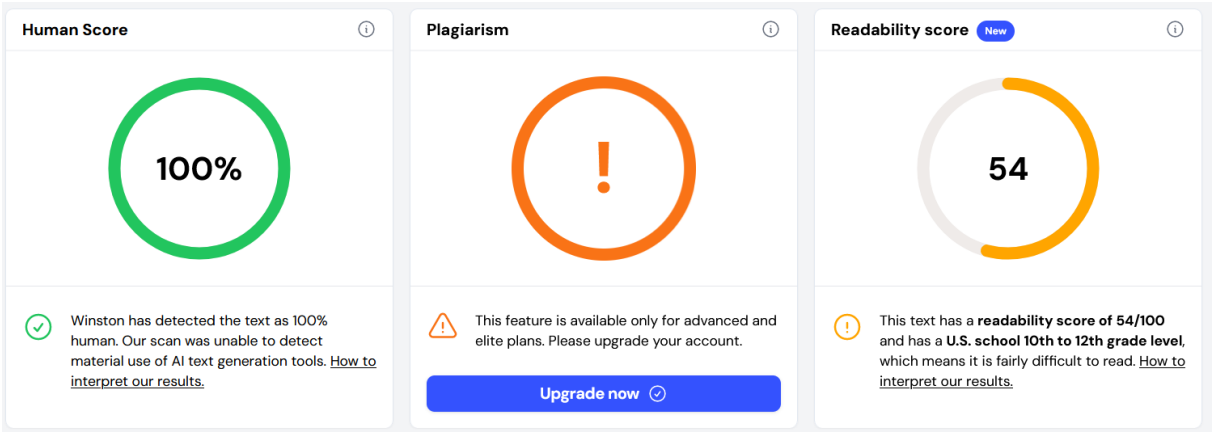

Figure 5. Winston AI, Report 1 (source: authors)

In the second step, essays from students who were limited to using ChatGPT only for the introduction were reviewed. In this case, as well, Winston AI provided the expected results. One of the relevant examples is shown in the following figure.

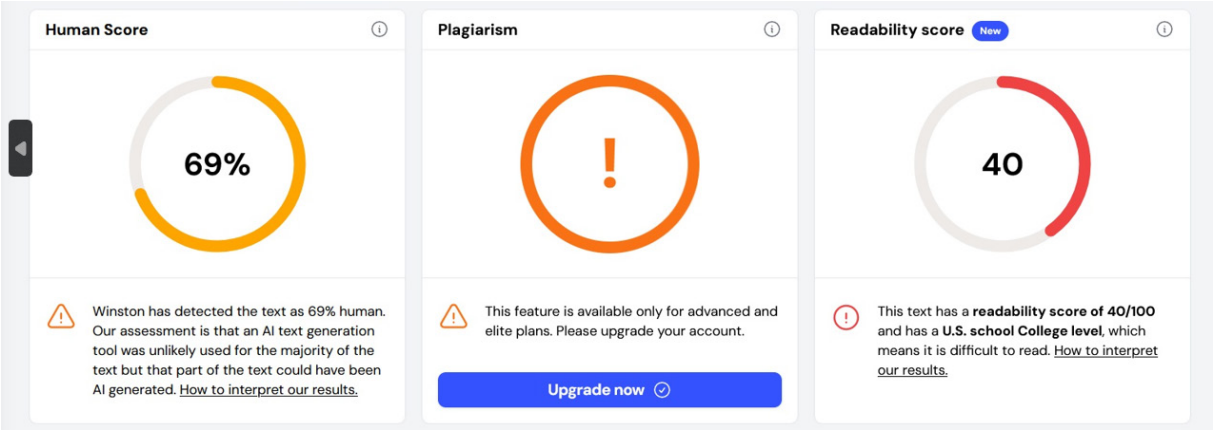

Figure 6. Winston AI, Report 2 (source: authors)

Finally, it was the turn of students whose task was to act as complete fraudsters. In the worst-case scenario (shown in the next figure), Winston AI detected that the student had 21% original work, with the rest being the work of ChatGPT or a similar AI tool. In other cases, the originality did not exceed 8%.

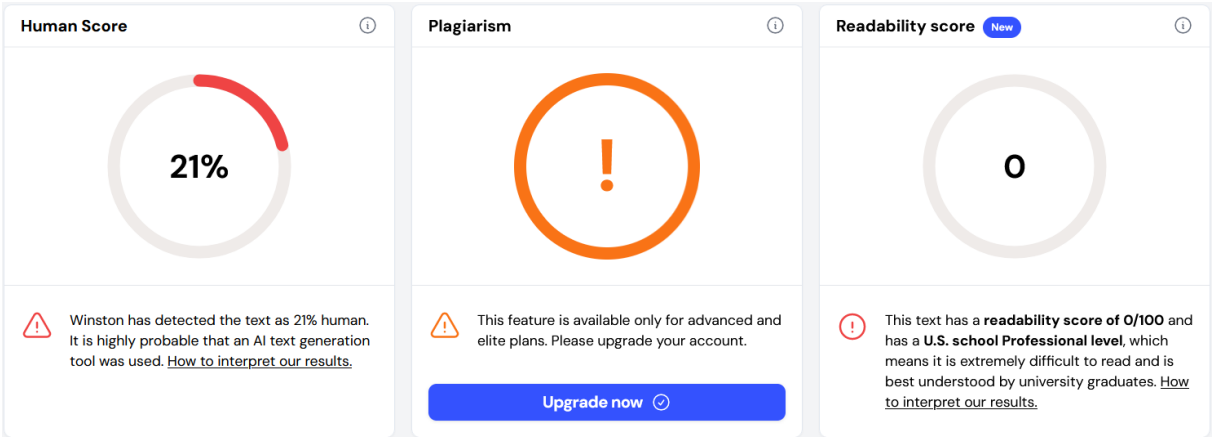

Figure 7. Winston AI, Report 3 (source: authors)

We can conclude that teachers are not powerless against this type of student fraud. It has been proven that tools like Winston AI can be of significant help to teachers in preventing unethical student behavior, simultaneously embracing technological progress with the potential to greatly enhance both educational learning and teaching methods. Additionally, Winston AI, in its full version, enables the detection of classical plagiarism as well.

Discussions

The educational process can be significantly improved by implementing AI tools and technologies. The advantages are numerous, and the following discussion is to approve the strength of the future connection between AI and the educational process.

Personalized learning and adaptive learning are some of the key advantages. Artificial intelligence can tailor learning for each individual student, depending on their capacity, memory ability, and comprehension. It will enable the preparation of learning materials for each student individually, which will meet their needs. Once the learning material is created, AI considers the concept of adaptive learning as a key to the successful educational process of the future. Artificial intelligence enables the determination of the material's difficulty based on students' achieved results. These educational platforms have the capability to adjust the material in such a way that students will neither be bored nor find it too difficult, thereby avoiding stress. This also applies to lifelong learning as a key to success in a modern business environment. AI tools can be used to create materials that provide personalized opportunities for continuous learning after

finishing school, thereby allowing for advancement at different stages of life depending on age and needs.

Concerning the learning process, chatbots and AI processing of students' data are the primary focus. Chatbots and virtual tutors can help students engage in active learning by answering questions about the covered material to see if they have mastered it. The student receives feedback, discussions are developed, or help is offered. This makes the entire learning process interactive. Data-driven policies imply the ways in which AI applications can enable the processing and analysis of a large set of data related to students' achieved results in different learning contexts. This is of great importance, as teachers can adjust the learning process and focus on areas where students have the poorest results.

The significant advantage of AI implementation in modern education is the automation of routine tasks. AI applications allow teachers to automate some of the activities related to creating tests (which can be adapted to different groups of students), reviewing tests, and analyzing achieved results. This way, teachers can focus on improving teaching and the materials students need for learning. Further, AI technologies can provide accessibility features, such as speech-to-text transcription, text-to-speech conversion, and translation services, to accommodate diverse learning styles and disabilities, ensuring that education is accessible to all students. Additionally, some routine tasks of teachers and administration can be automated by utilizing AI capabilities, leading to the optimization of educational process costs. Learning becomes more accessible and affordable.

Support for teachers can be significantly increased soon. By using AI, teachers can track how students are performing as well as recommend appropriate instructional approaches based on their preferences and needs. AI supports teaching staff by creating insights into student progress, providing suggestions for learning strategies, and offering directions for professional development based on specific needs and interests. AI support for teaching staff can further extend towards innovative teaching methods such as gamification, adaptive learning pathways, and immersive simulations, which will contribute to increasing student motivation, critical thinking, and problem-solving skills.

As previously proved, AI in education provides many benefits, yet several challenges and potential drawbacks are possible.

First, investments are not negligible. If educational settings aim to implement AI technologies it has to be prepared for considerable investment in infrastructure, software development, training, and ongoing maintenance. Educational institutions, particularly those with limited budgets, may find themselves out of the game. Once established, problems are possible. While AI systems are highly accurate, technical issues such as software bugs, system failures, or compatibility problems with existing infrastructure can arise. These issues can interrupt learning processes and erode students' confidence in AI-based educational tools.

AI applications in education mean collecting and analyzing large volumes of sensitive student data, including personal information, learning habits, and performance metrics. It could be a security risk and the potential for breaches of data protection regulations or unauthorized access. Additionally, ensuring fairness is challenging because AI algorithms can sometimes perpetuate existing biases and inequalities in education, such as those based on gender, race, or socioeconomic status. If the training data used to develop AI models is biased or unrepresentative, the resulting recommendations and decisions may unfairly disadvantage certain groups of students.

Furthermore, concern about over-relying on technology at the expense of human interaction and mentorship is real. Automation and the depersonalization of learning can reduce the quality of education and impede the development of essential social and emotional skills. The excessive application of AI tools and resources in the educational process can deepen the digital divide between students who come from different backgrounds and do not have equal access to the Internet and the necessary technology. The large-scale application of artificial intelligence can also change and restructure the work positions of teachers and administration since a large part of work tasks will be automated. Its application will certainly develop the need for the training of teachers in that area, so that they can use it successfully. One of the disadvantages of the application of artificial intelligence in education is the danger of stifling creativity, critical thinking, and skills to solve specific real-world problems that require the ability to research, analyze, and draw correct conclusions. Of course, the application of artificial intelligence in education can open up some ethical dilemmas related to the appropriate use of student data and the danger of applying decision-making algorithms, instead of applying logical reasoning on the part of humans.

AI tools may not be accepted by teachers, students, and their parents because they have been

taught to use traditional learning methods and because of concerns about losing their jobs. Resistance to change affects the possibilities for innovation in teaching.

The analysis of these disadvantages of the AI tools application can create proactive measures that will reduce or eliminate them. The measures should adhere to policies that will protect the privacy of students and teachers and allow fair and equal access for the teachers for their professional development. With the careful use of these tools, it is possible to improve the educational process, so that the students would achieve better results.

Figure 8. AI in Education - pros & cons (https://studycorgi.com/blog/can-ai-change-the-way-we-study-in-the-near-future/, 2023)

Conclusion

AI implementation, especially in the education process, brings a huge promise through learning experience transformation, significantly improving learning outcomes and forcing a lot of innovation in teaching and learning. On the other side, it brings a lot of challenges and potential risks that must be carefully handled.

The benefits can be huge. They consist of personalized learning, adaptive instruction, enhanced engagement, and data-driven insights. These kinds of benefits will lead learning processes to wider dimensions that include the different needs of modern learners and huge support for educators. Activities in educational institutions will be more efficient and effective, as well as more transparent, making high-quality education more accessible and equitable for all.

Further, various factors need to be considered due to the sensitivity of AI implementation in educational processes. These factors can be cost, technical issues, privacy concerns, bias mitigation, digital divide, job displacement, ethical dilemmas, and resistance to changes. Obtaining the full potential AI implementation into the education process, minimizing known risks, implies the application of well-established rules for all participants in the education process, including the application of ethical codes and support frameworks for both future students and teachers.

Finally, AI implementation in education aims to approach that is finely balanced and includes technological innovation combined with human based pedagogy. This approach relies on significant collaboration, among all participants of the educational process, creativity, critical thinking, and skills included in lifelong learning.

Based on the above, AI should be seen as a tool to support human expertise, and not as its replacement. The educator's role should be to encourage students to use all the modern tools and technologies, including AI, but in the way described in the discussion above. With significant planning and right implementation including constant evaluation, AI has the huge potential to revolutionize education and unlock new frontiers of learning for generations to come.

Acknowledgements

The research is the result of the individual engagement of the author with the aim of highlighting and processing the mentioned topics of the paper, using the resources provided by the University of Kragujevac, The Faculty of Mechanical and Civil Engineering in Kraljevo of the University of Kragujevac and The Faculty of Computer Science, Goce Delcev University, Stip.

Conflict of interests

The authors declare no conflict of interest.

Author Contributions

Conceptualization, V.M and M.J.P; methodology, V.M. and L.K.L.; software overview, L.K.L. and M.J.P; formal analysis, V.M, M.J.P. and L.K.L.; writing—original draft preparation, V.M, M.J.P. and L.K.L; writing—review and editing, V.M, M.J.P. and L.K.L. All authors have read and agreed to the published version of the manuscript.

References

Aldriye, H., Alkhalaf, A., & Alkhalaf, M. (2019). Automated grading systems for programming assignments: A literature review. *International Journal of Advanced Computer Science and Applications, 10*(3). http://dx.doi.org/10.14569/IJACSA.2019.0100328

Asi, L., Mojjada, H., Prasanna, M., & Deepika, Y. (2023). A Study on Artificial Intelligence in Marketing. *Retrieved from A Study on Artificial Intelligence in Marketing* https://doi.org/10.36948/ijfmr.2023.v05i03.3789

Athanassopoulos, S., Manoli, P., Gouvi, M., Lavidas, K., & Komis, V. (2023). The use of ChatGPT as a learning tool to improve foreign language writing in a multilingual and multicultural classroom. *Advances in Mobile Learning Educational Research*, *3*(2), 818-824. https://doi.org/10.25082/AMLER.2023.02.009

Bahoo, S., Cucculelli, M., Goga, X., & Mondolo, J. (2024). Artificial intelligence in Finance: a comprehensive review through bibliometric and content analysis. *SN Business & Economics*, *4*(2), 23, https://doi.org/10.1007/s43546-023-00618-x

Bharadiya, J. (2023). Artificial intelligence in transportation systems a critical review. *American Journal of Computing and Engineering, 6*(1), 34-45. https://doi.org/10.47672/ajce.1487

Cui, Y., Chen, F., Shiri, A., & Fan, Y. (2019). Predictive analytic models of student success in higher education: A review of methodology. *Information and Learning Sciences*, *120*(3/4), 208-227. https://doi.org/10.1108/ILS-10-2018-0104

Cotton, D. R., Cotton, P. A., & Shipway, J. R. (2024). Chatting and cheating: Ensuring academic integrity in the era of ChatGPT. *Innovations in education and teaching international*, *61*(2), 228-239. https://doi.org/10.1080/14703297.2023.2190148

Das, R., & Sandhane, R. (2021, July). Artificial intelligence in cyber security. In *Journal of Physics: Conference Series* (Vol. 1964, No. 4, p. 042072). IOP Publishing. https://doi.org/10.1088/1742-6596/1964/4/042072

De Andrade, I. M., & Tumelero, C. (2022). Increasing customer service efficiency through artificial intelligence chatbot. *Revista de Gestão*, *29*(3), 238-251. https://doi.org/10.1108/REGE-07-2021-0120

Dogan, M. E., Goru Dogan, T., & Bozkurt, A. (2023). The use of artificial intelligence (AI) in online learning and distance education processes: A systematic review of empirical studies. *Applied Sciences*, *13*(5), 3056. https://doi.org/10.3390/app13053056

Gandomi, A. H., Chen, F., & Abualigah, L. (2023). Big Data Analytics Using Artificial Intelligence. *Electronics, 12*(4), 957. https://doi.org/10.3390/electronics12040957

Ghosh, M., & Thirugnanam, A. (2021). Introduction to artificial intelligence. *Artificial Intelligence for Information Management: A Healthcare Perspective*, 23-44. https://doi.org/10.1007/978-981-16-0415-7_2

Gligorea, I., Cioca, M., Oancea, R., Gorski, A. T., Gorski, H., & Tudorache, P. (2023). Adaptive learning using artificial intelligence in e-learning: a literature review. *Education Sciences, 13*(12), 1216. https://doi.org/10.3390/educsci13121216

Gocen, A., & Aydemir, F. (2020). Artificial intelligence in education and schools. *Research on Education and Media*, *12*(1), 13-21, https://doi.org/10.2478/rem-2020-0003.

Harkut, D. G., & Kasat, K. (2019). Introductory chapter: artificial intelligence-challenges and applications. *Artificial Intelligence-Scope and Limitations*. https://doi.org/10.5772/intechopen.84624

Ipek, Z. H., Gözüm, A. I. C., Papadakis, S., & Kallogiannakis, M. (2023). Educational Applications of the ChatGPT AI System: A Systematic Review Research. *Educational Process: International Journal*, *12*(3), 26-55. https://dx.doi.org/10.22521/edupij.2023.123.2

Jayakrishnan, S. (2022). *Artificial intelligence (AI) in retailing-a systematic review and research agenda*. SSRN, http://dx.doi.org/10.2139/ssrn.4134959

Jordovic Pavlovic, M., Knežević, D., & Petrović, S. (2017). Data visualization and exploration of students database. In: *Proceedings of 10th International Conference Science and Higher Education in Function of Sustainable Development, October 6-7*, 2017., Mećavnik, Mokra Gora, Srbija, 2-16, ISBN978-86-83573-90-5

Karakose, T., Demirkol, M., Aslan, N., Köse, H., & Yirci, R. (2023). A conversation with ChatGPT about the impact of the COVID-19 pandemic on education: Comparative review based on human–AI collaboration. *Educational Process: International Journal*, *12*(3), 7-25. https://files.eric.ed.gov/fulltext/EJ1395258.pdf

Kuhail, M. A., Alturki, N., Alramlawi, S., & Alhejori, K. (2023). Interacting with educational chatbots: A systematic review. *Education and Information Technologies*, *28*(1), 973-1018. https://doi.org/10.1007/s10639-022-11177-3

Lin, C. C., Huang, A. Y., & Lu, O. H. (2023). Artificial intelligence in intelligent tutoring systems toward sustainable education: a systematic review. *Smart Learning Environments*, *10*(1), 41. https://doi.org/10.1186/s40561-023-00260-y

Mah, P. M. (2022). Analysis of artificial intelligence and natural language processing significance as expert systems support for e-health using pre-train deep learning models. *Acadlore Transactions on AI and Machine Learning*, *1*(2), 68-80. https://doi.org/10.56578/ataiml010201

Murtaza, M., Ahmed, Y., Shamsi, J. A., Sherwani, F., & Usman, M. (2022). AI-based personalized e-learning systems: Issues, challenges, and solutions. IEEE access, 10, 81323-81342. https://doi.org/10.1109/ACCESS.2022.3193938

Plathottam, S. J., Rzonca, A., Lakhnori, R., & Iloeje, C. O. (2023). A review of artificial intelligence applications in manufacturing operations. *Journal of Advanced Manufacturing and Processing*, *5*(3), e10159. https://doi.org/10.1002/amp2.10159

Singh Gill, S., Xu, M., Patros, P., Wu, H., Kaur, R., Kaur, K., ... & Buyya, R. (2023). Transformative Effects of ChatGPT on Modern Education: Emerging Era of AI Chatbots. *arXiv e-prints*, arXiv-2306. https://doi.org/10.1016/j.iotcps.2023.06.002.

Sodhar, I. N., Jalbani, A. H., Buller, A. H., Mirani, A. A., & Sodhar, A. N. (2020). Chapter-1 Natural Language Processing: Applications, Techniques and Challenges. *ADVANCES IN*, *1*. https://www.researchgate.net/profile/Petro-Trokhimchuck-2/publication/343981699_S_Beer_Centurial_Problem_in_Cybernetics_and_Methods_of_its_Resolution_p87-117/links/5f4be8d8458515a88b8f31c9/S-Beer-Centurial-Problem-in-Cybernetics-and-Methods-of-its-Resolution-p87-117.pdf#page=5

Spalević, Ž., Kaljević, J., Vučetić, S., & Milić, P. (2023). Enhancing Legally-Based E-Government Services in Education Through Artificial Intelligence. International Journal of Cognitive Research in Science, Engineering and Education, 11(3), 511-518. https://doi.org/10.23947/2334-8496-2023-11-3-511-518.

Steenbergen-Hu, S., & Cooper, H. (2014). A meta-analysis of the effectiveness of intelligent tutoring systems on college students' academic learning. *Journal of educational psychology*, *106*(2), 331–347. https://doi.org/10.1037/a0034752

Tajidini, F., & Kheiri, M. J. (2023). Recent advancement in Disease Diagnostic using machine learning: Systematic survey of decades, comparisons, and challenges. *arXiv preprint arXiv:2308.01319*.

Tayan, O., Hassan, A., Khankan, K., & Askool, S. (2023). Considerations for adapting higher education technology courses for AI large language models: A critical review of the impact of ChatGPT. Machine Learning with Applications, 100513. https://doi.org/10.1016/j.mlwa.2023.100513.

Tehseen Z. (2023) Transforming Education: AI-Powered Personalized Learning Revolution, https://www.techopedia.com/transforming-education-ai-powered-personalized-learning-revolution

https://blog.duolingo.com/large-language-model-duolingo-lessons/

https://www.washingtonpost.com/technology/2024/01/10/duolingo-ai-layoffs/

https://articles.noodlefactory.ai/what-is-an-ai-intelligent-tutoring-system-and-why-you-should-use-it

https://crowdmark.com/intelligent-tutoring-systems-connecting-ai-and-education/

https://www.memphis.edu/iis/projects/autotutor.php

https://www.devlinpeck.com/content/online-learning-statistics

https://livestorm.co/blog/online-teaching-tools-platforms

https://whatfix.com/blog/adaptive-learning-platforms/

https://www.hostinger.com/tutorials/ai-statistics?ppc_campaign=google_search_generic_hosting_all&bidkw=defaultkeyword&lo=2688&gad_source=1&gclid=Cj0KCQjw2a6wBhCVARIsABPeH1v8ZW6qnqvzoKKkEh8dIcYw73Uy2UrYINREESKUJEWEQi99SZJ0x_waAmgEEALw_wcB

https://www.classpoint.io/blog/students-using-ai-to-write-essays

https://www.scribbr.com/frequently-asked-questions/how-accurate-are-ai-detectors/

https://gowinston.ai/setting-new-standards-in-ai-content-detection/

Original scientific paper

Received: April 04, 2024.
Revised: June 13, 2024.
Accepted: June 21, 2024.

UDC:
37.091.12:005.963(574)
37.011.2:004
10.23947/2334-8496-2024-12-2-273-282

Check for updates

Empowering Preservice Teachers in Kazakhstan for Linguistic and Cultural Competence Through Technology-Integrated Learning

Abdraimova Banu [1*] , *Dyankova Gergana*[2]

[1] Kazakh Abylai Khan University of International Relations and World Languages, Almaty, Republic of Kazakhstan
e-mail: bbabdraimova@gmail.com
[2] South-West University "Neofit Rilski", Blagoevgrad, Bulgaria
e-mail: diankova_g@swu.bg

Abstract: The main purpose of this research is to promote language and cultural learning among novice teachers in Kazakhstan through the implementation of technology-oriented learning strategies. To assess the success of this strategy, a primary survey methodology combined with a quantitative research methodology was used. In the process of data collection, I distributed the survey instrument to a sample of 105 individuals, including 65 males and 40 females. Next, the gathered data were analyzed by SPSS, the software that was used for descriptive statistics, correlation analysis and ANOVA. This research was designed to identify the complicated connections between the introduction of technology and the language and cultural skills of preservice teachers. The significance of this study for educational practice in Kazakhstan cannot be overestimated. They promote the involvement of technology-based strategies as a source of fostering educational spaces that are more open and culturally relevant.

Keywords: *Preservice teachers, linguistic competence, cultural competence, technology-integrated learning, empowerment.*

Introduction

The development of linguistic and cultural competence among preservice teachers in Kazakhstan has become an inevitable necessity as a result of globalization and multiculturalism processes. Due to the growing numbers of immigrants and other international connections, educators need to develop the necessary skills for overcoming linguistic and cultural differences among the student population (Andreou, 2011). However, even after granting that language and culture have an impact on education, research shows that a considerable number of preservice educators do not receive enough training in linguistic and cultural competencies, resulting in inadequate teaching.

S. Tastanbek's survey of teacher education colleges in Kazakhstan showed that approximately 70% of preservice teachers lack the confidence to deal with linguistic diversity properly. Furthermore, 60% of the participants reported that they had difficulties including cultural perspectives in their teaching methods (Tastanbek, 2019). Moreover, in the era of rapidly advancing technology, there is also a possibility to enrich language and culture knowledge by using technology in educational methods. The incorporation of technology into teacher education courses offers a host of advantages, including the facilitation of interactive language classes and cultural immersion (Kotova et al., 2021). Furthermore, it allows teachers to navigate through a variety of digital resources and platforms covering all cultural situations. Therefore, the main aim of this study is to investigate the impact of technology-based learning on the development of linguistic and cultural proficiency among preservice teachers in Kazakhstan. The present research aims to identify the dire need for more culturally appropriate and inclusive educational practices in the region (Rao and Mandavilli, 2023).

Adaptation to a knowledge-based society "has not been a priori envisioned. It can only be

*Corresponding author: bbabdraimova@gmail.com

achievedthrough: redefining paradigms in education; operationalization of skills for work with information and communication technologies; the adequate deployment of educational programs aimed at reflecting on the upgrading of professional competences in a dynamically changing world" (Stosic, Dermendzhieva and Tomczyk, 2020). In an education framework, it is necessary for preservice teachers to become linguistically and culturally competent in view of increasingly multicultural communities. This is also confirmed by the finding that today "knowledge is individualized and contextualized, as such, pre-service and in-service teachers are now more than ever required to know the best ways to support learners to maximize their potential" (Badmus and Jita, 2024). Therefore, there is a need for technology integration in preservice teachers' training to develop their linguistic and cultural knowledge. Kazakhstan, as well as other countries, is becoming a projective environment for learners and cultural diversity (Govaris, 2011b). The Kazakh lexical community includes approximately one hundred ethnic groups and 130 languages and was provided by Brock (2008). With diversity ranging from opportunities to challenges, it becomes central for any teacher-in-training to be ingenuous to such diversity (Brock et al., 2008). To establish successful teaching and learning when students experience diversity, one must have linguistic and cultural awareness. The ability to express oneself in a variety of languages is a skill that linguistically competent preservice teachers are equipped with to help them communicate with students from different languages. Cultural competency skills help teachers understand different cultural standards, values and beliefs so that they can treat these perspectives with due respect. Studies show that teachers who are language and culturally competent have the skills to address different students' needs. Their better knowledge leads to a better understanding of class and improved academic performance (Bowman, 1993).

The crucial role of technology in teacher education must be put into practice in preparing preschool teachers for linguistic and cultural abilities. This corresponds to the "professional belief of the modern children's teacher that children are active participants in the process of their learning and development and should be provided with an educational environment in which they can not only initiate most of the activities necessary for their learning but also to experiment with different management and decision-making strategies in the pedagogical situation" (Dermendzhieva, Tasevska and Dyankova, 2022). The ability to study language, engage in cultural inquiries, and communicate at a global level is made more possible with innovation. The government has incentivized the use of technology in education in Kazakhstan by providing online courses to develop tech-savvy and tech-enabled students (Coelho, 2007). Although technology-aided methodologies for building preservice teachers' linguistic and cultural competency are actively employed, sufficient research in these fields is still needed. The present research article addresses the issue of how technology-integrated pedagogies enable Kazakhstani preservice teachers to gain linguistic and cultural proficiency to enhance instructional effectiveness (Makoelle and Burmistrova, 2021). Technology-based teacher education is widely discussed in the academic literature (Stanišić, Leković and Stošić, 2019; Stosic, Dermendzhieva and Tomczyk, 2020; Simonović, 2021; Vesić, Laković and Vesić, 2023), and this study expands it by assessing the role of technology in the acquisition of language, intercultural communication, and cultural awareness in preservice teachers (Georgogiannis, 2009). The aim of this study is to create a clear picture for policy makers, teacher educators and practitioners as to the ways in which technology can be used to solve the sudden need for linguistic and cultural competence in Kazakhstan and other countries, which implies a new direction for the design of bilingual teacher education programs (Govaris, 2011a).

Theoretical Framework

This research employs sociocultural theory from constructivism to incorporate technology in preservice teacher training for language and cultural skill enhancement. Social relationships, cultural practices, and language processes are crucial elements for learning within sociocultural theory (Figure 1). Language and culture influence each other and are part of the other in regard to people's mental perspectives and interactions (Abdelilah, 2001). Constructivism posits that students actively produce knowledge by means of purposeful engagement and environmental encounters. This study was carried out in teacher education programs using technology to create real collaborative expertise in fieldwork for prospective language and culture teachers (Argaw, 2022).

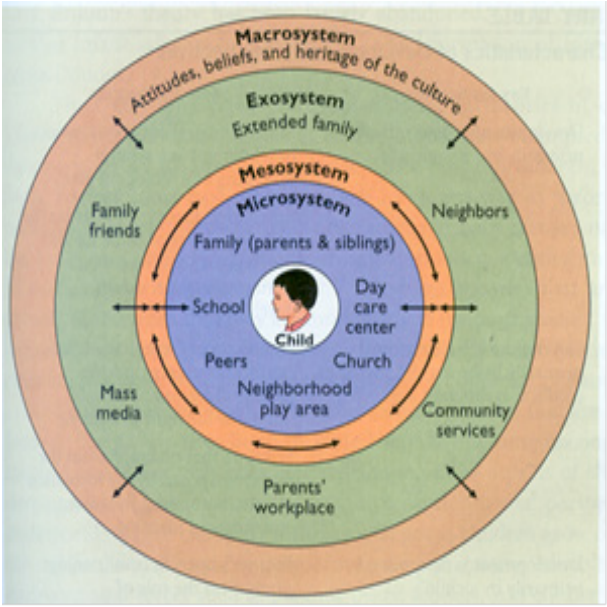

Figure 1. Sociocultural theory (McNabb, Hawkes and Rouk,1999)

According to sociocultural theory, technology promotes social interaction, supports language practice and fosters cross-cultural exploration, while learning environments are equipped with instructional tools that enable students to actively engage, critically think and reflect (Chen, 2011). The researcher adopts the theoretical lens for *appraising* the effectiveness of technology-integrated learning among preservice teachers in culturally competent linguistic performance, which is achieved *through* authentic language, cultural immersion and collaborative inquiry in a sociocultural setting (Chisholm, 1998).

Materials and Methods

The present study utilizes quantitative research methodology, using the primary survey approach (Figure 2), to investigate the functionality of technology-based learning in increasing the linguistic and cultural competency of preservice teachers in Kazakhstan (Çobanoğlu, 2020). The Qualtrics survey tool is specifically built to collect data related to the different attributes that constitute linguistic and cultural competencies such as language proficiency, intercultural communication skills, and cultural awareness (Mukatayev, 2019). The sample included 65 male and 40 female students from various preservice teacher education programmes presented at different institutions in Kazakhstan. The purposive sampling method was used to select participants, thus ensuring that individuals from various linguistic and cultural backgrounds were included within the scope of Kazakhstan. The survey was conducted through the use of Qualtrics (Daniyarova, 2020).

Figure 2. Primary Research Method

Qualtrics transmit the survey questionnaire to the target population for data collection. The questionnaire included closed-ended questions, Likert scale items and open-ended questions to collect quantitative and qualitative data on technology-integrated learning and the development of linguistic and cultural competence (Akhmetova, Kopzhassarova and DeVereaux, 2023). Following the data collection, an SPSS tool was used to carefully examine the survey data. The data analysis process starts with descriptive statistics for summarizing the demography of the participants and the survey responses and involves multiple

steps. Second, correlation analysis is employed to discover correlations between variables, for instance, technology use and language ability. ANOVA is applied to determine the differences in demographic factors, such as gender or linguistic background, in language and cultural competence scores (Nabi et al., 2016). This study will use SPSS to analyze data to establish whether technology integrated learning strategies can enhance linguistic and cultural competencies among preservice teachers in Kazakhstan, consequently increasing the quality of teacher education in the region (Egorov, Jantassova and Churchill, 2007).

Results

Research on providing preservice teachers in Kazakhstan for language and culture (technology-integrated teaching and learning) has improved its productivity. Overall, the Qualtrics based online survey collected and analyzed data from 105 people, including 65 men and 40 women, using the SPSS computer program (Irdianto, Lazareva and Yaniafari, 2023). Statistical procedures, such as descriptive statistics, correlation analysis, and ANOVA, were used. The descriptive approach of the data covered participants' demographic information, including survey responses regarding their foreign language competency, intercultural communication skills, and cultural awareness. The correlation analysis provided details about the relationships between technology use and linguistic and cultural competency. ANOVA also revealed gender and language background-based differences in cultural and communicative knowledge scores (Kanayeva, 2019). Practical learning has shown that technology-inclusive education contributes to improving the linguistic and cultural competencies of preservice teachers in Kazakhstan, thus supporting more inclusive and culturally responsive education in the region through such approaches.

Table 1. Participant statistics

Variable	N	%
Gender		
Male	65	61.9
Female	40	38.1
Educational level		
Bachelor	75	71.4
Master	25	23.8
PhD	5	4.8
Linguistic Competence Experience		
Low	20	19.0
Moderate	55	52.4
High	30	28.6
Cultural Competence Experience		
Low	25	23.8
Moderate	60	57.1
High	20	19.0

Table 1 shows an extensive overview of the number of participants involved in the research concerning the application of technology for preservice teachers learning linguistic and cultural skills in Kazakhstan (Kotova et al., 2021). The sample consisted mostly of male participants (61.9% of the participants were male), while 38.1% were female. For educational attainment, a large group of the participants had a bachelor's degree (71.4% of the respondents). This category was followed by individuals with master's degrees, who constituted 23.8% of the participants' group (Nair et al., 2022). The percentage of participants who held a PhD degree was lower, with only 4.8% being PhD holders. Considering language competency and experience, the distribution was distributed in an almost equal manner, as 19.0% of the respondents had low experience, 52.4% had moderate experience, and 28.6% had high experience. The

other part of the participants' exposure to cultural competence showed that 57.1% of the participants had a good level of experience. They were, subsequently, individuals with low experience (23.8%), individuals with moderate experience (19.0%), and, finally, individuals with high experience. This fact is a critical component of the study, as it reveals demographic and experience characteristics that are valuable in building the context and evaluating the results (Makoelle and Burmistrova, 2021).

Table 2. *Distribution of Responses (N/%)*

	Research Questions	Strongly Disagree (N/%)	Disagree (N/%)	Neutral (N/%)	Agree (N/%)	Strongly Agree (N/%)
1.	I feel confident in my ability to communicate effectively in multiple languages	5 (4.76%)	10 (9.52%)	15 (14.29%)	30 (28.57%)	45 (42.86%)
2.	I believe understanding cultural nuances is essential for effective teaching.	8 (7.62%)	12 (11.43%)	15 (14.29%)	30 (28.57%)	40 (38.10%)
3.	Integrating technology in language learning enhances linguistic proficiency.	6 (5.71%)	11 (10.48%)	17 (16.19%)	35 (33.33%)	36 (34.29%)
4.	Cultural sensitivity plays a crucial role in creating an inclusive classroom environment.	7 (6.67%)	9 (8.57%)	20 (19.05%)	35 (33.33%)	34 (32.38%)
5.	I find technology-enhanced cultural immersion activities beneficial for language acquisition.	5 (4.76%)	10 (9.52%)	18 (17.14%)	33 (31.43%)	39 (37.14%)
6.	I am open to incorporating diverse cultural perspectives into my teaching practices.	6 (5.71%)	8 (7.62%)	22 (20.95%)	34 (32.38%)	35 (33.33%)
7.	Technology-integrated learning activities help bridge language learning gaps among students.	7 (6.67%)	11 (10.48%)	20 (19.05%)	32 (30.48%)	35 (33.33%)
8.	Understanding cultural contexts improves my teaching effectiveness in language instruction.	5 (4.76%)	10 (9.52%)	16 (15.24%)	37 (35.24%)	37 (35.24%)

Table 2 depicts the distribution of the responses of the participants regarding eight research questions that focused on gains in language and cultural competency after the incorporation of technology in learner education. The majority of the participants agreed on all issues, which is a good indicator of their consistent attitudes toward language competence and cultural understanding through technology, which has been established as an effective tool (McNabb, Hawkes and Rouk,1999). These data illustrate that a considerable number of respondents positively agree with statements concerning language skills, cultural sensitivity, technology usage, and why diverse cultural views are important to teaching. The percentages of respondents who fully agreed on these statements ranged from 32.38% to 42.86%. Therefore, the abovementioned findings reveal that using technology in learning methods provides preservice teachers with linguistic and cultural competence in their settings in Kazakhstan (Mukatayev, 2019).

Table 3 *shows* the descriptive statistics of the developmental dimensions of the linguistic and cultural competence of preservice teachers *in* Kazakhstan *in terms* of technological education using advanced technologies (Nabi et al., 2016). Marked by an average score range, all questions resulted in scores of 4.15 to 4.31, signifying substantial consensus among the *groups. Pre*service teachers tend to have high levels of confidence in their capacity to teach linguistically advanced learners, understand that culture is important in communication, and embrace the innovation that comes with technology in teaching linguistically advanced learners (Nair et al., 2022). Such individuals are not only ready to bring along other cultural perspectives into their teaching approaches but also position successive technology-based learning activities as the missing link in the story of language acquisition disparities among students. The observed standard deviation values of 0.61 and 0.71 *indicate* that they fall within the range of a great degree of consistency in the outcomes obtained from the presented sample (Qanay, Courtney and Nam, 2021). This finding, thus, argues for the integration of technology in the process of training our educational system in Kazakhstan about culture and linguistic competence among prospective teachers and educators (Qanay, Courtney and Nam, 2021).

Table 3. *Descriptive Statistics*

Questions	N	Minimum	Maximum	Mean	STD
I feel confident in my ability to communicate effectively in multiple languages	105	1	5	4.20	0.67
I believe understanding cultural nuances is essential for effective teaching	105	1	5	4.15	0.71
Integrating technology in language learning enhances linguistic proficiency	105	1	5	4.31	0.61
Cultural sensitivity plays a crucial role in creating an inclusive classroom environment	105	1	5	4.26	0.65
I find technology-enhanced cultural immersion activities beneficial for language acquisition	105	1	5	4.28	0.63
I am open to incorporating diverse cultural perspectives into my teaching practices	105	1	5	4.29	0.62
Technology-integrated learning activities help bridge language learning gaps among students	105	1	5	4.27	0.64
Understanding cultural contexts improves my teaching effectiveness in language instruction	105	1	5	4.28	0.63

Table 4. *Correlation*

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Q1	1							
Q2	-0.09294	1						
Q3	-0.24441	-0.37833	1					
Q4	0.518969	-0.18242	-0.23009	1				
Q5	0.059249	0.689179	-0.3544	-0.29116	1			
Q6	0.082686	-0.29423	0.087307	-0.2196	-0.42109	1		
Q7	0.143553	-0.25985	0.309791	0.233053	-0.26222	-0.38111	1	
Q8	0.450005	0.218089	-0.61439	0.221555	0.202683	0.091604	-0.0985	1

The interactions of two variables, language and cultural competence, with technology between preservice teachers in Kazakhstan are revealed by the coefficients shown in Table 4. For each cell, *the* sign and value correspond to the strength and the angle of their link, respectively (Srisawasdi, Pondee and Bunterm 2018). On the other hand, there is a significant positive correlation between Q4, which *indicates* the significance of cultural sensitivity, and Q5, which *indicates* the benefits of technology-enhanced cultural activities. A relationship between increasing cultural sensitivity and *a* positive impression of virtual cultural tours as benefits can be suggested in this case (Tor, Başaran and Arık, 2022). To elaborate, Question 8, where there is a close knit between contextual and technological comprehension, displays an inverse correlation with Question 3, which measures the assimilation of technology. This indicates that people who place high value on cultural knowledge might not experience an upbeat perspective on technological integration in the learning of languages. The revealed correlations focus on the intricate interrelations of linguistic training and cultural enhancement with the introduction of technology in *curricula* as training programs for teachers in Kazakhstan (Abdelilah, 2001).

Table 5. *ANOVA test*

SUMMARY

Groups	Count	Sum	Average	Variance
Q1	105	447	4.257143	0.500549
Q2	105	431	4.104762	0.498535
Q3	105	425	4.047619	0.545788
Q4	105	454	4.32381	0.509524
Q5	105	428	4.07619	0.455678
Q6	105	460	4.380952	0.372711
Q7	105	437	4.161905	0.521612
Q8	105	446	4.247619	0.495788

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	10.78095	7	1.540136	3.159105	0.002653	2.020568
Within Groups	405.619	832	0.487523			
Total	416.4	839				

The one-way *ANOVA* of *the* mean scores for *the* eight survey items on linguistic and cultural competence and technological integration among *the* Kazakhstani student-teachers is *shown* in the table above. The ANOVA results indicate that at least one survey item has a significantly different mean score ($F(7, 832) = 3.159$, $p = 0.002653$). Participants may have a wide range of opinions on linguistic and cultural competence and technology integration (Srisawasdi, Pondee and Bunterm 2018). Further comparative *studies* may ensure *that* the survey questions differ greatly. These results highlight the role of alternative points of view and experience in the design of technology-mediated learning activities to enhance the linguistic and cultural competency of preservice instructors in Kazakhstan (Argaw, 2022).

Discussions

This study was designed to develop *the* linguistic and cultural skills of preservice teachers in Kazakhstan via technology-infused learning. Its findings are worth mentioning (Chisholm, 1998). The researcher utilized an online Qualtrics-based survey to collect data from 105 participants, among *whom* 65 were male and 40 were female, and employed *statistical* methods such as descriptive statistics, correlation analysis, and ANOVA to assess how *the* integration of technology is connected to linguistic and cultural competence (Tor, Başaran and Arık, 2022). The sex ratio of *the* participants *was* primarily male (61.9%), and most of the participants *had a* bachelor's *degree* (71.4%), which suggests the need for equitable recruitment and educational intervention that *could* be tailored to both genders and different educational levels (Chen, 2011).

The descriptive statistics *revealed* consistent responses among participants *in terms of* cultural and linguistic proficiency (Çobanoğlu, 2020). The *participants were more likely* to express themselves accurately in multiple languages, with a mean of 4.20 out of 5. *Additionally,* culture awareness *is valuable* for successful teaching, as it had *an* average rate of 4.15. Moreover, respondents had a very positive view of the use of technology in language teaching, with a score of 4.31 indicating *its* usefulness *in improving* language proficiency. This evidence underpins the *advantages* of integrating technology into *the* learning environment and boosting linguistic and cultural comprehension among Kazakh preservice teachers (Daniyarova, 2020).

Correlation analysis has *revealed* certain relationships between technology use and linguistic and cultural competence (Akhmetova, Kopzhassarova and DeVereaux, 2023). Moreover, the recognition of cultural sensitivity was found to have a strong relationship *with* the perception of beneficial activities, which included technology-enhanced cultural immersion, *demonstrating a link* between cultural understanding and technology adoption. Moreover, it was found that *there* was *a* negative *correlation* between

understanding of cultural contexts and technology integration, which means that those who *prioritize* cultural understanding regard technology integration less positively. *Research* shows *that* the interplay between technology, cultural awareness, and language instruction is complicated*;* hence*, multifaceted* methods in teaching are needed (Egorov, Jantassova and Churchill, 2007).

The ANOVA results continued to clarify the differences in mean scores among the survey items, representing the varying standpoints and opinions of the participants (Irdianto, Lazareva and Yaniafari, 2023). The clear existence of such gaps highlights the significance of the need to incorporate diverse views when designing technology-mediated learning activities. This shows how technology can assist *in* the creation of *an* inclusive education environment that is culturally responsive*,* which in turn complies with the larger goals that aim at increasing linguistic and cultural competence among preservice teachers in Kazakhstan (Tor, Başaran and Arık, 2022). The study findings thus showcase the promising effect of integrating technology into learning processes *that* enable preservice teachers to acquire the necessary skills and skills *that are* redundant to multiethnic educational environments, in turn boosting the rise of inclusive and culturally responsive educational practices in Kazakhstan (Kanayeva, 2019).

Conclusions

Overall, this research study was designed to boost the linguistic and cultural proficiency of preservice teachers in Kazakhstan through the integration of technology in the learning process. This research has shown that the results were good for these methods. The use of a Qualtrics based online survey and statistical data analysis methods such as descriptive statistics, correlation analysis and ANOVA revealed that there were significant relationships between technology integration and the linguistic and cultural competence of the participants.

The findings reported the highest agreement on the topics of cultural sensitivity, technology-oriented learning activities, and understanding of the culture of the environment. Moreover, the research underscores the value of language and culture teaching strategies that address the different perspectives and life experiences of students.

The findings also emphasize the ability of technology-based learning to extend linguistic and cultural competencies among preservice teachers in Kazakhstan and thus to make educational approaches more inclusive and culturally responsive in this region.

Acknowledgements

The authors would like to thank the respondents who participated in the research and the reviewers who made a valuable contribution to the quality of the work by giving constructive suggestions.

Conflict of interest

The authors declare no conflicts of interest.

Author Contributions

Conceptualization, A.B. and G.D.; methodology, A.B.; writing—original draft preparation, A.B. and G.D.; writing—review and editing, A.B. and G.D.; Analysis, discussion and conclusion, A.B. and G.D.; All authors have read and agreed to the published version of the manuscript.

References

Abdelilah, S. S. (2001). Developing cross-cultural communicative competence via computer-assisted language learning: The case of preservice ESL/EFL teachers. *Alt-j*, 9(3), pp.53–64. https://doi.org/10.1080/0968776010090306.

Akhmetova, D.R., Kopzhasarova, U.I. & DeVereaux, C. (2023). The effectiveness of MOOCs in ESP for technical students: A Kazakhstan case study. *XLinguae*, 16(2), pp.3–15. https://doi.org/10.18355/xl.2023.16.02.01.

Andreou, E. (2011). Dancing with wolves – processes and mechanisms of victimization in and out of school. Thessaloniki: Epicenter. https://catalogue.libver.gr/webopac/FullBB

Argaw, T.M. (2022). *Influence of computer –assisted pedagogy in enhancing teachers' competence in catholic secondary schools in Addis Abeba, Ethiopia*. [online] ir.cuea.edu. http://ir.cuea.edu/jspui/handle/1/12154

Badmus, O. T., & Jita, L. C. (2024). Preservice Teachers' Level of Knowledge on Elements and Rationale for Nature of Science: Towards Advancing Quality Instruction. International Journal of Cognitive Research in Science, Engineering and Education (IJCRSEE), 12(1), 77–87. https://doi.org/10.23947/2334-8496-2024-12-1-77-87

Bowman, S. (1993). Career Intervention Strategies for Ethnic Minorities. https://doi.org/10.1002/j.2161-0045.1993.tb00241.x

Brock, L. L., Nishida, T. K., Chiong, C., Grimm, K. J., & Rimm-Kaufman, S. E. (2008). Children's perceptions of the classroom environment and social and academic performance: A longitudinal analysis of the contribution of the Responsive Classroom approach. Journal of School Psychology, 46(2), 129-149. https://doi.org/10.1016/j.jsp.2007.02.004

Chen, Y. (2011). The Influence of Integrating Technology in Language Learning Courses. https://kuscholarworks.ku.edu/handle/1808/8053

Chisholm, I. M. (1998). Six elements for technology integration in multicultural classrooms. *Journal of Information Technology for Teacher Education*, 7(2), pp.247–268. https://doi.org/10.1080/14759399800200033.

Çobanoğlu, H. (2020). ELT Students' and Instructors' Perceptions, Practices and Needs about the Use of Technology in ELT. http://hdl.handle.net/11129/5133.

Coelho, C. (2007). Management of discourse deficits following TBI: Progress, caveats, and needs. Seminars in Speech and Language 28: 122-135. https://doi.org/10.1055/s-2007-970570

Daniyarova, S. (2020). Exploring Pre-Service Teachers' Perceptions of Research Engagement in Bachelor Studies. https://nur.nu.edu.kz/handle/123456789/4904

Dermendzhieva, S., TasevskaD. & Dyankova, G. (2022), Psychosocial tasks of developmentin preschool age and specificsof the game mechanism in kindergarten. [*Psihosotsialni zadachi na razvitieto v preduchilishtna vuzrast I spetsifika na igroviya mekhanizum v detskata gradina*]Diogenes, 30 (1), 53-73. https://doi.org/10.54664/UOQN2526

Egorov, V. V., Jantassova, D.D. & Churchill, N. (2007). Developing Pre-service English Teachers' Competencies for Integration of Technology in Language Classrooms in Kazakhstan. *Educational Media International*, 44(3), pp.255–265. https://doi.org/10.1080/09523980701491732.

Georgogiannis, P. (2009). Education, Intercultural competence and readiness of primary and secondary school teachers: Steps for a change in education. Volume 1, Patras. http://pgeorgogiannis.inpatra.gr/praktika/2009_12o_vo1

Govaris, C. (2011a). Interculturality in the Greek Curriculum - A Critical Consideration. ISBN:978-960-88298-2-4

Govaris, C. (2011b). Introduction to intercultural education. Athens: Interaction. https://www.politeianet.gr/%20books/9789609539579-gkobaris-christos-diadrasi-eisagogi-sti-diapolitismiki-ekpaideusi-213431

Irdianto, W., Lazareva, I.N. & Yaniafari, R.P. (2023). *The Challenge of EFL Teachers in Technology-Integrated Learning in the Society 5.0*. https://doi.org/10.2991/978-2-38476-054-1_64.

Kanayeva, G. (2019). Facilitating teacher leadership in Kazakhstan. https://www.repository.cam.ac.uk/items/bf82da10-d95f-45de-b8c8-8c3c08a153e2

Kotova, A., Serdyuk, V., Avdieienko, I., Lenska, O. & Orina Ivaniga (2021). Integration of content and language integrated learning elements in the education of nonlinguistic specialty students by means of information technologies. *Sabiedrība, integrācija, izglītība*, 1, pp.316–326. https://doi.org/10.17770/sie2021vol1.6239.

Makoelle, T.M. & Burmistrova, V. (2021). Teacher education and inclusive education in Kazakhstan. *International Journal of Inclusive Education*, pp.1–17. https://doi.org/10.1080/13603116.2021.1889048.

McNabb, M., Hawkes, M. and Rouk, U. (1999). *Critical Issues in Evaluating the Effectiveness of Technology*. [online] ERIC. https://eric.ed.gov/?id=ED452827

Mukatayev, D. (2019). *Running head: exploring teachers' perceptions, challenges and strategies for teaching culturally diverse students Exploring Teachers' Perceptions, Challenges and Strategies for Teaching Culturally Diverse Students in Kazakhstan*. https://nur.nu.edu.kz/bitstream/handle/123456789/4322/Dauren%20Mukatayev%20Thesis+Author%20Agreement.pdf?sequence=1

Nabi, Y., Zhaxylykova, N. E., Kenbaeva, G. K., Tolbayev, A. and Bekbaeva, Z. N. (2016). Education Quality in Kazakhstan in the Context of Competence-Based Approach. *International Journal of Environmental and Science Education*, [online] 11(10), pp.3423–3435. https://eric.ed.gov/?id=EJ1114671

Nair, S., Awayz, M.H., Devaiah, M.V. & Nair, M.R. (2022). Technology Integrated Learning – A Case Study. *Education@ETMA*, [online] 1(1), pp.16–19. http://etma-india.com/index.php/educationatetma/article/view/48

Qanay, G., Courtney, M. & Nam, A. (2021). Building teacher leadership capacity in schools in Kazakhstan: a mixed method study. *International Journal of Leadership in Education*, pp.1–27. https://doi.org/10.1080/13603124.2020.1869314.

Rao, S. & Mandavilli, S. R. (2023). Empowering 'Linguistic have-nots': Empowering 'Linguistic have-nots' in the interests of faster economic, social and cultural progress and development across cultures and societies. SSRN Electronic Journal. 2023. https://dx.doi.org/10.2139/ssrn.4598055

Srisawasdi, N., Pondee, P. & Bunterm, T. (2018). Preparing preservice teachers to integrate mobile technology into science laboratory learning: an evaluation of technology-integrated pedagogy module. *International Journal of Mobile Learning and Organization*, 12(1), p.1. https://doi.org/10.1504/ijmlo.2018.089239.

Tastanbek, S. (2019). Kazakhstani Pre-Service Teacher Educators' Beliefs on Translanguaging.https://doi.org/10.13140/RG.2.2.30276.40329

Tor, D., Başaran, S.D. & Arık,E. (2022). Examining of the Digital Literacy Level of Teacher Candidates. *Ahi Evran Üniversitesi Kırşehir Eğitim Fakültesi Dergisi*, [online] 23(2), pp.2027–2064. https://doi.org/

Simonović, N. (2021). Teachers' Key Competencies for Innovative Teaching. International Journal of Cognitive Research in Science, Engineering and Education (IJCRSEE), 9(3), 331–345. https://doi.org/10.23947/2334-8496-2021-9-3-331-345

Stanišić, T., Leković, M., & Stošić, L. (2019). Relationship between the quality of higher education and balkan countries' competitiveness. International Journal of Cognitive Research in Science, Engineering and Education (IJCRSEE), 7(3), 49–59. https://doi.org/10.5937/IJCRSEE1903049S

Stosic, L., Dermendzhieva, S., & Tomczyk, L. (2020). Information and communication technologies as a source of education. World Journal on Educational Technology: Current Issues, 12(2), 128–135. https://doi.org/10.18844/wjet.v12i2.4815

Vesić, D., Laković, D., & Vesić, S. L. (2023). Use of Information Technologies in Higher Education From The Aspect of Management. International Journal of Cognitive Research in Science, Engineering and Education (IJCRSEE), 11(1), 143–151. https://doi.org/10.23947/2334-8496-2023-11-1-143-151

Original scientific paper

UDC: 316.644-057.874:51

Received: March 14, 2024.
Revised: July 13, 2024.
Accepted: August 07, 2024.

10.23947/2334-8496-2024-12-2-283-293

Pupils' Avoidance Strategies in Mathematics and Their Perception of the Teachers' Performance and Mastery

Danijela Milošević[1*], *Nevena Trifunović*[2], *Bisera Jevtić*[1]

[1] University of Niš, Faculty of Philosophy, Department of pedagogy, Serbia,
e-mail: danijela.milosevic@filfak.ni.ac.rs; bisera.jevtic@filfak.ni.ac.rs
[2] Academy of educational medical vocational studies in Kruševac, Serbia, e-mail: stanisavljevicnevena@gmail.com

Abstract: The aim of this research was to examine the attitudes of pupils about avoidance strategies in mathematics and their perception of the way mathematics teachers work. The research was conducted in the Republic of Serbia on a sample of 1165 primary school pupils. A quantitative approach was applied with a standardized instrument made up of five subscales which examined three avoidance strategies (novelty avoidance, providing assistance and self-handicapping) and two categories which include the style and method of the teacher's work (targeted structured teaching and mastery). The results have shown that pupils are mostly inclined towards the novelty avoidance strategy. The research has also revealed some differences when it comes to pupils' attitudes about avoidance strategies and their perception of the teacher's approach in relation to their success at school and grade levels in mathematics. It was shown that the school location was a significant independent variable in determining the differences in pupils' perceptions of the mastery of the teacher. It can be concluded that good didactic methodical organization of teaching, continuous monitoring of pupil progress, the teacher's pedagogical approach, developing pupils' skills in overcoming learning difficulties and monitoring their own work are some of the primary prerequisites for overcoming avoidance strategies and improving the educational work of teachers.

Keywords: *avoidance strategies, mastery learning, mathematics education, student attitudes and perceptions, teaching styles.*

Introduction

Mathematics education is a field of research which has been examined for decades with regard to the pedagogical context, teaching and learning. In the 21st century mathematics has had a special significance since it influences the process of logical and systematic thinking and enables the acquisition of skills for constructive problem solving (Dewanti, Kartowagiran, and Jailani, 2020). Mathematics education contributes to the readiness of young people to live in the modern world since a certain level of mathematical knowledge, mathematical reasoning and the use of the tools prepare students for a better understanding and problem solving out of school (Pavlović-Babić and Baucal, 2012).

In the basic system of education and upbringing of the Republic of Serbia, mathematics still represents a school subject which requires everyday, systematic and continuous work. The results of the International Student Assessment (PISA) show that more than a third of the pupils in Serbia have mathematical achievements below the basic level, which is significantly higher than the OECD average (Videnović and Čaprić, 2020). Lack of mathematical knowledge and skills makes the process of learning more difficult. There is a fear and student workload (Wang, 2021), which thus affects their further progress. The research has shown that lack of prior knowledge, a low level of students' attention and interest are becoming increasingly common in teaching mathematics. On the other hand, it has been found that teachers do not apply student-centered methods and they also lack teaching management skills (Baran, 2019).

To what extent anticipated student goals will be achieved depends on their abilities, understand-

*Corresponding author: danijela.milosevic@filfak.ni.ac.rs

ing instructions, the level of perserverance in solving the task and the quality of teaching. Students who show greater engagement in learning, have clear personal goals and the motivation to learn. They also have a greater ability to endure the challenges they encounter while mastering the knowledge of mathematics. They express a greater sense of belonging to the environment in which they study due to their self-efficacy and self-confidence. They also have positive feelings towards mathematics, they accept the opportunities that mathematics provides and they are inspired to use mathematical skills in everyday life. On the other hand, students who have a negative attitude towards mathematics are not motivated to study, and often show resistance when it comes to acquiring new mathematical knowledge (Willis, 2010). Students who do not desire to acquire new mathematical knowledge, resort to using different avoidance strategies which make it difficult for them to master the content and also negatively affect their mathematical achievements. Students prone to avoid mathematics do not want to ask their teachers or peers for help because they want to hide their own lack of ability, that is, not understanding mathematical content (Ramirez et al., 2018). They feel less efficient at work and they refuse to ask for help due to the feeling of fear that they will show themselves as less capable or successful in front of others (Klinger, 2011). For the same reason, students are often prone to use the self-handicapping strategy, which refers to the way of regulating a threat that undermines their self-esteem. This strategy is manifested by the student procrastinating in solving the task and finding reasons not to invest any effort in solving it (Schwinger et al., 2014). The third type of avoidance strategy includes resistance to novel approaches to solving problems (Turner et al., 2002). Students, due to their fear of making a mistake, often avoid new ways of problem-solving or learning new teaching content. Closedness to novelty prevents the student from making progress and improving their skills and experiences (Pan et al., 2020).

The application of avoidance strategies in mathematics is conditioned by the quality of teaching and the way teachers work. How the students will interpret the content and in what time they will master it greatly depends on the quality of teaching, that is, OF (from) the teacher. While the application of inadequate learning methods contributes to the bad mathematical performance of students (Geary, 2011), effective methods used by the teacher in working with students have a long-term effect on students' achievement (Munawaroh, 2017), but also on their interest and emotional well-being (Davadas, and Lay, 2018). If the teaching process is performed at a low level, students might develop various learning difficulties, which also affects their academic achievements (Uysal, 2015). Research has shown that the quality of teaching is reflected in the way students experience the goal structure in the classroom and the way they perceive the mastery of the teacher. It has been proven that the mentioned avoidance strategies are related to the low level of mastery and that the use of these strategies greatly depends on the motivational and affective support of teachers (Turner et al., 2002). Other research has found that the goal structure focused on classroom performance is related to students' personal goals. Those students value the idea of learning and show a greater level of self-efficacy, i.e. they show greater motivation and perseverance in work. On the other hand, when it comes to mastery, the teacher realizes activities which develop students' competences, that is they strive for their personal development (Fokkens-Bruinsma, Van Rooij, and Canrinus, 2020). The results of the research have shown that pupils' perception of mastery is positively related to their emotional and cognitive engagement (Uçar and Sungur, 2017).

Bearing in mind the presented results, as well as the fact that learning math is an interactive and dynamic process that requires long-term work, some of the most common problems in students' approach to mathematics are negative attitudes about mathematics, fear of failure, low level of persistence in solving tasks, lack of motivation of students in mastering the teaching content in mathematics, lack of peer cooperation in mastering mathematical knowledge, inadequate relationship between students and the teacher, etc. When it comes to the approach of mathematics teachers, problems arise, such as insufficient didactic-methodical competence of mathematics teachers, unrealistic expectations about achieving results from students, and lack of motivation to work and provide assistance to students in mastering the teaching content. The mentioned problems affect the formation of students' negative attitudes towards mathematics and the use of avoidance strategies, which indicates the need for new scientific knowledge obtained from this work.

Starting from the fact that pupils are primary users of the school program which regulates all the content, processes and activities aimed at achieving principles, goals and the standard of achievement, the research examined their attitudes about avoidance strategies in mathematics and their perception of the way mathematics teachers work, as a key factor in improving the teaching process.

Materials and Methods

Research Questions, Research Aim and Research Tasks

The starting point were the following research questions: 1) Which avoidance strategies in mathematics are the pupils most inclined to? and 2) Can school success, grades in math and the school location influence pupils' perception of avoidance strategies in mathematics and the way mathematics teachers work?

The aim of the research was to examine pupils' attitudes about avoidance strategies in mathematics and their perception of the style and methods mathematics teachers use in their work. There is very little research dealing with student strategies of avoiding mathematics, especially in the Republic of Serbia. For this reason, the research was conducted with the intention of providing new findings and pedagogical implications for the improvement of educational practice. The research started with the following tasks:

1. Determine the orientation of pupils towards avoidance strategies in mathematics.
2. Examine pupils' attitudes about avoidance strategies in mathematics (novelty strategies, help seeking and self-handicapping) with regard to independent variables (school success and grade level in mathematics).
3. Examine pupils' perceptions of the way mathematics teachers work (targeted structured teaching and mastery) with regard to independent variables (school success, grade level in mathematics and school location).

The research was based on the assumption that students will show the greatest inclination towards strategies for avoiding novelties, as well as that, about all three variables, students' answers will differ based on mathematics grade, school success, and school location.

Sample

In the Republic of Serbia, primary education is obligatory and it is comprised of two levels, each of them lasting 4 years. The first cycle is from the 1st to the 4th grade and it comprises children aged 7-10. The second cycle is from the 5th to the 8th grade and it is attended by pupils aged 11-14. Secondary education comprises only one level lasting four years. High school students are aged from 15 to 18.

The total sample of the research includes 1165 primary school pupils, from the second cycle (5th – 8th grade) on the territory of the Republic of Serbia. Out of 1165 pupils, 275 (23.6%) are from rural schools and 890 (76.4%) from urban schools. Taking into account the data on the total number of the children enrolled in the second cycle in primary schools of the Republic of Serbia for 2020/2021 school year (https://bit.ly/3brdLDq) and the total sample of this research, the sample size fully meets the 95% confidence interval.

Research Instruments and Procedures

Five sub-scales were used in the research. A scale to avoid help seeking, developed by Ryan, was used here (Ryan, Gheen, and Midgley, 1998), all the other scales were taken from the Patterns of Adaptive Learning Survey (Midgley, Kaplan, and Middleton, 2001). The pupils responded to the items on the scale from 1 (not at all true) to 5 (very true). The validity of the subscales is shown in Table 1.

Table 1. *Reliability of instrument sub-scales*

Sub-scales	Cronbach α
Avoiding novelty	.84
Avoiding help seeking	.81
Self-handicapping strategies	.82
Classroom performance	.82
Classroom mastery	.75

There are three scales in the survey concerning avoidance strategies and two scales assessing

pupils' perceptions of the mastery and performance goal structure. All the subscales turned out to be reliable and valid, which is confirmed by the Cronbach α value of internal consistency, which ranges from .75 to .84.

In conducting the research, all ethical standards were respected. Firstly, the school principals were contacted and with their approval cooperation with the pedagogists was established. After a detailed examination of the instrument, the pedagogists confirmed the linguistic adequacy of the claims in it, namely, that the claims do not violate children's dignity in any way. Considering that minors were examined, the parents were informed about the aim and way of conducting the research in collaboration with the pedagogists and teachers. With their consent, the pupils completed the assessment scale and were given the opportunity to give up at any time. Completing the instrument lasted for 15 minutes. The pupils and schools participating in the research were guaranteed complete anonymity.

Data Analysis

The arithmetic mean (M), as one of the measures of the central tendency, and the standard deviation (SD), as one of the dispersion measures that measured the deviation from the average were used for the purpose of this research. The analysis of variance (ANOVA) was also used to determine the differences between the variables, Post hoc analysis to determine the differences between groups and a t-test to determine the differences between the independent samples. The statistical analysis was done in the software SPSS.25.

Results

In order to determine the differences in pupils' attitudes about avoidance strategies in mathematics and the style and method of the teacher's work in relation to the independent variables, t-test and the analysis of variance (ANOVA) were applied. Avoidance strategies that primary school students resort to in their math classes were established first (Table 2).

Table 2. *Pupils' attitudes about avoidance strategies in mathematics*

Strategies	N	M	SD
Avoiding novelty	1165	3.21	1.08
Avoiding help seeking	1165	2.44	1.02
Self-handicapping	1165	2.03	1.01

The results indicate that the pupils are mostly oriented towards the novelty avoidance strategy (M=3.21, SD=1.08), then help seeking (M=2.44, SD=1.02), and they are least oriented towards the self-handicapping strategy (M=2.03, SD=1.01).

The differences in the pupils' attitudes about avoiding novelty, avoiding help seeking and self-handicapping strategies in mathematics teaching with regard to school success are shown in Table 3. For this purpose, the Post hoc test was conducted.

Table 3. *Post hoc analysis the pupils' attitudes about avoidance strategies in mathematics and school success*

Strategies	Academic performance		Mean difference	SE	p
Avoiding Novelty	Excellent	Insufficient	-2.64345	1.56162	.908
		Sufficient	2.68988	3.10393	1.000
		Good	-1.92287*	.68071	.048
		Very good	-1.92093*	.34520	.000
Avoiding Help Seeking	Excellent	Insufficient	-2.60446	1.46641	.760
		Sufficient	-.60446	2.91468	1.000
		Good	-2.81034*	.63921	.000
		Very good	-1.98907*	.32415	.000
Self-Handicapping	Excellent	Insufficient	-2.11119	1.45343	1.000
		Sufficient	-.19452	2.88889	1.000
		Good	-2.79256*	.63355	.000
		Very good	-1.72840*	.32128	.000

**The mean difference is significant at the .05 level*

Table 3 shows that statistically significant differences (p<.05) were found in the pupils' answers about avoidance strategies in mathematics relative to their school success. More precisely, some differences were found between individual groups (excellent success in regard to good and very good) in relation to pupils' attitudes about avoiding novelty, avoiding help-seeking and self-handicapping strategies. It was determined that the pupils with good and very good school success would rather choose mathematical problems that they know how to solve than those they had never solved before. On the other hand, it turned out that the pupils with excellent success were more open to acquiring new mathematical knowledge. In regard to help-seeking, while solving mathematical problems, its confirmed statistically significant differences between the group of pupils with excellent success in regard to groups of students with good and very good success. The pupils with good and very good school success significantly rather than the pupils with excellent school success find reasons for insufficient orientation towards solving mathematical problems. Generally speaking, the results obtained suggest that pupils with excellent school success are aimed at acquiring new knowledge, but they ask for help less than others. The pupils with bad school success did not show openness to learning new content in mathematics, and they also had a greater need to use the self-handicapping strategy.

The Post hoc analysis was used to determine which groups of students, in relation to their grade in mathematics, there are significant differences in attitudes about avoidance strategies in mathematics (Table 4).

Table 4. *Post hoc analysis the pupils' attitudes about avoidance strategies in mathematics based on the final grade*

Strategies	Math grade**		Mean difference	SE	p
Avoiding Novelty	2	1	1.96611	.95361	.395
		3	1.21483	.49588	.144
		4	2.47327*	.47943	.000
		5	4.27990*	.44768	.000
Avoiding Help Seeking	2	1	1.29440	.89865	1.000
		3	1.35510*	.46730	.038
		4	2.79384*	.45180	.000
		5	4.13725*	.42188	.000
Self-Handicapping	2	1	2.34314	.89644	.091
		3	1.05683	.46615	.236
		4	2.50328*	.45069	.000
		5	3.61294*	.42084	.000

**The mean difference is significant at the .05 level*

***Math grade in previous semester - The student's marks in each subject are averaged at the end of every semester and final grades are determined by the following ranges: 5 (excellent), 4 (very good), 3 (good), 2 (sufficient) is the lowest passing grade, 1 (insufficient) is the lowest possible grade, and the failing one*

Significant differences in the answers were determined among pupils with different grades in mathematics in the categories of avoiding novelty (F=27.141, df=4, p=.000), avoiding help-seeking (F=28.423, df=4, p=.000) and self-handicapping strategies (F=22.201, df=4, p=.000). Applying post hoc analysis (Table 4) showed that in all three categories, the pupils with a lower math grade (2-sufficient) showed lower orientation towards the desire to acquire new -mathematical knowledge, with a tendency to avoid help-seeking and to find excuses for their failures in solving mathematical problems. On the other hand, the pupils with higher grades (4 and 5) showed negative attitudes toward avoiding strategies which indicate that those groups of pupils are oriented toward achieving success in mathematics.

Considering that the pupils showed different attitudes about avoidance strategies in mathematics, the research also determined their perceptions of the way mathematics teachers work. For this purpose, the analysis of variance (ANOVA) and Post hoc analysis was used to explore differences between groups.

Table 5. *Post hoc analysis the pupils' attitudes about the way mathematics teachers work relative to their school success*

	Academic performance		Mean difference	SE	p
Classroom performance	Insufficient	Sufficient	-3.25000	3.35346	1.000
		Good	-4.93137*	1.62667	.025
		Very good	-4.28205	1.52423	.050
		Excellent	-3.85260	1.51219	.110
Classroom mastery	Insufficient	Sufficient	-8.25000	3.85216	.324
		Good	-7.67647*	1.86857	.000
		Very good	-7.03571*	1.75090	.001
		Excellent	-6.70404*	1.73707	.001

**The mean difference is significant at the .05 level.*

Significant differences were identified in the attitudes of pupils of different school success about perceived classroom performance-focused goal structure (F=2.752, df=4, p=.027) and perceived classroom mastery-focused goal structure of mathematics teachers (F=4.494, df=4, p=.001). The results in Table 5 show that the pupils with good school success had a statistically significant positive attitude about classroom performance in comparison with pupils with insufficient success. This implies that students with good success positively value giving feedback to the teacher and their promptness in informing the pupils about their achievements. When it comes to perceiving classroom mastery, the pupils with good, very good and excellent school success have significantly positive attitudes in comparison with a group of insufficient success pupils.

Table 6 shows the Post hoc results and between groups confirms significant differences in the pupils' perception of the way the teacher works.

Table 6. *Post hoc analysis the pupils' perceptions of the way the teacher works relative to their final math grade*

	Math grade		Mean difference	*SE*	*p*
Classroom performance	2	1	-2.07843	1.08330	.553
		3	-3.54357*	1.07105	.010
		4	-3.63345*	1.06134	.006
		5	-4.54455*	1.04329	.000
Classroom mastery	2	1	2.07843	1.08330	.553
		3	-1.46514	.56332	.094
		4	-1.55502*	.54463	.044
		5	-2.46612*	.50856	.000

**The mean difference is significant at the .05 level*

Results of the ANOVA indicate that there are differences in the pupils' perceptions relative to the level of their grades in mathematics, when it comes to mastery (F=9.159, df=4, p=.000) and goal structures in class (F=2.947, df=4, p=.019). Post hoc analysis presented in Table 6 implies that the pupils with higher grades in mathematics (4 and 5), in comparison with pupils with lower grades (2), have statistically significantly positivily attitudes toward teachers' strategies oriented to classroom performance and classroom mastery. Generally, the pupils with the higher grade (4 and 5) evaluated the teacher's work more positively, they claimed to be more encouraged by the teacher to look for new or unusual ways when dealing with mathematical problems, and to give them feedback about achievement in mathematics.

Table 7 shows the differences in the pupils' perceptions of the style and way the teacher works relative to the location of the school they attend. A t-test was used for this purpose.

Table 7. *t-test results for the difference between the pupils' perceptions about the way mathematics teachers work relative to the school location*

	School location	M	SD	t	df	p
Classroom performance	Rural	3.31	.99	1.719	1163	.086
	Urban	3.18	1.05			
Classroom mastery	Rural	4.05	.88	2.613	525.854	.009
	Urban	3.88	1.03			

There are significant differences in the pupils' perceptions when it comes to the category of perceived classroom mastery-focused (t=2.613, df=525.854, p=.009). The pupils attending a rural school assessed the teacher's work more positively than the pupils from urban schools. Therefore, the pupils from rural schools estimated that their mathematics teachers encouraged the desire to acquire knowledge and the teachers' methods positively influenced them to show greater interest in understanding mathematics. There were no differences in their perceptions relative to the school location in terms of student goal structure.

Discussions

A significant result found in this research indicates that primary school pupils in the Republic of Serbia show supporting attitudes towards the use of novelty avoidance strategies in mathematics. Research based on a sample of Latvian and Lithuanian students confirmed that the students showed little interest in learning mathematical content (Cēdere et al., 2015). Another study had the same results, except that it discovered that the reasons for obtaining such results stem from a lack of enthusiasm and student self-initiative to explore mathematics. There was a conclusion that the students were afraid of the difficulties they encountered while solving mathematical problems (Cēdere, Jurgena, and Targamadze, 2018). Another study proved the opposite, namely, it was found that primary school pupils used self-handicapping strategies the most and novelty avoidance the least (Turner et al., 2002). Taking into account the results obtained in this and other research, it can be concluded that pupils lack perseverance, willingness to learn and work, which encourages them to use different avoidance strategies in mathematics. Pupils are willing to acquire new knowledge when the content they are learning is related to their interests, experiences and when it has the function of preparing them for real life. It has been shown that the level of motivation and interest depends on the pupil's affective attitude towards mathematics, which also affects the quality of student achievement (Antonijević, 2012). It is known that mathematics is a school subject which requires higher levels of logical reasoning, therefore the teacher's approach is extremely important when it comes to mastering the content properly. Motivation to learn largely depends on the teacher's approach and their methodological skills, and thus resorting to the mentioned strategies. Teachers face new challenges that oblige them to make teaching material interesting, changeable and innovative.

This research has found differences in pupils' attitudes about the help avoidance strategy in relation to school success. It has turned out that pupils with medium school success are most oriented towards the help avoiding strategy. The results have shown that pupils with a high level of achievement, self-confidence and belief in their own abilities frequently asked for additional resources and participated in discussions with teachers and other pupils for better understanding and clarifying the teaching content (Akilli and Genç, 2017). Other research has shown that students who are prone to seeking help from teachers or peers have greater achievements in mathematics throughout the school year. Pupils who positively assessed the teacher's emotional support showed orientation towards seeking help (Schenke et al., 2015). Recent research has confirmed that quality social relations are crucial for creating the feelings of security and freedom. Due to efficient relationships, students do not feel any discomfort and feel free to seek help from others (Peeters, Robinson, and Rubie-Davies, 2020). Therefore, students' perceptions of the emotional support from teachers and peers greatly determine the decision to seek help. Students have the need to belong, they want their needs, desires and interests to be respected and accepted. If the teacher creates positive relationships and cares for student needs, students are likely to show greater motivation to learn, and thus they will feel more confident and free to ask for help. This finding has great pedagogical significance because it highlights the importance of a proper approach to working with students and the development of positive social relations within the department. It also emphasizes the importance of cooperation among students in the process of adopting teaching content, which can contribute to better learning results. However, teachers must develop interpersonal, socioemotional and pedagogical competencies in order to achieve the above. As Simonović (2021) concluded, in accordance with new modern requirements, teachers must develop a new profile based on various competencies.

One of the obtained results in this research is that the pupils with bad school success showed a greater need to use the self-handicapping strategy. The results of another study confirm the results obtained, which proves that the application of the self-handicapping strategy is positively related to pupils' motivation (Akin, Abaci, and Akin, 2011). The results obtained are in accordance with the expectations be-

cause they confirm that the level of perseverance, motivation and engagement in the task is much lower with pupils who have bad school success than with those who achieve better school success. The pupils who often used the self-handicapping strategy showed a lower level of clarity of self-perception, lower academic self-efficacy, they felt a higher level of anxiety while completing the test, they used superficial learning strategies and achieved lower academic results (Gadbois and Sturgeon, 2011). The results of the research have shown that the pupils who perceived mastery in a positive way used self-handicapping, help-seeking and novelty avoidance strategies less frequently (Turner et al., 2002). One of the emerging solutions is nurturing the goals of a masterful approach since it is one of the ways to reduce the level of implementing these strategies (Schwinger et al., 2014). The task of a mathematics teacher is to use the feeling of frustration that makes the pupil give up for developing constructive strategies to solve the problem in an efficient way (Goldin, 2010). Taking into account that research has shown that it is more difficult to establish emotional control and management of unpleasant emotions in younger students (Di Leo, 2019), the pedagogical challenge before teachers is how to recognize the first signs of negative emotional reactions in order to avoid a negative impact on student results. As research has shown that students with lower academic performance and worse grades in mathematics more often use self-handicapping strategies, it is necessary for teachers to devise strategies that would help students overcome the fear of failure and provide them with additional support in mastering mathematical knowledge. This finding is of great importance because it emphasizes the emotional aspect of achieving positive educational outcomes, as well as the importance of an individualized approach in teaching. By implementing these aspects, it is possible to reduce student frustration and increase motivation for learning mathematics.

When it comes to the results concerning pupils' perceptions about the way teachers work, three key findings have been discovered. The first confirms the differences in the pupils' responses about the teacher's performance and mastery goal structure, relative to the pupils' school succes. An interesting fact is that the pupils with medium school succes assessed the category of performance-focused and mastery-focused goal structure most positively. The reasons for obtaining such results stem from the fact that the teacher's approach is not crucial to pupils with better school success because they have already built self-confidence, intrinsic motivation and work habits. On the other hand, emotional support from teachers is very important to pupils with bad school success for their perseverance and motivation to work, therefore they recognize it and expect it from the teacher more often. Another result obtained is that the pupils had different perceptions of the teacher's mastery in relation to the grade level in mathematics. The pupils with the highest grade assessed the students' goal structure and mastery in class more positively than the pupils with lower grades. The results indicate that mathematics teachers are more oriented towards pupils who achieve higher grades in mathematics than towards those who achieve lower succes in mathematics. The pupils' perceptions indicate their dissatisfaction with the approach mathematics teachers use. One of the reasons for such an approach could be weak interest in learning, slow student progress and, as it was previously proven, orientation towards avoidance strategies. Nevertheless, the teacher is expected to provide the greatest emotional support, motivate them, praise them and come up with a way of making mathematics more interesting and simple to learn. This finding is of extreme importance because it indicates the need for changes in teaching practice that include identifying students with lower academic achievement who manifest anxiety towards mathematics, developing and implementing interventions to reduce anxiety, as well as encouraging the reflective practice of mathematics teachers. Such an approach could contribute to the improvement of mathematical achievements and the development of positive attitudes towards mathematics in further education.

The third result confirms that the pupils attending rural schools assessed the mastery of math teachers in the classroom more positively than those attending urban schools. The reason for obtaining such a result lies in the fact that in the Republic of Serbia, the number of pupils in rural and urban school classes differs a lot. The average number of children in a urban school class is about 24 pupils, whereas there are only a few pupils in rural school classes, who are mostly in different grades (the so-called combined classes). Consequently, the dynamics of the class and the working atmosphere differ to a great extent. Teachers in rural schools have more time available. For this reason, they can establish a stronger bond and emotional support with their pupils, and that is why the pupils attending rural schools assessed the teacher's mastery more positively. In favour of this claim, there is research conducted in Serbia which showed that the school climate was related to demographic variables, namely that a more favourable school climate was established in smaller places, where schools had a significantly smaller number of

pupils (Vujačić, Đević, and Jošić, 2020). This result once again confirms that a positive climate in the classroom has statistically significant and positive effects on self-efficacy and student engagement (Vidić, 2021), which indicates the importance of teachers in creating a stimulating atmosphere for learning.

Therefore, the general results indicate that students with lower academic performance and worse grades in mathematics often use avoidance strategies, while the teacher's approach significantly affects their interest, enjoyment of learning and the formation of attitudes towards the subject. We should bear in mind recent research results that have shown that teachers' approaches differ in terms of whether they teach natural or social science. It has been proven that science teachers were more oriented towards the approach which implied a traditional way of work (giving a lecture and asking questions), whereas social science teachers used a student-centered approach, which encouraged the students to solve problems and make decisions on a daily basis (Teppo, Soobard, and Rannikmäe, 2021). Accordingly, the importance of applying innovative teaching models is evident because they provide the possibility of active student participation, which contributes to the creation of favorable conditions for learning and work, and thus reduces the possibility of using avoidance strategies.

Based on the previous, but also the obtained research findings a significant contribution would be to establish the connection between the use of the teacher's work methods and students' avoidance strategies, as well as to investigate students' avoidance strategies, perceptions of performance-focused and mastery-focused goal structures in social science and compare it to the results of this research. In the context of the examined categories, the research could improve the findings which include examining the link between performance and mastery goal structures and students' orientation towards avoidance strategies in mathematics.

Conclusions

The research examined pupils' attitudes about avoidance strategies in mathematics and their perceptions of the way mathematics teachers work. The results show that the pupils are mostly oriented towards the novelty avoidance strategy, which indicates their lack of motivation to acquire new mathematical knowledge. The second result of this research shows that the pupils with bad school success and lower grades in mathematics are the most resorted to avoidance strategies.

The third result confirms differences in the pupils' perceptions of the teachers' performance-focused and mastery-focused goal structures in relation to their school success and grade level in mathematics. The final result revealed differences in the pupils' perceptions of the teachers' mastery in relation to whether they attend a city or a rural school. Considering that the pupils with bad school success and lower grades in mathematics were more inclined to avoidance strategies, it can be concluded that they need the greatest support and assistance in learning.

Taking into account the obtained results, it can be concluded that teaching students how to learn, showing understanding and providing help when they face learning difficulties, as well as learning how to apply acquired knowledge and skills in their daily life should be one of the priority goals of modern of mathematics education in the 21st century.

Implications

Starting from the fact that the use of pupils' avoidance strategies in mathematics stems from their fear of mistake and failure when solving tasks, it is suggested to develop pupils' intrinsic motivation and implement the strategy of learning from mistake, in order to accept novelty in mathematics. To enhance help seeking, it is important to nurture the pedagogical approach and quality relationships in the classroom and introduce active methods of teaching. To reduce the self-handicapping strategy, it is important to develop self-confidence, self-management skills, self-regulation, and personal responsibility for the success or failure of a pupil's work.

Also, teacher's support in learning, continuous monitoring of pupils progress, and development of a pedagogical atmosphere in the classroom can lead to positive changes, namely, to the decline in avoidance strategies, development of a positive attitude towards mathematics and achieving higher levels of mathematical knowledge and skills. That implicates the development of didactic-methodical, pedagogical,

socio-emotional, and other teacher competencies.

Acknowledgements

The authors would like to thank the respondents who participated in the research. This study was supported by the Ministry of Science, Technological Development and Innovations of the Republic of Serbia (Contract No. 451-03-66/2024-03).

Conflict of interests

The authors declare no conflict of interest.

Author Contributions

Conceptualization, D.M., B.S. and N.T.; data curation, D.M. and N.T.; methodology, D.M. and B.S.; resources, D.M., N.T. and B.S.; formal analysis, D.M., N.T. and B.S.; D.M., N.T. and B.S.; validation, D.M., N.T. and B.S.; writing—original draft preparation, D.M., N.T. and B.S.; writing—review and editing, D.M., N.T. and B.S. All authors have read and agreed to the published version of the manuscript.

References

Akilli, M., & Genç, M. (2017). Modelling the effects of selected affective factors on learning strategies and classroom activities in science education. *Journal of Baltic Science Education*, *16*(4), 599-611. http://dx.doi.org/10.33225/jbse/17.16.599

Akin, A., Abaci, R., & Akin, Ü. (2011). Self-handicapping: A conceptual analysis. *Journal of Educational Sciences*, *3*(3), 1155-1168.

Antonijević, R. (2012). Contextual factors of the students' achievements in the area of mathematics. *Inovacije u nastavi-časopis za savremenu nastavu* [Innovations in teaching- Journal of Contemporary Teaching], *25*(3), 5-14.

Baran, M. (2019). Identifying barriers when teaching science and mathematics in low economy regions: swansea and hakkari as case studies. *Journal of Baltic Science Education*, *18*(6), 848-865. https://doi.org/10.33225/jbse/19.18.848

Cēdere, D., Jurgena, I., & Targamadze, V. (2018). Interest of latvian and lithuanian students in science and mathematics. *Journal of Baltic Science Education*, *17*(1), 31-42. https://dx.doi.org/10.33225/jbse/18.17.31

Cēdere, D., Jurgena, I., Helmane, I., Tiltiņa-Kapele, I., & Praulīte, G. (2015). Cognitive interest: problems and solutions in the acquisition of science and mathematics in schools of Latvia. *Journal of Baltic Science Education*, *14*(4), 424-434. https://bit.ly/3fGR3sZ

Davadas, S. D., & Lay, Y. F. (2017). Factors affecting students' attitude toward mathematics: A structural equation modeling approach. *Eurasia Journal of Mathematics, Science and Technology Education*, *14*(1), 517-529. https://doi.org/10.12973/ejmste/80356

Dewanti, S. S., Kartowagiran, B., & Jailani, R. (2020). Lecturers' experience in assessing 21st-century mathematics competency in Indonesia. *Problems of Education in the 21st Century*, *78*(4), 500-515. https://doi.org/10.33225/pec/20.78.500

Di Leo, I., Muis, K. R., Singh, C. A., & Psaradellis, C. (2019). Curiosity… Confusion? Frustration! The role and sequencing of emotions during mathematics problem solving. Contemporary educational psychology, *58*, 121-137. https://doi.org/10.1016/j.cedpsych.2019.03.001

Fokkens-Bruinsma, M., Van Rooij, E. C. M., & Canrinus, E. T. (2020). Perceived classroom goal structures as predictors of students' personal goals. *Teachers and Teaching*, *26*(1), 88-102. https://doi.org/10.1080/13540602.2020.1740195

Gadbois, S. A., & Sturgeon, R. D. (2011). Academic self-handicapping: Relationships with learning specific and general self perceptions and academic performance over time. *British Journal of Educational Psychology*, *81*(2), 207-222. https://doi.org/10.1348/000709910X522186

Geary, D. C. (2011). Consequences, characteristics, and causes of mathematical learning disabilities and persistent low achievement in mathematics. *Journal of Developmental & Behavioral Pediatrics*, *32*(3), 250-263. https://doi.org/10.1097/dbp.0b013e318209edef

Goldin, G. A. (2010). Problem solving heuristics, affect, and discrete mathematics: A representational discussion. In G. Kaiser, & A. Sriraman (Eds.), *Theories of Mathematics Education* (pp. 241-250). Springer. http://dx.doi.org/10.1007/978-3-642-00742-2_24

Klinger, C.M. (2011). 'Connectivism': A new paradigm for the mathematics anxiety challenge? *Adult Learning Mathematics: An international journal*, *6*(1), 7-19. https://files.eric.ed.gov/fulltext/EJ1068259.pdf

Midgley, C., Kaplan, A., & Middleton, M. (2001). Performance-approach goals: Good for what, for whom, under what circumstances, and at what cost? *Journal of Educational Psychology*, *93*(1), 77-86. https://psycnet.apa.org/doi/10.1037/0022-0663.93.1.77

Munawaroh, N. (2017). The influence of teaching methods and learning environment to the student's learning achievement

of craft and entrepreneurship subjects at vocational high school. *International Journal of Environmental & Science Education*, *12*(4), 665-678.

Pan, S. C., Sana, F., Samani, J., Cooke, J., & Kim, J. A. (2020). Learning from errors: Students' and instructors' practices, attitudes, and beliefs. *Memory*, *28*(9), 1105-1122. https://doi.org/10.1080/09658211.2020.1815790

Pavlović-Babić, D., & Baucal, A. (2012). *Podrži me, inspiriši me. PISA 2012 u Srbiji: Prvi rezultati* [Support me, inspire me. PISA 2012 in Serbia: First results]. Institute of Psychology, Faculty of Philosophy, Center for Applied Psychology. https://bit.ly/3zS5LWy

Peeters, A., Robinson, V., & Rubie-Davies, C. (2020). Theories in use that explain adolescent help seeking and avoidance in mathematics. *Journal of Educational Psychology, 112*(3), 533-550. https://doi.org/10.1037/edu0000423

Ramirez, G., Hooper, S.Y., Kersting, N.B., Ferguson, R., & Yeager.D. (2018). Teacher math anxiety relates to adolescent students' math achievement. *AERA open*, *4*(1), 1–13. https://doi.org/10.1177/2332858418756052

Ryan, A. M., Gheen, M. H., & Midgley, C. (1998). Why do some students avoid asking for help? An examination of the interplay among students' academic efficacy, teachers' social–emotional role, and the classroom goal structure. *Journal of Educational Psychology*, *90*(3), 1-8. https://psycnet.apa.org/doi/10.1037/0022-0663.90.3.528

Schenke, K., Lam, A. C., Conley, A. M., & Karabenick, S. A. (2015). Adolescents' help seeking in mathematics classrooms: Relations between achievement and perceived classroom environmental influences over one school year. *Contemporary Educational Psychology*, *41*, 133-146. https://doi.org/10.1016/j.cedpsych.2015.01.003

Schwinger, M., Wirthwein, L., Lemmer, G., & Steinmayr, R. (2014). Academic self-handicapping and achievement: A meta-analysis. *Journal of Educational Psychology*, *106*(3), 744-761. http://dx.doi.org/10.1037/a0035832

Simonović, N. (2021). Teachers' key competencies for innovative teaching. International Journal of Cognitive *Research in Science, Engineering and Education (IJCRSEE)*, *9*(3), 331-345. https://doi.org/10.23947/2334-8496-2021-9-3-331-345

Teppo, M., Soobard, R., & Rannikmäe, M. (2021). Grade 6 & 9 student and teacher perceptions of teaching and learning approaches in relation to student perceived interest/enjoyment towards science learning. *Journal of Baltic Science Education*, *20*(1), 119-133. https://doi.org/10.33225/jbse/21.20.119

Turner, J. C., Midgley, C., Meyer, D. K., Gheen, M., Anderman, E. M., Kang, Y., & Patrick, H. (2002). The classroom environment and students' reports of avoidance strategies in mathematics: A multimethod study. *Journal of Educational Psychology*, *94*(1), 88-106. https://doi.org/10.1037/0022-0663.94.1.88

Uçar, F. M., & Sungur, S. (2017). The role of perceived classroom goal structures, self-efficacy, and engagement in student science achievement. *Research in Science & Technological Education*, *35*(2), 149-168. https://doi.org/10.1080/02635143.2017.1278684

Uysal, S. (2015). Factors affecting the mathematics achievement of Turkish students in PISA 2012. *Educational Research and Reviews*, *10*(12), 1670-1678. https://doi.org/10.5897/ERR2014.2067

Videnović, M., & Čaprić, G. (2020). *Pisa 2018: Izveštaj za Republiku Srbiju* [Pisa 2018: Report for the Republic of Serbia]. Ministry of Education, Science and Technological Development of the Republic of Serbia. https://ceo.edu.rs/wp-content/uploads/2022/11/PISA-izvestaj-2018.pdf

Vidić, T. (2021). Students' school satisfaction: The role of classroom climate, self-efficacy, and engagement. *International Journal of Cognitive Research in Science, Engineering and Education (IJCRSEE)*, *9*(3), 347-357. https://doi.org/10.23947/2334-8496-2021-9-3-347-357

Vujačić, M. B., Đević, R. S., & Jošić, S. M. (2020). School climate as factor of educational effectiveness of schools: Secondary data analysis from TIMSS 2015 study. *Inovacije u nastavi- časopis za savremenu nastavu* [Innovations in teaching-Journal of Contemporary Teaching], *33*(2), 15-28. http://dx.doi.org/10.5937/inovacije2002015V

Wang, L. (2021). The analysis of mathematics academic burden for primary school students based on PISA data analysis. *Frontiers in Psychology*, *12*, 229. https://doi.org/10.3389/fpsyg.2021.600348

Willis, J. (2010). *Learning to love math: Teaching strategies that change student attitudes and get results*. ASCD.

Original scientific paper

Received: January 02, 2024.
Revised: May 11, 2024.
Accepted: May 20, 2024.

UDC:
378.091.212
159.947.2-057.875(597.14)
10.23947/2334-8496-2024-12-2-295-315

Check for updates

The Moderating Effect of Policies on Student's Attractiveness in electing Future Higher Education Institution: An Analysis in South of Vietnam

Bich-Hang Vuong[1*], *Hsin-Kuang Chi*[1], *Yo-Yu Liu*[1], *Dang Anh Luc*[2], *Shu-Fang Yuan*[1]

[1] Department of Business Administration, Nanhua University, Taiwan
e-mail: vuongbichhang@nhu.edu.tw, hkchi@nhu.edu.tw, liuyoyu@gmail.com, june@nhu.edu.tw
[2] Ho Chi Minh City University of Economics and Finance - UEF
e-mail: lucda@uef.edu.vn

Abstract: Higher education is becoming more competitive due to recent events like globalization and the rise of private colleges both domestically and internationally. Fierce rivalry among Vietnam's higher education institutes (HEI) to draw students in with a variety of policies. The research conducted a survey based on the choice and brand equity models with the data collection from 788 students. Primary data were analyzed by the SPSS and PLS software with the SEM linear structural model and discovered that the university's brand equity (BE) has a significant effect on students' attractiveness. The HEI's policies positively affect their characteristics and image that can increase the university's BE. The mediator testing showing school image can increase the effect of School characteristics or brand equity as well as on policies. The research finding that for rising up the admission, HEI should focus on building strong BE by making a good image of school.

Keywords: *Attractiveness in higher education; moderating effect; brand equity; university's policy; school characteristics.*

Introduction

Vietnam's education, especially higher education has passed many stages of vicissitude along with the country's development, and it is greatly influenced by the ideology and philosophy of foreign educations such as China, France, Soviet Union, United States, etc. Therefore, there are difficulties in reforming such education. It is not possible to renew it in a disparate way by sporadic policies, but national education as a whole need to be reformed.

As a result of a recent Cabinet decision (Resolution 14/2005/NQ-CP, November 2, 2005) affirming the autonomy of higher education institutions in Vietnam, it specifically mentions a number of steps that need to be taken into consideration. This choice has major implications. The Socialist Republic of Vietnam's constitution upholds Ho Chi Minh's ideas as well as the dominance of the Communist Party and the ideals of Marxism-Leninism. Its political structure has placed a significant emphasis on governmental control and centralized planning. Despite fast change, the legacy of a Soviet higher education model is still present in its higher education system. Therefore, it is important to make a formal commitment to giving higher education institutions autonomy (Hayden and Thiep, 2007).

Higher education activities have undergone a tremendous and wonderful shift in recent years. In order to attract and recruit students, tertiary institutions confront rising challenges and compete with one another (Jafari and Aliesmaili, 2013; Fiona Harden et al., 2014).

According to Tansel and Bircan (2006), tertiary education has always been seen as a luxury rather than a need or as an elite activity (Harris, 2013). In such a dynamic environment, selecting the best higher education institution is extremely important for all students (Tamtekin Aydın, 2015), and the process of

*Corresponding author: vuongbichhang@nhu.edu.tw

selecting a university is extremely complex (Tamtekin Aydın, 2015; Marginson, 2007; Truong et al., 2016). This is because choosing a university affects students' orientation toward their future careers as well as their motivation for their studies, commitment to their studies, and interactions with their peers.

Understanding the factors that influence a student's or a related person's choice of university as the basis for recruiting strategies, the implementation of training programs, and the development of each university in the competitive environment has many advantages in the world of tertiary institutions (Jafari and Aliesmaili, 2013; Emanuela Maria Avram, 2014). From the viewpoint of the students, choosing to attend a certain university is important for their future jobs and other aspects of life (Emanuela Maria Avram, 2014). According to Naidoo (2007) and Marginson (2018), higher levels of education will result in higher wages, longer professional careers, more work opportunities, and more life satisfaction. On the other hand, the student's life could be irreparably harmed by the incorrect decision.

In the study of Carvalho et al. (2020), the decision of a higher education institution (HEI) is a long-term personal investment that affects one's future career, which contributes to its uniqueness. For students and other stakeholders, studying at a higher education facility is more crucial. Also, as a result of globalization processes, economies become more competitive (Tran et al., 2020). This competitiveness can be increased by making investments in education (Tran et al., 2020). In order to help students in the South of Vietnam make the best choices and to aid institutions in understanding these aspects and developing appropriate administration programs, this study aims to explore major factors impacting university choice. It serves as a resource for educators in higher education who know where to put their educational ideas, particularly in private higher education.

Theoretical Framework and Hypotheses Development

Model Choice and Behavioral Decision-Making

The market idea has driven HEIs' pro-active behavior toward clients and prospective students. The relationship between students and HEIs has evolved into one of customer-service supplier as the primary result of changed competitive landscape. This is a widespread trend that was originally identified in affluent nations and is currently spreading to poor nations. Higher education transforms from a public good that benefits society to a private good or service that a university offers to its pupils. The student-university connection is becoming more commercialized, as numerous authors have already noted (Judson and Taylor, 2014; Mitić and Mojić, 2020). Students are seen as clients, and universities' goals shift to providing superior value to rivals and determining how to best position themselves in the marketplace (Mitić and Mojić, 2020). Chapman was one of the first to incorporate this consumer behavior theory into school in 1986, claims (Hanssen and Mathisen, 2018). Economic models, sociological models, and integrated or information processing models can be used to categorize consumer decision-making models. Economic models, sociological models, and mixed or information-processing models are the three basic categories into which consumer decision-making models can be divided. It is advised that prospective students use economic models to inform their decision by using a logical procedure to balance the apparent benefits and expenses (Flores and Flores, 2022). Sociological choice/status attainment models identify the variables that affect a student's desire to pursue academic goals. According to Simões and Soares (2010), these factors have evolved over the course of the student's life. These models' primary objective in representing economic and social elements is to help HEIs determine the most effective intervention techniques to draw in new students (Bonnema and Van DerWaldt, 2008). To create "a modern higher education student-choice model" (Wilkins and Huisman, 2015) drew from the three combined models of (Simões and Soares, 2010; Chakhaia and Bregvadze, 2018; Mitić and Mojić, 2020).

In actuality, there aren't many research on how students from developing nations choose their universities. Wilkins and Huisman (2015) contend that their model also combines elements of contemporary marketing and consumer behavior insight while offering a thorough model to explain student choice behavior that is based on the research of the aforementioned integrated model.

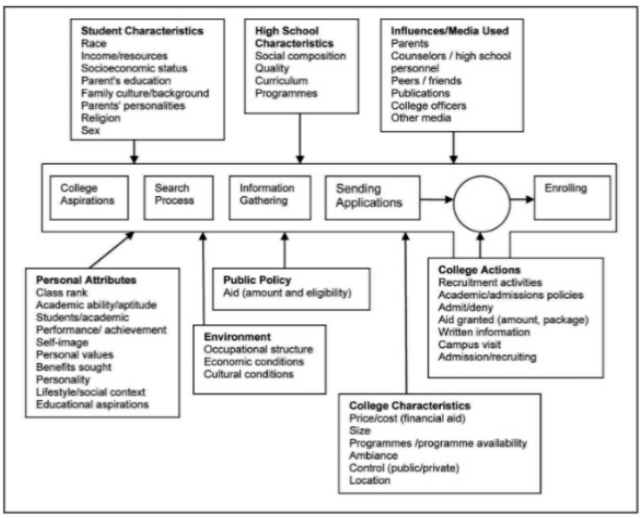

Figure 1. A contemporary higher education student-choice model (Vrontis et al. 2007, 982)

School Characteristic and Brand Equity

The characteristics of the university clearly influence how students choose their school. According to Chapman and Hutcheson (1982 this study investigated differences in (1); Mitić and Mojić (2020) this category could be further broken down into many indicators, such as the standard of instruction and education, the reputation of the professors, the facilities, the location, the cost of tuition, the support policies for students, etc.

Public universities, private universities, and foreign universities (which award degrees from institutions abroad but are based in Vietnam) make up the three main categories of universities that exist today not only in the globe but also in Vietnam. In terms of the functioning of the university, the current universities in the world exist in the form of a teaching-oriented university and a research-oriented university. These two responsibilities are combined in Vietnam Universities and given additional weight to create the three essential pillars that every university must possess. It serves as a community service event. According to Bezmen and Depken (1998), it may be broadly categorized by two different questions: how do people select whether or not to attend HEI? and where do they opt to attend? These two options are connected, but they are clearly distinct in terms of the theoretical, empirical, and practical ramifications. The demand for particular institutions has been explained by factors including intercollegiate athletic achievement (Bezmen and Depken, 1998) and the university's status as a public or private college (Dunnett et al., 2012). Several of these research have discovered a correlation between the demand for education and the cost of attendance. Bezmen and Depken (1998) revealed that the majority of measures used to determine the out-of-pocket cost of higher education, such as tuition, tuition plus room and board, lost wages, or all dollars spent by a typical full-time student, are consistent with the positive association identified in this subsample approach.

As according Shafaei et al. (2019), Brand Equity (BE) is "a collection of assets, such as name recognition, devoted patrons, perceived quality, and associations that are tied to the brand and provide value to the offered product or service." As other scholars have stressed Soni and Govender (2018); Pinna et al. (2018) a company's brand name is viewed as a valuable asset that increases an organization's future earnings. Brand equity is obviously a multi-dimensional notion, as shown by the definitions above (Balmer et al., 2020).

Like any other professional service, the high education (HE) service has distinctive qualities that have significant implications for creating a marketing plan. The main factor contributing to the significant perceived danger associated with HE consumption is its intangibility. Researchers have discovered ways to solve this marketing conundrum by incorporating concrete cues into the service. As a result, each university's unique qualities play a significant role in building its reputation. Accordingly, the following hypothesis is:

H1: School characteristic positively influences Brand Equity

School Characteristics and School Image

The development of the economies of many countries is increasingly dependent on the higher education sector. Not only the international students but also domestic students are looking for evidence of higher quality in the services given because they are unsure and must make risky selections when choosing an institution (Angell et al., 2008). The most significant factors influencing the college selection process, according to Wilkins et al. (2013), are college "quality" and cost considerations. Taylor and Reed (2008) found seven determinants of college choice using component analysis and discriminant analysis such as financial aid, parent's preference, specific academic programs, size of school, location of campus, athletic facilities, social activities. The aforementioned elements also serve as the foundation for the fundamental aspects of school characteristics. The prestige and reputation of the institution are also enhanced by making sure that one of the aforementioned aspects is effectively applied or by achieving several results in the aforementioned area. Several academics have stated that the reputation and output quality of the training programs, the students, the alumni communities, the accomplishments of the teaching staff, the student service faculty, etc. all contribute to the school's image. While Gatewood et al. (1993) or the image associated with the name of an organization, and recruitment image—the image associated with its recruitment message—were studied. Data collected from five student groups indicate that the image of an organization is related to the in-formation available ahout it. Additional results are that different exter-nal groups only moderately agree on ratings of corporate image, poten-tial applicants have different corporate and recruitment images of the same organizations, and corporate image and recruitment image are significant predictors of initial decisions about pursuing contact with organizations. The job choice process can be characterized as a series of decisions made by an applicant as to which jobs and organizations to pursue for possible employment. Following Schwab, Rynes, and Aldag's (1987) described image as simply being connected with the organization's name, Arpan et al. (2003) said that image and reputation have frequently been used interchangeably. Researchers Pinna et al. (2018) who examined the perceptions of colleges and universities noted that the perception of the services offered by a university is both communicative and cognitive in nature. The university's image is influenced by a number of concrete and intangible factors, values, and communication. Hence, we present the following hypothesis:

H2: School Characteristics positively influences School's Image

School Image and Brand Equity

Brand equity in terms of consumer understanding of a brand, which is assessed by brand awareness and brand image, is referred to as "consumer-based brand equity" (CBBE) (Keller Kevin Lane, 2013). A positive brand image is therefore made up of favorable, powerful, and distinctive brand associations in consumers' minds and is able to boost the likelihood of brand choice and brand loyalty since brand image relates to the consumer's views of a brand (Keller Kevin Lane, 2013).

The necessity of creating strong university brands has been recognized by HEIs around the world, and many now treat students like customers (Khoshtaria et al., 2020; Mourad et al., 2020; Guilbault, 2018). Strong, positive, and distinctive associations with the brand may not be attained in this situation until after the person has completed the experience, which typically entails earning a degree. This experience is a mid- to long-term commitment that will have an impact on one's identity after consumption (Soni and Govender, 2018). With such a high risk, brand equity can significantly reduce risk (Mourad et al., 2020).

Universities can therefore raise this expenditure to develop and profit on a distinctive brand image and set themselves apart from other institutions. A university degree is a one-time purchase, which is another unique characteristic of HEIs that must be taken into consideration when evaluating brand equity. So, loyalty cannot be measured in terms of repeat business, but it may be seen in the decision of a student to continue their postgraduate studies at the same school (Soni and Govender, 2018) or in the dedication of alumni (Pedro et al., 2018). Therefore, we propose the following hypothesis:

H3: School Image positively influences Brand Equity

Policies and Brand Equity

According to Carvalho et al. (2020), prospective students may research other students' opinions about the HEI before making a decision in order to form their own opinions and thought processes. Brand

equity can therefore be a key differentiating factor and a crucial factor in influencing students' choices. Furthermore, other stakeholders like policymakers and funding organizations can be influenced by the brand equity of HEIs. Thus, Hemsley-Brown et al. (2016) argued that deeper knowledge of issues like brand identity, meaning, image, and reputation can help brand owners connect with stakeholders including faculty, students, alumni, employers, and others more effectively as higher education institutions work to create distinctive identities. Due to trends in international student mobility, declining university funding, and government-sponsored recruitment drives, universities are fighting more and more for elite academics and international students.

However, the cost of goods or services is one of the most crucial and significant elements that make up an organization's policy toward its clients. In this words, Balmer (2011) described the cost of an organization's goods and services, including the goodwill component in the valuation of its corporate and product brands, is referred to as price. In a university setting, pricing often refers to the tuition charge. This relates to the annual tuition fee that a HEI assesses a student for a program of study and is necessary for enrollment (Ivy, 2008). According to research on student attractiveness in higher education, tuition costs play a role in how desirable students are (Naidoo, 2007; Binsardi and Ekwulugo, 2003). Promotion, like all other service businesses, includes all the methods universities might employ to inform the public about their products, including advertising, publicity, public relations, and sales promotional activities. Universities may think about covering study costs or offering scholarships to draw students, particularly those who are overseas students who want to attend our school, in the same way that manufacturing firms employ promotions, gifts, or discounts.

Due to the intangible character of services, people were added as a second component. Any university employees who contact with potential students and current students once they are enrolled at the university are included in the people component of the marketing mix. They could include academic, administrative, and support personnel. However, at the graduate level, student perceptions of teaching staff reputations can play a significant role in the selection process (Cubillo et al., 2006; Ivy, 2001). The image and status of academic staff are a factor in the recruitment of undergraduate students, but this is a topic for discussion. Students' impressions of service quality are influenced by the administrative and academic support offered to the delivery of higher education services, both on the front lines and in what can be viewed as the background. Ivy (2008) an illustrious Professor's publications or research record may not matter as much to a prospective student as the straightforward manner in which a telephone inquiry is addressed in determining whether or not they will maintain that university in their list of alternatives. Thus, the following hypothesis is:

H4: School's policies positively have influence on Brand Equity

The mediating role of School Image

The actual perceptions of an organization held by external stakeholders are often referred to as its "image" by marketing researchers (Brown et al., 2006). The importance of marketing in helping to build positive institutional images that will draw in students, staff, and resources has increased as universities have been subjected to more competitive market forces. Universities can boost their public image and goodwill by attracting top-notch professors, sponsorship, and students by comprehending how higher education institutions build enticing brands (Hemsley-Brown et al., 2016). Higher education and other services require customers to evaluate options without having firsthand experience with the product, hence organization image is crucial (Moogan et al., 1999). The researchers contend that better branding and marketing communications are necessary, as are better customer service and more individualized attention as well as a stronger focus on company ethics and social responsibility (Wilkins and Huisman, 2015). Institutions also build branch campuses, foreign partnerships, and other kinds of transnational education, which means they are in competition with universities all over the world for students in addition to their home university (Padlee et al., 2010).

Since there are numerous parties and organizations with an interest in or concern for the university or college, determining quality in higher education is more complicated than it is for other types of services (Hailat et al., 2021)the stakeholders are divided into two categories: internal and external stakeholders. This study aims to explore the diverse basic needs of the university internal stakeholders (students, academic staff, and employees. According to Al-Alak and Alnaser (2012), the distinction between customer

perceptions and expectations of service is referred to as service quality. According to a research by Sung and Yang (2008), there are three ways to gauge how desirable a university is perceived: External prestige, University's personality, University's reputation. However, the two researchers have therefore explored these additional components as dimensions to these factors. According to their argument, the reputation of a university depends on these seven factors: funding, the institution's overall image, program renown, the caliber of its research and instruction, funding, environmental considerations, and extracurricular activities (Hailat et al., 2021). Therefore, we propose the hypothesis is:

H5: The image of school plays a mediate role in shaping and influencing its characteristics and Brand Equity

The moderating role of Policies

Regardless of the varying political systems and economic conditions, university governance has been changing in numerous countries due to pressure from public spending cuts in many nations, the marketization of higher education, and worries about regional and national competitiveness (Mai et al., 2022). Particularly nowadays, many nations, like Vietnam, view education as part of the service sector of their economies. It is pretty obvious that the existing autonomous higher education system is well-liked throughout the world. Yet, there are also big variances between each continent's policies and mechanisms for autonomy. Depending on the autonomy model each nation selected. There are a number of models of university autonomy that the universities throughout the world follow, according to (Mai et al., 2022), including:

- The state authority model: The university board members are mostly in the service of the state bureaucracy under this paradigm, which "sought to shield the institution from over-mighty external interests by the state" (Neave, 2003; Dobbins and Knill, 2017). In accordance with this model, the state gives funds to public universities, establishes managerial positions, and makes decisions regarding student enrollment quotas, degree program curricula, etc. Universities are regarded "rational instruments used to accomplish national interests" and are accorded extremely minimal autonomy privileges (Dobbins et al., 2011). This style is common in nations that were influenced by both the Napoleonic and the Soviet models.
- The academic oligarchy model: This concept has its origins in the tradition of academic autonomy and the close connection between research and teaching. Public universities' ability to self-govern is constrained due to state interference. Although universities serve society and science under this model, academic matters are unaffected by socio-economic needs because university operations are supported by the public budget. Collegial governance by the professoriate, who are referred to as civil servants in universities, is crucial to this style of academic governance. University senates are "committed to the pursuit for the truth through intellectual freedom" (Dobbins and Knill, 2009). In nations shaped by the Humboldtian model, this model is common.
- The Anglo-American market-oriented model: In this type of model, the State typically employs legislative tools to encourage university competition and avoid or address higher education market failures (Ferlie et al., 2008). Universities must provide academic services to target consumers as commercial firms in order to compete more successfully for students and financial resources: "The role of government is restricted to supplying cash and formulating broad higher education regulations." The universities themselves choose the academic and financial policies of the institutions (Mora, 2001).

Prior research of Findikli (2017) mentioned to Burton Clark's Triangle of Coordination in higher education system, but the market category was dropped when van Vught, Frans A. (1989) reduced Clark's triangle of higher education governance to a two-dimensional space of governance. Other authors have additionally expanded on Vught's work.

According to Mai et al. (2022), the dual authority of the academic community and state bureaucracy is what propels ***the state control model***. In this model, the state accredits university governing board members and executive heads, promulgates admission standards, determines academic staff salaries, etc. ***The state supervising model***, on the other hand, is prevalent in nations with Anglo-Saxon traditions and is distinguished by a reduced authority of the state bureaucracy. According to this paradigm, the state enacts higher education policies rather than interfering with the higher education system through "means

of detailed regulation and strong oversight." The establishment of legislative frameworks, accrediting standards, and public funding may have a significant impact on institutional governance (Bleiklie and Kogan, 2007).

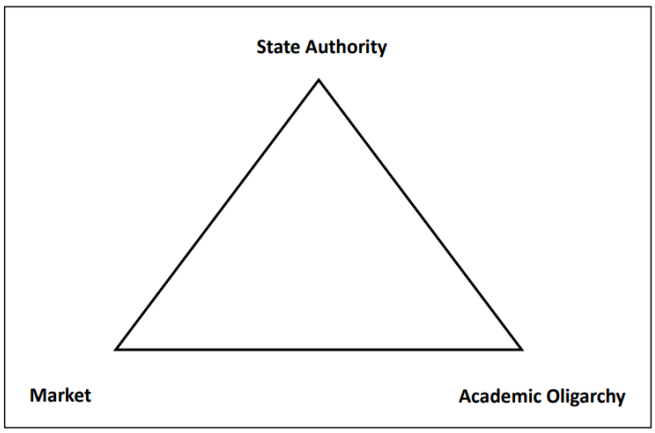

Figure 1. Clark's triangle of coordination. Adapted from Clark (1983: 143)

Vietnam has seen numerous iterations of educational reform. (Resolution 14/2005/NQ-CP, November 2, 2005) is a significant turning point that profoundly alters the higher education system, with the autonomy mechanism of the University displaying the most visible differences. The state control model in higher education in Vietnam is being modified, and since the early 1990s, there has been a decline in the power of the state bureaucracy. Resolution 14/2005/NQ-CP suggested four goals for institutions of higher learning, including: establishing a system for higher education quality assurance and accreditation, removing line-ministry control, allowing institutional autonomy to higher education institutions, drafting a higher education statute (Hayden and Thiep, 2007). It can be observed that university autonomy is an unavoidable tendency that society requires and has progressed towards. Tuition costs and training programs, however, are the two aspects of university autonomy that students and parents are most worried about. Vietnamese society and education have been greatly impacted by colonial products, particularly French imperialism and Chinese feudalism. It is not surprising that Vietnam's educational strategy is affected by the Chinese educational model given that contemporary society still possesses similar antiquated traits. Despite the adoption of Anglo-Saxon country models for higher education governance (Hong, 2018) key elements of the Soviet model and Chinese features are still fiercely guarded (Hong, 2018; Ying et al., 2017). The Napoleonic model of university governance was retained in France after the Bologna Process despite the country's transition from a traditional model (the Napoleonic model) to marketized and academic self-rule models (Dobbins and Knill, 2017). This is because the country's higher education structure design is still under the control of the state.

A university is a higher education facility established by a public, private, or nonprofit organization to provide individuals with the best training possible for gainful employment and the welfare of humanity (Thorens, 2006). In reality, universities received just a small amount of public support and had autonomy under their original conventional foundation as a part of an elite system (Berdahl, 1990). According to Mai et al. (2022) over time, university autonomy varies; and university autonomy depends on 'the legal and practical framework for higher education' promulgated by the public authorities (Kehm et al., 2019). Hence, the hypothesis 6 is:

H6: Policies play moderating role in School Characteristics and Brand Equity.

Brand Equity and Student's Attractiveness

Following DOI MOI (1986), Vietnam became more open to global economic integration, which presents both numerous opportunities and difficulties for every individual. The concept of "lifelong learning" has been developed by people as a result of integration, the establishment of a foundation to support societal development, knowledge exchange, and the increasing value placed on education by the new social development orientation. According to human capital and screening theories, students (often with the support of their families) who decide to enroll in tertiary education attempt to be as certain as they can that they will receive an education of the highest quality, allowing them to better signal themselves on the

job market and thereby enhance prospects of social mobility and private returns enhance prospects to education (Cattaneo et al., 2019). Wong and Chiu (2019) founded that these universities were forced to pay more attention to the educational services they offer and base at least part of their competitiveness on them in order to survive in the age of the student consumer, globalization and internationalization, uncertain career prospects, and labor challenges, although this was not always beneficial for the universities going through similar processes elsewhere. For those who currently come from middle- and upper-class families, selectivity still has to do with the hope of improving employment prospects and the possibility of maintaining current social standing in the future (Cattaneo et al., 2019). As a result of quicker and easier access to information (such as the Internet but also university rankings; see Cashell (2011), families now have practical tools to make more deliberate decisions (Simões and Soares, 2010). These, in the other hands, might not be enough to prevent students and families from having unrealistic expectations regarding the projected returns on their investments in higher education (Abbiati and Barone, 2017). The psychological theory of social identity, namely its branch theory of corporate brand identification (Balmer and Liao, 2007), is used in this study to explain how multilateral place dimensions, among other factors, significantly increase the appeal of corporate brands. Since 2007, a unique body of research on the concept of corporate brand identification has evolved (Balmer et al., 2010; Tuškej and Podnar, 2018). Moreover, Tuškej and Podnar (2018) emphasized that company brand identification is the perception, emotion, and value of a shared identity with a company brand and directly affect to customer's awareness.

H7: Brand Equity influences on Student's Attractiveness.

Policies and Student's Attractiveness

Universities have been steadily changing the structure of education so that it is now a public service rather than just a public benefit. To be more specific, a distinct market for educational services has emerged (Truong et al., 2016). As a result, many see higher education as a service that is rendered to clients who are students (Yusoff et al., 2015). According to Akareem and Hossain (2016), the entire student market can be divided into smaller groups through segmentation, and university administrators can then assess the appeal of each group to determine which segment or segments to target with their marketing campaigns. The right student group is crucial for universities, according to the report, as these are the students who will eventually make up the target market and constitute a devoted student body (Akareem and Hossain, 2016).

Numerous factors influence consumers' purchasing decisions, according to marketing research's application of customer behavior theory. Researchers specifically categorize their findings into three stages: prior to purchase, throughout the decision-making process (Jillapalli and Jillapalli, 2014), and post-purchase behavior of the customers. But the author of this study just wishes to concentrate on the fundamental examination of the salient features that customers—here referred to as students—are most frequently interested in. These include: services to assist students in their academic endeavors, scholarships, and tuition. According to Akareem and Hossain (2016) research, perceptions of the quality of higher education are significantly influenced by extracurricular activities and scholarship as well.

We must take into account how well HE adheres to the definition of the economic market in order to determine whether or not an economic market logic is justified (Nedbalová et al., 2014). The four mechanisms of autonomy, price, competition, and information can effectively simplify and condense the extensive explanation of market conditions provided by these eight freedoms; namely, the freedom of entry, freedom to specify the product, freedom to use available resources and freedom to determine prices (Hemsley-Brown, 2011). These four mechanisms and the fundamental Marketing Mix have a lot in common (Nedbalová et al., 2014). According to Hemsley-Brown (2011), students would pay tuition fees out of their own pockets (or the resources of their immediate family) if HE were to adopt the economic market approach to pricing. Typically, governments argue that these kinds of laws are implemented to protect public finances, encourage university competition, and provide students more freedom to choose where to spend their borrowed or personal funds (Nedbalová et al., 2014).

Numerous studies on students' satisfaction with the caliber of higher education services have been conducted in Vietnam. Hai (2022) claims that society has given higher education's quality a lot of thought. Students now have to pay to use the highest caliber services. In order to draw students, university development and educational quality improvement must coexist. Enhancing student satisfaction and service

quality at the institution is important not only to fulfill accreditation requirements but also to attract the new students coming. Hai (2022) study on students' satisfaction with the level of services provided by universities in Ho Chi Minh City put up a model of six elements: overall facilities, departmental support, academic counseling, job placement, canteen services, and dormitories. Therefore, the hypothesis 8 should be supposed:

H8: Policies influences on Student's Attractiveness.

School's image and Student's Attractiveness

Higher education institutions are now compelled to fight with scarce resources and, at the same time, recruit more potential candidates, which is hotly contested among the numerous competing institutions. These more competitive market arrangements endanger the future of some schools. According to Duarte et al. (2010) a less competitive university may end up losing some of its students and knowledge capital as a result of the harmonization of the various academic degrees, which will increase the mobility and employability of students, professors, researchers, and technicians.

Image is a crucial component of contemporary strategic management in these institutions, according to (Luque-Martínez and DelBarrio-García, 2009). This is because of rising competition, dwindling public funding for higher education, and social debate about the need for universities to increase their capacity to generate their own income (Marginson, 2018; Binsardi and Ekwulugo, 2003). The study of Ali-Choudhury (2009) argued that Universities have been forced by these changes to engage in more marketing operations in order to build and maintain strong brands that will increase awareness and set them apart. Universities are now paying a lot more attention to their image because they understand how important it is to have a unique, positive reputation in order to draw the greatest faculty, staff, and possible financing sources (Bok, 1992; Theus, 1993; Arpan et al., 2003).

H9: School's image influences on Student's Attractiveness

Research Model

This study's research framework is based on the formulation of the research hypotheses (Figure 1). In order to evaluate the relationship between School Characteristics (SC) and Student Attractiveness (SA) through Brand Equity (BE) and Policies ((P/PO), the study incorporates the Choice model and BE theory (Zinkhan and Smith, 1992).

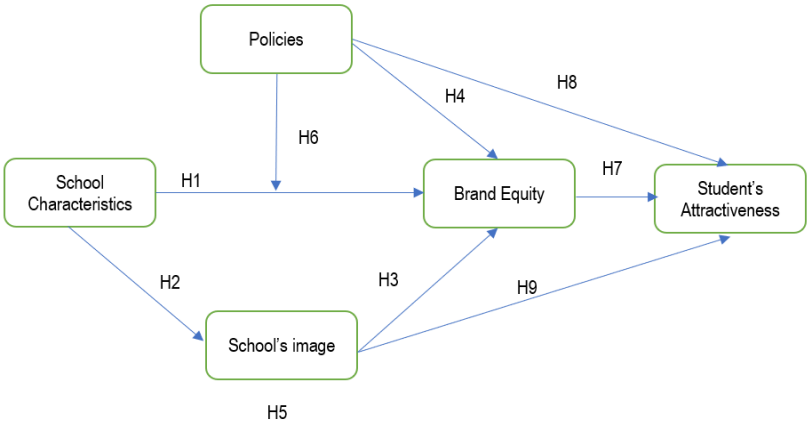

Figure 1. *Research Framework.*

Materials and Methods

Data collection and Measures

The research focuses on students who live and study in both high school and higher education

institutions in the South of Vietnam. To meet the research objective, this study designs a survey questionnaire with 56 questions, that provide the five Likert scale for answer the questions (1 = Strongly disagree; 2 = Disagree; 3 = Confused; 4 = Agree; 5= Strongly agree). Due to social distancing for protecting Covid-19 disease, this survey was used a convenient sample collection method. The authors uploaded this survey questionnaire on google drive then share the link to the teachers in high schools and universities in the Southern region. The data was collected from Dec 2nd, 2021 to Jan 10th, 2022.

The formula created by Marcoulides and Saunders (2006) was used to determine the target sample size and is as follows:

$$n = \frac{Z^2_{\frac{\alpha}{2}}.\sigma^2}{e^2}$$

while Z is considered as the standard score, σ is standard deviation, and e is tolerance of ambiloquy.

As the five Likert scale for answer the questionnaires, the research population was calculated following:

$$n = \frac{Z^2_{\frac{\alpha}{2}}.\sigma^2}{e^2} = \frac{Z^2{}_{\frac{\alpha}{2}}.\sigma^2}{5x^2}$$

in case e = 2%, Z = 1.96, and σ = 1.3.

The expectant number of samples should be:

$$n = \frac{1.96^2 \times 1.3^2}{(5 \times 0.02)} = 649.2$$

By this way, the expectant size should be higher than 700.

The Appendix A contains a list of the questionnaire items, their factor loadings, and Cronbach's alpha. Five constructs made up the questionnaire: (1) School Characteristics (SC), (2) School Image (SI), (3) Brand Equity (BE), (4) Policies (P/PO), and (5) Attractiveness of Students (SA). The questionnaire had six sections and 56 questions in all, six of which asked for extended personal information about the respondent's status and academic plans. The subsequent questions asked the participants to provide their thoughts on SC, SI, BE, P, and SA as factors in their HEI decision.

Questionnaire Translation

The questionnaire was translated from English to Vietnamese and then modified for Vietnamese respondents. It was done using the back-translation technique. In cross-cultural research and global marketing, back translation—first proposed by Vuong and Bui (2023) is used to assess and regulate the quality of questionnaire translations. Two professionals, one with a degree in English from an Australian university and the other from an Indian university, both of whom have master's degrees in their fields, handled the translation. The questionnaire's final version was produced after a two-week translation procedure.

Results

Respondent Characteristics

According to Table 1, 63.8% of the respondents with valid responses were female. The responders with the highest percentage of those under the age of 18 received 83.5%. The majority of them (63.6%) attend public high schools, but their intentions for undergraduate study are very different, with virtually all (82.2%) of them opting for international universities.

Table 1: Characteristics of Respondents

Descriptive Variable		Frequency (N=788)	Percentage (%)
Gender	Female	503	63.8
	Male	285	36.2
Age (years old)	Under 18	659	83.5
	From 19-24	108	13.6
	24 above	21	2.6
Status (in high school)	Studying in public school	501	63.6
	Studying in private school	17	2.2
	Studying in International School	270	34.2
Intention (For University)	To study in public school	25	3.2
	To study in private school	43	5.5
	To study in international school	648	82.2
	Others (Vocational school, no plan, working, etc.)	72	9.1
Total		**788**	**100**

Evaluation of the Measurement Model

The measurement model was assessed using partial least squares structural equation modeling (PLS-SEM), which also provided reliability, convergent validity, and discriminant validity. The outcomes of the evaluation of the measuring model are shown in Tables 2 and 3.

Table 2. *Assessment of Reliability and Convergent Validity.*

Variable	AVE	CR	Cronbach's Alpha	
BE	0.723	0.913	0.872	0.717
PO*SC	1.000	1.000	1.000	
PO	0.711	0.925	0.898	
SC	0.599	0.881	0.831	
SI	0.719	0.911	0.870	0.592
SA	0.692	0.900	0.851	0.644

Table 2 shows that all of the composite reliability (CR) values are more than 0.881, and the Cronbach's alpha coefficients fall between 0.831 and 0.898. This value is reliable because it is higher than the 0.7 cutoff value. The constructions' average extracted variance (AVE), which is more than the 0.5 cutoff and ranges between 0.599 and 0.723, shows construct convergence. According to (Algebra et al., 1981), the square root of the AVE, which is shown in Table 3, is greater than that of its strongest association to any test construct. The heterotrait-monotrait (HTMT) values should be all less than 0.85 to get these requirements; however, in Table 3 some factors are a little bit higher than 0.85, these elements nearly reach 0.9. According to (Henseler et al., 2015), HTMT 0.90 in order to differentiate between these two HTMT absolute criteria.

Assessment of R^2 Value

Three endogenous latent variables—SI, BE, SA—had their (adjusted) R^2 values determined. In SI, it was discovered that SC perception explained 59.2% of the variance. Furthermore, the exogenous variables can account for 71.7% of the variance in BE. Finally, the corresponding independent variables are responsible for explaining, respectively, 64.4% of SA.

Table 3. *Discriminant Validity Results (Fornell–Larcker and HTMT Criteria).*

Fornell-Larcker Criterion

	Brand Equity	PO x SC	Policies	School Characteristics	School's image	Student's Attractiveness
Brand Equity	0.850					
PO x SC	-0.179	1.000				
Policies	0.720	-0.349	0.843			
School Characteristics	0.784	-0.258	0.753	0.774		
School's image	0.800	-0.222	0.759	0.769	0.848	
Student's Attractiveness	0.771	-0.185	0.703	0.776	0.714	0.832

Heterotrait-Monotrait Ratio (HTMT)

	Brand Equity	PO x SC	Policies	School Characteristics	School's image	Student's Attractiveness
Brand Equity						
PO x SC	0.190					
Policies	0.809	0.367				
School Characteristics	0.902	0.290	0.863			
School's image	0.897	0.238	0.858	0.900		
Student's Attractiveness	0.895	0.200	0.801	0.889	0.829	

Assessment of Effect Size f^2

The amount to which the exogenous factors in the constructs influence the endogenous variables was not revealed by the analysis of the route coefficient, hence the f^2 value evaluation was carried out. The findings are shown in Table 5. Effect size is regarded as small, medium, or large if f^2 is more than 0.02, 0.15, or 0.35, in accordance with (Cohen, 1978;Ketchen, 2013). There is no relationship between the independent and dependent variables if f^2 is less than 0.02. In this study, SA is significantly impacted by BE (f^2=0.212) while SI has been greatly impacted by SC (f^2=*1.452).* The correlations between SC and BE, SI and BE, and the mediating effect of SI on SC and BE (with all f^2 values = 0.15 to 0.2) have medium-sized effects. There is no moderating effect exists between PO and BE; moderating role of PO on SC and BE due to the f^2 = 0.011; under 0.02 as the requirement in need.

Table 4. *Multicolinearity Test (VIF)*

	Brand Equity	PO x SC	Policies	School Characteristics	School's image	Student's Attractiveness
Brand Equity						3.032
PO x SC	1.146					
Policies	3.019					2.576
School Characteristics	2.937				1.000	
School's image	3.020					3.449
Student's Attractiveness						

Evaluation of the Structural Model

The parameter estimates of the pathways connecting the research constructs were used to evaluate the structural model. The sample of 788 respondents underwent a nonparametric bootstrapping process using a subsample of 5000 in order to assess the significance of each path coefficient and test the hypotheses.

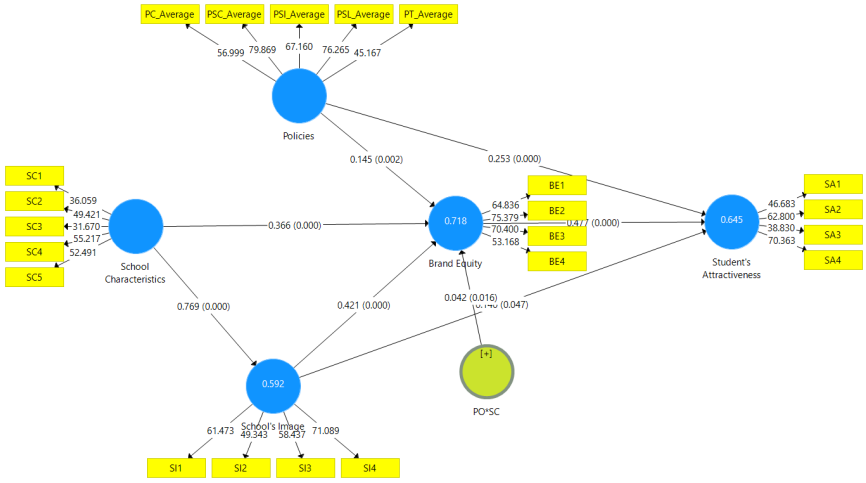

Figure 2. *The result of research structural model*

Multicollinearity Test

When there is a significant association between two or more constructs, multicollinearity results. Due to the inflated standard errors caused by multicollinearity, it is impossible to reliably determine the influence of independent variables or compare them (Garson, 2016). In the research of Sarstedt et al. (2014) but its use in family business research remains in its infancy. This lag in SEM's application holds especially true for partial least squares SEM (PLS-SEM mentioned that in generally, VIF values greater than five show that the indicators are collinear. The following formula can be used to calculate the VIF for the i^{th} indicator with the help of the R^2 values of the i^{th} regression:

$$VIF_i = \frac{1}{1 - R_i^2}$$

Therefore, Table 4 shows that some variance inflation factor values are lower than 4.0. The authors might draw the conclusion that the research model does not exhibit the multicollinearity phenomenon in this case.

Table 5. Results of hypothesis testing

Hypothesis	Relation	Path coefficient	F^2	Standardized Deviation	t-value	p-value	Remarks
H1	SC->BE	0.366	0.162	0.052	7.112	0.000	Significant
H2	SC-> SI	0.769	1.452	0.019	40.765	0.000	Significant
H3	SI->BE	0.421	0.209	0.055	7.633	0.000	Significant
H4	PO->BE	0.145	0.025	0.048	3.046	0.002	Significant
H5	SI->SC->BE	0.201	0.209	0.027	5.814	0.000	Significant
H6	PO*SC->BE	0.042	0.011	0.018	2.414	0.016	Significant
H7	BE->SA	0.477	0.212	0.054	8.804	0.000	Significant
H8	PO->SA	0.253	0.070	0.054	4.713	0.000	Significant
H9	SI->SA	0.140	0.019	0.071	1.987	0.047	Significant

The link between the constructs in the model was assessed using the bootstrapping resampling method. 5000 bootstrapping subsamples were advised by (Leguina, 2015). The path coefficients for testing the hypotheses are shown in Table 5. The findings show that BE, PO, and SI are impacted by SC. H1, H3, and H4 are therefore supported. With their moderating and mediating effects, PO and SI also have an impact on BE; nonetheless, the results indicate that H5 and H6 are significant as H2 is supported. Ad-

ditionally, it was determined that BE, PO and SI affected SA. Thus, H7, H8, H9 are also supported.

A straightforward slope test was carried out to better comprehend the interaction impact (Uyanık and Güler, 2013).

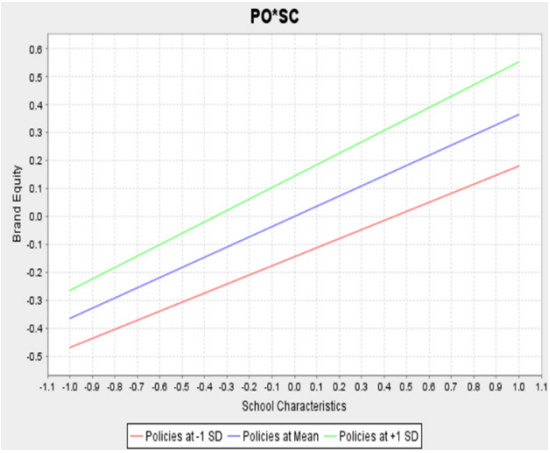

Figure 3. *The moderating effect of Policies response in the relationship between School Characteristics and Brand Equity*

Discussions

Examining the connections between the school characteristics, school's image, policies, brand equity as the independent variables, and student's attractiveness as the dependent factor was the aim of this study. The findings of the study also raise a number of conclusions, discussions, and implications for further investigations.

It is evident that the development patterns of society have a substantial impact on the features of the school. According to Nguyen (2007), the education system in Vietnam has a lengthy history and has been greatly impacted by colonialists. Huong and Fry (2004) also stated that curricula, school models, and educational ideologies are impacted in that community. The educational philosophy of Confucius, in conjunction with the examination system that requires passing it, greatly influences and intensifies competitiveness among applicants for university admission. Higher education, however, has a very distinct role in the context of the globalization of education and the economic development mechanism's effect towards a socialist market economy. In order to improve the efficacy and efficiency of educational services, a number of changes were implemented, such as the consolidation of universities, the reduction of state monopolies in the field of education, the expansion of the variety of educational offerings, the realignment of curricula to better suit the demands of the market, and the introduction of competition in the educational sector (Nguyen, 2007). Since we view higher education as a service sector and students as potential customers, SC attitudes have an immediate effect on BE and SI, according to (Khoshtaria et al., 2020) their attempts fail because universities do not thoroughly grasp the uniqueness of the service they provide. This study aims to help universities understand what constitutes consumer-based brand equity. Also, it is dedicated to find out whether brand equity dimensions (elements; Guilbault, 2018). Students typically use school characters like (employability, curriculum, academic reputation, faculty, and research environment) (Jafari and Aliesmaili, 2013) and BE, SI as a basis for your decision-making because education is an intangible good that is challenging to measure (Hemsley-Brown et al., 2016). As a result, the university realized how to improve the school's reputation (SI) by assembling a pool of outstanding teachers, providing sponsorship, encouraging volunteerism and charitable endeavors, fostering a sense of community among alumni, and other means that reinforce the school's standing (BE) and define its distinctive features (SC).

In the second, SA is directly impacted by PO, SI, and BE. When a customer owns a brand, BE and its image serve them not only as a means of expressing their trust but also as a means of affirming their own worth (Vuong and Bui, 2023). University Education Products are special, which makes them intangible. Relying on brand reputation and image also helps parents and students feel less anxious and minimizes the amount of time they need to research and decide. In addition, it is evident that SI significantly

influences the choice decision (SA) when Cost- Opportunity theory is applied to explain the relationship between PO and BE. This makes perfect sense when learners choose to invest in a long-term future during a relatively long period of youth and anticipate outcomes and accomplishments. As a result, BE and SI also start to play a significant role in encouraging them to select the Brand University that best suits their needs (Li et al., 2016).

The third point, where PO plays a moderating impact on SC and BE, provides a clear explanation of how the educational autonomy mechanism in Vietnamese universities shapes university education in the country. Given Vietnam's lengthy history of integrating elements of the Chinese educational model, the SoViet educational model, and the colonial regime's influence, university autonomy represents a critical turning point in the country's educational history (Mai et al., 2022). Global economic and educational integration can take many different shapes if the government's centralized participation in all major higher education operations is minimized or privatized (Ryu and Nguyen, 2021). The tuition policy, training programs, student subsidies, and most notably the sharp rise in extra services in the learning environment that are heavily focused on are some of the major developments in this process. Dunnett et al. (2012) research also revealed a strong correlation between the tuition factor (Price in marketing mix) and every criterion, including course reputation, university reputation, quality of instruction and training, location, and service. Since education is more than a product and the evaluation has further complicated by inherent service properties, such as intangibility, homogeneity, inseparability, and perishability, the authors firmly emphasized that this is a highly involved decision and difficult service.

The last but not least, the variables SC, PO, BE, SI, and SA have a strong connection and mutual influence to create the Model fit of this research. Maintaining the number of students selecting a university (SA) is a crucial decision for a university when we view higher education as a business. The variables SC, PO, BE, SI, and SA have a close relationship and mutual influence. Maintaining the number of students selecting a university (SA) is a crucial decision for a university when we view higher education as a business. The findings of the research also indicate that, provided the school is both sufficiently reputable and BE strong, a student's decision to attend does not significantly depend on its location.

Limitations and Future Research

DOI MOI has a significant influence on economic growth. Simultaneously, it implemented numerous reforms that altered Vietnam's education policy, particularly in the area of higher education (Mai et al., 2022). Nevertheless, in order to align with the trend of globalization in higher education, the reform process still needs to be revised and finished. Given the increasing diversity of colleges operating in Vietnam and their licenses, this is particularly significant from a policy perspective. For parents and students to feel more comfortable when selecting a university and major, the state must establish suitable and easily accessible promulgation and management systems.

Although research data is gathered in 2022, there is also a belief that policies pertaining to higher education at each university can be flexible in certain ways because of the influence of the autonomy mechanism. Potential students may feel uneasy or hesitant while picking a university to study because of the fluctuating number of permissible scopes, such as tuition, and changes in scholarship programs over time.

The country's post-graduation human resources are changing as a result of globalization of education, which presents both opportunities and challenges. Many nations, including Vietnam, are experiencing a brain drain. Education managers have a great deal of responsibility in this area as well and must exercise caution. When the effort to draw exceptional students is insufficient, many developed nations will have the chance to extend invitations to gifted Vietnamese nationals to study and work there, which will quickly impede the process of sustainable development for both the nation and the region (L.Hoang et al., 2018).

Conclusions

It is evident that as the information economy grows, education—particularly higher education—plays a bigger and bigger role. This research is significant as a business-oriented approach, particularly for educational investors or those working in educational management, as it allows them to clearly perceive the concerns that prospective students actually worry about. Furthermore, the study's findings demonstrate the critical role that the services category plays in the development of educational policies and practices. Public schools need to focus more on this aspect of the new university education autonomy mechanism, as it is currently not fully synchronized nationwide.

The manuscript's published form was approved by all authors after they had read it.

Appendix A

Table A1. *Questionnaire Items and Research Constructs.*

Research Constructs and Items	Mean	Standard Deviation	Adopted from
Brand Equity (BE)			
BE1	3.997	0.877	Aaker (Tina Vukasovič, 2002); (Pinar et al., 2014)
BE2	4.150	0.723	
BE3	4.216	0.742	
BE4	3.987	0.867	
Policies (PO)			
PC_Average	4.120	0.660	Martin Hayden (Hayden and Thiep, 2007); James Monks (Monks, 2009); Sanjay Soni (Soni and Govender, 2018)
PSC_Average	4.290	0.614	
PSI_Average	4.378	0.634	
PSL_Average	4.213	0.633	
PT_Average	4.202	0.626	
Student's Attractiveness (SA)			
SA1	3.900	0.889	Carolina L. Santos et al. (Santos et al., 2018)
SA2	3.952	0.860	
SA3	4.141	0.793	
SA4	4.049	0.830	
School Characteristics (SC)			
SC1	4.397	0.732	Andre´ Siganos (Siganos, 2008); H. Hoang et al. (H. D.Hoang et al., 2020)
SC2	4.282	0.750	
SC3	3.586	1.099	
SC4	4.235	0.788	
SC5	4.008	0.834	
School's Image (SI)			
SI1	4.239	0.733	Harrison Hao Yang (Annetta and Holmes, 2006)
SI2	4.157	0.766	
SI3	4.201	0.718	
SI4	4.232	0.732	

Author Contributions

Conceptualization: B-H.V & S-F.Y; Methodology: B-H.V; Investigation: B-H.V & Y-Y.L, Software: B-H.V & Y-Y.L; Formal analysis: H-K.C; Validation: B-H.V & H-K.C; Resource: B-H.V; Writing—original draft: B-H.V; Writing—review & editing: S-F.Y & H-K.C; Supervision: H-K.C & S-F.Y. All authors have read and agreed to the published version of the manuscript

References

Abbiati, G., & & Barone, C. (2017). Is university education worth the investment? The expectations of upper secondary school seniors and the role of family background. *Rationality and Society*, *29*(2), 113–159. https://doi.org/10.1177/1043463116679977

Akareem, H. S., & Hossain, S. S. (2016). Determinants of education quality: what makes students' perception different? *Open Review of Educational Research*, *3*(1), 52–67. https://doi.org/10.1080/23265507.2016.1155167

Al-Alak, B. A., & Alnaser, A. S. M. (2012). Assessing the relationship between higher education service quality dimensions and student satisfaction. *Australian Journal of Basic and Applied Sciences*, *6*(1), 156–164.

Algebra, T. H. E., Factor, O. F., & Modeling, S. (1981). Erratum: Structural Equation Models with Unobservable Variables and Measurement Error: Algebra and Statistics. *Journal of Marketing Research*, *18*(4), 427. https://doi.org/10.2307/3151335

Ali-Choudhury. (2009). UNIVERSITY MARKETING DIRECTORS' VIEWS ON THE COMPONENTS OF A UNIVERSITY BRAND. *International Review on Public and Nonprofit Marketing*, *6*(11).

Angell, R. J., Heffernan, T. W., & Megicks, P. (2008). Service quality in postgraduate education. *Quality Assurance in Education*, *16*(3), 236–254. https://doi.org/10.1108/09684880810886259

Annetta, L. a., & Holmes, S. (2006). Creating Presence and Community in a Synchronous Virtual Learning Environment Using Avatars. *International Journal of Instructional Technology and Disatnce Learning*, *3*(8), 27–43.

Arpan, L. M., Raney, A. A., & Zivnuska, S. (2003). A cognitive approach to understanding university image. *Corporate Communications: An International Journal*, *8*(2), 97–113. https://doi.org/10.1108/1356328031047535

Balmer, J. M. T. (2011). Corporate heritage identities, corporate heritage brands and the multiple heritage identities of the British Monarchy. *European Journal of Marketing*, *45*(9–10), 1380–1398. https://doi.org/10.1108/03090561111151817

Balmer, J. M. T., & Liao, M. N. (2007). Student corporate brand identification: An exploratory case study. *Corporate Communications*, *12*(4), 356–375. https://doi.org/10.1108/13563280710832515

Balmer, J. M. T., Liao, M. N., & Wang, W. Y. (2010). Corporate brand identification and corporate brand management: How top business schools do it. *Journal of General Management*, *36*(2), 77–102. https://doi.org/10.1177/030630701003500404

Balmer, J. M. T., Mahmoud, R., & Chen, W. (2020). Impact of multilateral place dimensions on corporate brand attractiveness and identification in higher education: Business school insights. *Journal of Business Research*, *116*(January 2018), 628–641. https://doi.org/10.1016/j.jbusres.2019.03.015

Berdahl, R. (1990). Academic Freedom, Autonomy and Accountability in British Universities. *Studies in Higher Education*, *15*(2), 169–180. https://doi.org/10.1080/03075079012331377491

Bezmen, T., & Depken, C. A. (1998). School characteristics and the demand for college. *Economics of Education Review*, *17*(2), 205–210. https://doi.org/10.1016/S0272-7757(97)00025-3

Binsardi, A., & Ekwulugo, F. (2003). International marketing of British education: Research on the students' perception and the UK market penetration. *Marketing Intelligence & Planning*, *21*(5), 318–327. https://doi.org/10.1108/02634500310490265

Bleiklie, I., & Kogan, M. (2007). Organization and governance of universities. *Higher Education Policy*, *20*(4), 477–493. https://doi.org/10.1057/palgrave.hep.8300167

Bok, D. (1992). Reclaiming the Public Trust. *Change: The Magazine of Higher Learning*, *24*(4), 13–19. https://doi.org/10.1080/00091383.1992.9937114

Bonnema, J., & Van DerWaldt, D. L. R. (2008). Information and source preferences of a student market in higher education. *International Journal of Educational Management*, *22*(4), 314–327. https://doi.org/10.1108/09513540810875653

Brown, T. J., Dacin, P. A., Pratt, M. G., & Whetten, D. A. (2006). Identity, intended image, construed image, and reputation: An interdisciplinary framework and suggested terminology. *Journal of the Academy of Marketing Science*, *34*(2), 99–106. https://doi.org/10.1177/0092070305284969

Carvalho, L., Brandão, A., & Pinto, L. H. (2020). Understanding the importance of eWOM on Higher Education Institutions' brand equity. *Journal of Marketing for Higher Education*, *0*(0), 1–19. https://doi.org/10.1080/08841241.2020.1788196

Cashell, P. (2011). Rankings and the Reshaping of Higher Education: The Battle for World-Class Excellence. *Tertiary Education and Management*, *17*(4), 373–375. https://doi.org/10.1080/13583883.2011.601753

Cattaneo, M., Horta, H., Malighetti, P., Meoli, M., & Paleari, S. (2019). Universities' attractiveness to students: The Darwinism effect. *Higher Education Quarterly*, *73*(1), 85–99. https://doi.org/10.1111/hequ.12187

Chakhaia, L., & Bregvadze, T. (2018). Georgia: Higher Education System Dynamics and Institutional Diversity. *Palgrave Studies in Global Higher Education*, 175–197. https://doi.org/10.1007/978-3-319-52980-6_7

Chapman, D. W., & Hutcheson, S. M. (1982). Attrition from Teaching Careers: A Discriminant Analysis. *American Educational Research Journal*, *19*(1), 93–105. https://doi.org/10.3102/00028312019001093

Cohen, J. (1978). *Evaluation and Program Planning* (Alan L. Sockloff (ed.); Vol. 1). Pergamon Press.

Cubillo, J. M., Sánchez, J., & Cervio, J. (2006). International students' decision-making process. *International Journal of Educational Management*, *20*(2), 101–115. https://doi.org/10.1108/09513540610646091

Dobbins, M., & Knill, C. (2009). Higher education policies in Central and Eastern Europe: Convergence toward a common model? *Governance*, *22*(3), 397–430. https://doi.org/10.1111/j.1468-0491.2009.01445.x

Dobbins, M., & Knill, C. (2017). Higher education governance in France, Germany, and Italy: Change and variation in the impact of transnational soft governance. *Policy and Society*, *36*(1), 67–88. https://doi.org/10.1080/14494035.2017.1278868

Dobbins, M., Knill, C., & Vögtle, E. M. (2011). An analytical framework for the cross-country comparison of higher education governance. *Higher Education*, *62*(5), 665–683. https://doi.org/10.1007/s10734-011-9412-4

Duarte, P. O., Alves, H. B., & Raposo, M. B. (2010). Understanding university image: A structural equation model approach. *International Review on Public and Nonprofit Marketing*, *7*(1), 21–36. https://doi.org/10.1007/s12208-009-0042-9

Dunnett, A., Moorhouse, J., Walsh, C., & Barry, C. (2012). Choosing a University: A conjoint analysis of the impact of higher fees on students applying for university in 2012. *Tertiary Education and Management*, *18*(3), 199–220. https://doi.org/10.1080/13583883.2012.657228

Emanuela Maria Avram. (2014). The particularities of services and the importance of marketing in higher education. *Management Intercultural*, *15*(32), 13–19. https://www.ceeol.com/search/article-detail?id=535013

Ferlie, E., Musselin, C., & Andresani, G. (2008). The steering of higher education systems: A public management perspective. *Higher Education*, *56*(3), 325–348. https://doi.org/10.1007/s10734-008-9125-5

Findikli, B. (2017). Exploring higher education governance: analytical models and heuristic frameworks. *Journal of Higher Education and Science*, *7*(2), 392. https://dergipark.org.tr/en/pub/highereducsci/issue/61493/918232

Fiona Harden; Gabrielle Davis; Kerrie Mengersen. (2014). The tertiary debate : a case study analysis of factors considered when applying for university entry by traditional age school leavers in Brisbane. *Australian Universities Review*, *56*(1), 39–46. https://search.informit.org/doi/10.3316/aeipt.201721

Flores, F., & Flores, F. (2022). *Strategies for Organizational Sustainability in Higher Education* [Walden University]. https://www.proquest.com/openview/9654651b74c0cb0325daca59b532e54c/1?pq-origsite=gscholar& cbl=18750

Garson, G. D. (2016). *Partial Least Squares. Regression and Structural Equation Models-Statistical Publishing Associates*. https://doi.org/1626380392

Gatewood, R. D., Gowan, M. A., & Lautenschlager, G. J. (1993). Corporate Image, Recruitment Image And Initial Job Choice Decisions. *Academy of Management Journal*, *36*(2), 414–427. https://journals.aom.org/doi/abs/10.5465/256530

Guilbault, M. (2018). Students as customers in higher education: The (controversial) debate needs to end. *Journal of Retailing and Consumer Services*, *40*(July 2016), 295–298. https://doi.org/10.1016/j.jretconser.2017.03.006

Hai, N. C. (2022). Factors Affecting Student Satisfaction with Higher Education Service Quality in Vietnam. *European Journal of Educational Research*, *11*(1), 339–351. https://doi.org/10.12973/EU-JER.11.1.339

Hailat, K. Q., Alshreef, A. A., Azzam, I. A., & Darabseh, F. (2021). Stakeholder approach and the impact of brand image within higher education in the Middle East: Student and staff perspective. *Journal of Public Affairs*, *21*(1). https://doi.org/10.1002/pa.1941

Hanssen, T. E. S., & Mathisen, T. A. (2018). Exploring the Attractiveness of a Norwegian Rural Higher Education Institution Using Importance-Performance Analysis. *Scandinavian Journal of Educational Research*, *62*(1), 68–87. https://doi.org/10.1080/00313831.2016.1212254

Harris, M. S. (2013). Defining institutional diversity. *ASHE Higher Education Report*, *39*(3), 1–121. https://doi.org/10.1002/aehe.20009

Hayden, M., & Thiep, L. Q. (2007). Institutional autonomy for higher education in Vietnam. *Higher Education Research and Development*, *26*(1), 73–85. https://doi.org/10.1080/07294360601166828

Hemsley-Brown, J. (2011). The marketisation of higher education and the student consumer , edited by Mike Molesworth, Richard Scullion, and Elizabeth Nixon . *Journal of Marketing Management*, *27*(11–12), 1294–1297. https://doi.org/10.1080/0267257x.2011.614734

Hemsley-Brown, J., Melewar, T. C., Nguyen, B., & Wilson, E. J. (2016). Exploring brand identity, meaning, image, and reputation (BIMIR) in higher education: A special section. *Journal of Business Research*, *69*(8), 3019–3022. https://doi.org/10.1016/j.jbusres.2016.01.016

Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, *43*(1), 115–135. https://doi.org/10.1007/s11747-014-0403-8

Hoang, H. D., Hoang, H. T., Bui, Q. T., & Nguyen, L. P. (2020). Choice of Higher Education Institution Among Vietnamese Students: An Exploratory Factor Analysis. *PalArch's Journal of Archaeology of Egypt/Egyptology*, *17*(4), 222–233. https://ezproxy.sunway.edu.my/login?url=https://search.ebscohost.com/login.aspx?direct=true& db=asn& AN=147767073&site=ehost-live

Hoang, L., Tran, L. T., & Pham, H. H. (2018). Vietnamese government policies and practices in internationalisation of higher education. *Higher Education Dynamics*, *51*, 19–42. https://doi.org/10.1007/978-3-319-78492-2_2

Hong, M. (2018). Public university governance in China and Australia: a comparative study. *Higher Education*, *76*(4), 717–733. https://doi.org/10.1007/s10734-018-0234-5

Huong, P. L., & Fry, G. W. (2004). Education and economic, political, and social change in Vietnam. *Educational Research for Policy and Practice*, *3*(3), 199–222. https://doi.org/10.1007/s10671-005-0678-0

Ivy, J. (2001). Higher education institution image: A correspondence analysis approach. *International Journal of Educational Management*, *15*(6), 276–282. https://doi.org/10.1108/09513540110401484

Ivy, J. (2008). A new higher education marketing mix: The 7Ps for MBA marketing. *International Journal of Educational Management*, *22*(4), 288–299. https://doi.org/10.1108/09513540810875635

Jafari, P., & Aliesmaili, A. (2013). Factors Influencing the Selection of a University by High School Students. *J. Basic. Appl. Sci. Res*, *3*(1), 696–703. www.textroad.com

Jillapalli, R. K., & Jillapalli, R. (2014). Do professors have customer-based brand equity? *Journal of Marketing for Higher Education*, *24*(1), 22–40. https://doi.org/10.1080/08841241.2014.909556

Judson, K. M., & Taylor, S. A. (2014). Moving from Marketization to Marketing of Higher Education: The Co-Creation of Value in Higher Education. *Higher Education Studies*, *4*(1), 51–67. https://doi.org/10.5539/hes.v4n1p51

Kehm, B. M., Huisman, J., & Stensaker, B. (2019). The European Higher Education Area. *The European Higher Education Area*, *January 2009*. https://doi.org/10.1163/9789087907143

Keller Kevin Lane. (2013). Conceptualizing, measuring, and managing customer-based brand equity. *Journal of Marketing*, *57*(1), 1–22.

Ketchen, D. J. (2013). A Primer on Partial Least Squares Structural Equation Modeling. *Long Range Planning*, *46*(1–2), 184–185. https://doi.org/10.1016/j.lrp.2013.01.002

Khoshtaria, T., Datuashvili, D., & Matin, A. (2020). The impact of brand equity dimensions on university reputation: an empirical study of Georgian higher education. *Journal of Marketing for Higher Education*, *30*(2), 239–255. https://doi.org/10.1080/08841241.2020.1725955

Leguina, A. (2015). A primer on partial least squares structural equation modeling (PLS-SEM). *International Journal of Research & Method in Education*, *38*(2), 220–221. https://doi.org/10.1080/1743727x.2015.1005806

Li, D., Granizo, M. G., & Gardó, T. F. (2016). The value trade-off in higher education service: A qualitative intercultural approach to students' perceptions. *Intangible Capital*, *12*(4), 855–880. https://doi.org/10.3926/ic.706

Luque-Martínez, T., & DelBarrio-García, S. (2009). Modelling university image: The teaching staff viewpoint. *Public Relations Review*, *35*(3), 325–327. https://doi.org/10.1016/j.pubrev.2009.03.004

Mai, A. N., Do, H. T. H., Mai, C. N., & Nguyen, N. D. (2022). Models of university autonomy and their relevance to Vietnam. *Journal of Asian Public Policy*, *15*(3), 394–410. https://doi.org/10.1080/17516234.2020.1742412

Marcoulides, & Saunders. (2006). Editor's Comments: PLS: A Silver Bullet? *MIS Quarterly*, *30*(2), iii. https://doi.org/10.2307/25148727

Marginson, S. (2007). The public/private divide in higher education: A global revision. *Higher Education*, *53*(3), 307–333. https://doi.org/10.1007/s10734-005-8230-y

Marginson, S. (2018). *Dynamics of National and Global Competition in Higher Education Author (s): Simon Marginson Published by : Springer Stable URL :* http://www.jstor.org/stable/29735003 *Higher Education (2006) 52 : 1-39 ? Springer 2006 Dynamics of national and global com*. *52*(1), 1–39. https://doi.org/10.1007/sl0734-004-7649-x

Mitić, S., & Mojić, D. (2020). Student choice of higher education institutions in a post-transitional country : evidence from Serbia. *Economic Research-Ekonomska Istraživanja*, *33*(1), 3509–3527. https://doi.org/10.1080/1331677X.2020.1774794

Monks, J. (2009). The impact of merit-based financial aid on college enrollment: A field experiment. *Economics of Education Review*, *28*(1), 99–106. https://doi.org/10.1016/j.econedurev.2008.03.002

Moogan, Y. J., Baron, S., & Harris, K. (1999). Decision-making behaviour of potential higher education students. *Higher Education Quarterly*, *53*(3), 211–228. https://doi.org/10.1111/1468-2273.00127

Mora, J. G. (2001). Governance and management in the new university. *Tertiary Education and Management*, *7*(2), 95–110. https://doi.org/10.1080/13583883.2001.9967044

Mourad, M., Meshreki, H., & Sarofim, S. (2020). Brand equity in higher education: comparative analysis. *Studies in Higher Education*, *45*(1), 209–231. https://doi.org/10.1080/03075079.2019.1582012

Naidoo, V. (2007). Research on the flow of international students to UK universities: Determinants and implications. *Journal of Research in International Education*, *6*(3), 287–307. https://doi.org/10.1177/1475240907083197

Neave, G. (2003). The Bologna declaration: Some of the historic dilemmas posed by the reconstruction of the community in Europe's systems of higher education. *Educational Policy*, *17*(1), 141–164. https://doi.org/10.1177/0895904802239290

Nedbalová, E., Greenacre, L., & Schulz, J. (2014). UK higher education viewed through the marketization and marketing lenses. *Journal of Marketing for Higher Education*, *24*(2), 178–195. https://doi.org/10.1080/08841241.2014.973472

Nguyen, H. (2007). *The Impact of Globalisation on Higher Education in China and Vietnam: Policies and Practices*. 68–77. http://www.ece.salford.ac.uk/proceedings/papers/07_07.pdf

Padlee, S. F., Kamaruddin, A. R., & Baharun, R. (2010). International Students' Choice Behavior for Higher Education at Malaysian Private Universities. *International Journal of Marketing Studies*, *2*(2), 202–211. https://doi.org/10.5539/ijms.v2n2p202

Pedro, I. M., Pereira, L. N., & Carrasqueira, H. B. (2018). Determinants for the commitment relationship maintenance between the alumni and the alma mater. *Journal of Marketing for Higher Education*, *28*(1), 128–152. https://doi.org/10.1080/08841241.2017.1314402

Pinar, M., Trapp, P., Girard, T., & Boyt, T. E. (2014). University brand equity: An empirical investigation of its dimensions. *International Journal of Educational Management*, *28*(6), 616–634. https://doi.org/10.1108/IJEM-04-2013-0051

Pinna, R., Carrus, P. P., Musso, M., & Cicotto, G. (2018). The effects of students: University identification on student's extra role behaviours and turnover intention. *TQM Journal*, *30*(5), 458–475. https://doi.org/10.1108/TQM-11-2017-0153

Ryu, J. H., & Nguyen, A. T. (2021). Internationalization of higher education in Vietnam: current situations, policies, and challenges. *International Journal of Comparative Education and Development*, *23*(3), 227–241. https://doi.org/10.1108/IJCED-10-2020-0074

Santos, C. L., Rita, P., & Guerreiro, J. (2018). Improving international attractiveness of higher education institutions based on text mining and sentiment analysis. In *International Journal of Educational Management* (Vol. 32, Issue 3). https://doi.org/10.1108/IJEM-01-2017-0027

Sarstedt, M., Ringle, C. M., Smith, D., Reams, R., & Hair, J. F. (2014). Partial least squares structural equation modeling (PLS-SEM): A useful tool for family business researchers. *Journal of Family Business Strategy*, *5*(1), 105–115. https://doi.org/10.1016/j.jfbs.2014.01.002

Shafaei, A., Nejati, M., & Maadad, N. (2019). Brand equity of academics: demystifying the process. *Journal of Marketing for Higher Education*, *0*(0), 1–13. https://doi.org/10.1080/08841241.2019.1605438

Siganos, A. (2008). Rankings, governance, and attractiveness of higher education: The new french context. *Higher Education in Europe*, *33*(2–3), 311–316. https://doi.org/10.1080/03797720802254205

Simões, C., & Soares, A. M. (2010). Applying to higher education: Information sources and choice factors. *Studies in Higher Education*, *35*(4), 371–389. https://doi.org/10.1080/03075070903096490

Soni, S., & Govender, K. (2018). The relationship between service quality dimensions and brand equity: Higher education students' perceptions. *Journal of Management and Business Administration. Central Europe*, *26*(3), 71–87. https://doi.org/10.7206/jmba.ce.2450-7814.236

Sung, M., & Yang, S. U. (2008). Toward the model of university image: the influence of brand personality, external prestige, and reputation. *Journal of Public Relations Research*, *20*(4), 357–376. https://doi.org/10.1080/10627260802153207

Tamtekin Aydın, O. (2015). University Choice Process: A Literature Review on Models and Factors Affecting the Process. *Yuksekogretim Dergisi*, *5*(2), 103–111. https://doi.org/10.2399/yod.15.008

Tansel, A., & Bircan, F. (2006). Demand for education in Turkey: A tobit analysis of private tutoring expenditures. *Economics of Education Review*, *25*(3), 303–313. https://doi.org/10.1016/j.econedurev.2005.02.003

Taylor, R. E., & Reed, R. R. (2008). An Identification and Analysis of Students' Expectation and Views Regarding Foreign-Sourced Tertiary Education Programs Delivered in China: Inverstigating the Next Stage of Internationalisation and Market Entry for Foreign Universities. *Journal of Marketing for Higher Education*, *15*(2), 37–41. https://doi.org/10.1300/J050v15n02_01

Theus, K. T. (1993). Academic reputations: The process of formation and decay. *Public Relations Review*, *19*(3), 277–291. https://doi.org/10.1016/0363-8111(93)90047-G

Thorens, J. (2006). Liberties, freedom and autonomy: A few reflections on academia's estate. *Higher Education Policy*, *19*(1), 87–110. https://doi.org/10.1057/palgrave.hep.8300111

Tina Vukasovič. (2002). Managing Consumer-Based Brand Equity in Higher Education. *International Schoolfor Social And-BusinessStudies And*, *13*(1), 75–90.

Tran, K. T., Nguyen, P.V., Do, H. T. S., & Nguyen, L. T. (2020). University students' insight on brand equity. *Management Science Letters*, *10*(9), 2053–2062. https://doi.org/10.5267/j.msl.2020.2.006

Truong, H.Van, Pham, C. H., & Vo, N. H. (2016). Service Quality and Students Level of Satisfaction in Private Colleges in Vietnam. *International Journal of Financial Research*, *7*(3). https://doi.org/10.5430/ijfr.v7n3p121

Tuškej, U., & Podnar, K. (2018). Consumers' identification with corporate brands: Brand prestige, anthropomorphism and engagement in social media. *Journal of Product and Brand Management*, *27*(1), 3–17. https://doi.org/10.1108/JPBM-05-2016-1199

Uyanık, G. K., & Güler, N. (2013). A Study on Multiple Linear Regression Analysis. *Procedia - Social and Behavioral Sciences*, *106*, 234–240. https://doi.org/10.1016/j.sbspro.2013.12.027

vanVught, Frans A., E. (1989). Governmental Strategies and Innovation in Higher Education. In *Books; Information Analyses; Collected Works - General*. Taylor and Francis Group, 1900 Frost Rd., Suite 101, Bristol, PA 19007. https://eric.ed.gov/?id=ED334954

Vuong, T. K., & Bui, H. M. (2023). The role of corporate social responsibility activities in employees' perception of brand reputation and brand equity. *Case Studies in Chemical and Environmental Engineering*, *7*. https://doi.org/10.1016/j.cscee.2023.100313

Wilkins, S., & Huisman, J. (2015). Factors affecting university image formation among prospective higher education students: the case of international branch campuses. *Studies in Higher Education*, *40*(7), 1256–1272. https://doi.org/10.1080/03075079.2014.881347

Wilkins, S., Shams, F., & Huisman, J. (2013). The decision-making and changing behavioural dynamics of potential higher education students: the impacts of increasing tuition fees in England. *Educational Studies*, *39*(2), 125–141. https://doi.org/10.1080/03055698.2012.681360

Wong, B., & Chiu, Y. L. T. (2019). Let me entertain you: the ambivalent role of university lecturers as educators and performers. *Educational Review*, *71*(2), 218–233. https://doi.org/10.1080/00131911.2017.1363718

Ying, Q., Fan, Y., Luo, D., & Christensen, T. (2017). Resources allocation in Chinese universities: hierarchy, academic excellence, or both? *Oxford Review of Education*, *43*(6), 659–676. https://doi.org/10.1080/03054985.2017.1295930

Yusoff, M., McLeay, F., & Woodruffe-Burton, H. (2015). Quality Assurance in Education Dimensions driving business student satisfaction in higher education Article information : *Quality Assurance in Education*, *23*, 86–104.

Zinkhan, G. M., & Smith, D. C. (1992). Book Review: Managing Brand Equity: Capitalizing on the Value of a Brand Name. *Journal of Marketing*, *56*(2), 125–128. https://doi.org/10.1177/002224299205600211

Original scientific paper

UDC: 159.947.2-057.875

Received: April 10, 2024.
Revised: June 17, 2024.
Accepted: Jule 06, 2024.

10.23947/2334-8496-2024-12-2-317-334

Check for updates

Motivation Types: A Key Factor in Self-regulated ESP Learning

Jelisaveta Šafranj[1*], *Vesna Bulatović*[1], *Dragana Gak*[1]

[1]University of Novi Sad, Faculty of Technical Sciences, Novi Sad, Serbia,
e-mail: savetas@uns.ac.rs, vesna.bulatovic@uns.ac.rs, dgak@uns.ac.rs

Abstract: The objective of this paper is to examine the impact of motivational orientations, or various forms of motivation, on the success of foreign language (L2) learning as a measure of self-regulation for ESP (English for Specific Purposes) students. It has been postulated that the nature of motivation has a substantial impact on second language (L2) learning, as evidenced by success as a measure of self-regulated learning. This association remains consistent even when moderator variables such as gender, age at which L2 learning begins, and years of L2 learning are integrated. This empirical research covered 460 respondents, of whom 245 (53%) were male. The students attended the Faculty of Technical Sciences (FTS) at the University of Novi Sad. The Foreign Language Learning Motivation Questionnaire (LLOS-IEA) was used as an instrument. Scale reliabilities were measured using Cronbach's alpha indicating satisfactory reliability. An achievement test with 50 tasks and a general data questionnaire were applied. PROCESS macro for SPSS was used for statistical analyses. The initial results indicate that students are highly motivated, with Intrinsic regulation (Knowledge, Achievement, and Stimulation) and Identified regulation achieving the highest scores with good motivational orientation that are significant predictors of self-regulation, which was also seen as an indicator on the L2 achievement test. Additionally, their levels of amotivation are low, while their levels of various categories of motivation are moderate. A notable positive predictor is identified regulation, suggesting that motivation facilitated by identified regulation is linked to an improved grade in L2 and overall achievement. Furthermore, it was determined that ESP students exhibit distinct types of motivation compared to other students, which serves as an indicator of self-regulation in ESP learning. It was established that ESP accomplishments are determined by the types of motivation present in L2 learning. The age of starting L2 learning, years of L2 learning, and gender are insignificant factors in the relationship between the observed variables. Also, it is recommended that future studies should be based on a larger corpus and include not only students of the technical sciences but also students of the social sciences in order to overcome its limitations.

Keywords: *types of motivation, self-regulation, ESP students, L2 learning*

Introduction

Self-regulation in learning refers to the capacity to cultivate knowledge, abilities, and attitudes that facilitate and enhance the learning process, as well as transfer it to different learning contexts (Baumert et al., 1998; Sorić, 2014; Oga-Baldwin et al., 2022). Numerous studies examine it in relation to theoretical approaches and models, in addition to their practical validation. Ziegler et al. (2021) note that effective learning is more important than a high IQ. The same author emphasises that effective learning rooted in self-regulated learning is essential for high achievement. As Zimmerman (2002) remarks, self-regulation in learning is unlikely a mental ability or skill of performing a specific task but a guiding process by which students transform their mental abilities into learning skills. Therefore, it is not about the characteristics that someone possesses, which accordingly can be more or less effective, but about changing a learning style, which is reflected in success in self-regulation and recognised in the fields of meta-cognition and learning motivation. This is important for L2 learning, as it directs the search for ways to develop the above-mentioned mechanisms of self-regulation.

For several decades, motivation has been at the top of the list of research topics in many areas of learning and teaching activity, along with teaching pedagogy, whose role in the speed and success of L2

*Corresponding author: savetas@uns.ac.rs

learning is also important. Researchers noticed its importance as an incentive to begin L2 learning, and its subsequent role as an impetus for the continuation of a lengthy and frequently tedious educational process (Dörnyei, 1998). Consequently, despite its complexity and multifaceted nature (Gardner et al., 1985), which is composed of several factors such as the value of the task, the level of success that learners expect, self-confidence, and understanding the reasons for their success or failure on the task (Dörnyei and Ushioda, 2011), motivation has been the focus of researchers for decades due to its complexity. Attention is specifically focused on the types of motivation and motivational strategies that help students adopt positive attitudes towards language learning and develop motivation. This requires knowledge of the motivational levels of the group and individuals in order to define and adjust didactic instructions to the needs of those who are learning, since different levels or types of motivation presuppose different approaches to encourage students, facilitate learning, and make it more efficient (Reinders et al., 2023; Wolters et al., 2023). Regarding the ESP students, there is a belief that they learn easily and quickly, as well as that they have a high level of internal motivation. This research aims to investigate these assumptions as well as check the relationship between the type of motivation and achievement.

Pedagogical psychology links research on motivation to the acquisition of L2 skills. Gardner and her associates (1985) investigated the basic elements of motivation for L2 learning: *motivational intensity or effort, desire to master L2, and attitude towards L2 learning*. According to Dörnyei and Ushioda (2011), Gardner´s research is important for this field as he noticed the difference between motivation and orientation, i.e., goal. According to Gardner, the goal is an incentive that creates motivation and directs it towards achieving the desired effects. Thus, orientation is considered a significant precursor, or driver of motivation: *integrative orientation,* or interest in interacting with the L2 group, and *instrumental orientation*, interest in the more materialistic and practical advantages of L2 learning, i.e., seeking a better career (Dörnyei and Ushioda, 2011; Mystkowska-Wiertelak and Bielak, 2023).

Dörnyei and Ushioda (2011) introduced a novel L2 learning method known as «L2 motivational self-respect,» which establishes a connection between L2 learning and personal identity. This method has implications for the acquisition of L2 skills, as it fosters the development of self-motivation and self-maturity among students.

In opposition to Gardner's emphasis on integrity, Dörnyei's perspective is that instrumental orientation has a more significant influence on L2 acquisition in the context of English as a Foreign Language (EFL). In addition, he emphasises the necessity of a more pragmatic education, a focused approach, the study of reality in the classroom, and the identification and examination of motives for L2 learning in the classroom (Dörnyei and Ushioda, 2011). These are all factors that teachers should consider when motivating students for L2 learning.

Also, it is important to point out more details about motivational orientations because their characteristics could be employed to quantify the impact of didactic instructions on the academic efficiency of L2 students in accordance with the characteristics of their motivation. The initial occurrence of amotivation is the failure of students to recognise the connection between their actions and the repercussions of these actions. Amotivated L2 learners are under the impression that they are squandering their time while learning L2. In addition, the difference between demotivation and amotivation should be noted as well. Dornyei (2001a) made a significant finding that holds relevance for educators: when students perceive outcomes as unreasonable and unattainable, it results in amotivation as they recognise that the objective is beyond their capabilities and unattainable. Consequently, amotivation is defined as an absence of motivation.

Instruments such as the *Academic Motivation Scale* (AMS 28 or 32) and the *Foreign Language Learning Motivation Questionnaire* (LLOS-IEA; Noels, Pelletier, Clement and Vallerand, 2000, etc.) are accepted and used in the majority of research. These analyses are grounded in Self-Determination Theory (SDT), as they have received confirmations of their metric properties, including factor analysis, dimensionality, reliability, and construct validity, in statistical analyses conducted in multiple countries. The hypothetical 7-factor model was also mainly confirmed: *Internal motivation - knowledge; Internal motivation - achievement; Internal motivation - stimulation; External motivation - identified; external motivation - introjected; External motivation - external regulation; Amotivation*. They will be briefly explained in the following part of this paper.

Thus, aspects of motivation line up along the continuum, depending on the internalization of behaviour (Deci, 1975; Deci and Ryan, 1985). It is common to distinguish three types of motivation: *internal* and *external* motivation, with *amotivation* located at the far left end of the continuum.

Amotivation represents a state of lack of motivation, and the locus of control is indeterminate. In amotivated students, there is a lack of congruence between opinions and activities, and in the academic context, this means that they failed to define reasons for schooling or see any point in it (Niemiec et al., 2009). External motivation is divided into four narrower aspects and defined as regulation. External regulation reflects a behaviour that is determined by external reinforcements with less effective consequences and short-term effects (Hagger and Chatzisarantis, 2007; Ryan et al., 2008; Henry and Liu, 2023; Al-Hoorie, 2024).

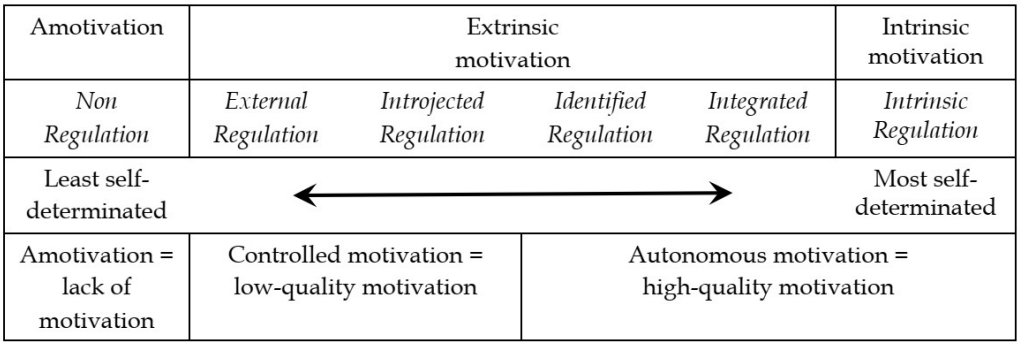

Figure 1. Continuum of self-determination (Ryan and Deci, 2000:72)

Extrinsic or external motivation refers to the pressure or reward of the social environment for L2 learning. Extrinsically motivated students aim to acquire knowledge for better career opportunities and the like. As a result, because external influences stimulate motivation, removing them could potentially lead to the student ceasing to acquire the second language (Noels et al., 2001). Therefore, it pertains to external motivation, encompassing a diverse array of actions employed to attain a specific objective rather than solely for personal fulfilment (Deci, 1975). The first conceptions of external motivation describe behaviour that is not self-determined, and the term implies behaviour that is encouraged by external factors (punishment, reward, control). More recently, researchers (Ryan et al., 1990; Deci and Ryan, 1985; Alastair and Meng, 2024) determined that external motivation varies along the self-determination continuum. *External regulation, introjection,* and *identification* are used to describe self-determination from low to high levels. In recent literature, *external regulation* is often presented as a type of motivation that refers to behaviour controlled by external factors. (rewards, restrictions, imposition of demands, expectation, etc.).

Introduced regulation occurs when people start to internalize the reasons behind their actions, when they believe their environment has influenced their behavior but have not fully integrated it into their personal value system, and especially when they value and consider their behavior to be significant. Such situations arise as a consequence of avoiding a sense of guilt. Understanding their importance and contribution to self-realization leads to identified regulation. Consequently, *identified regulation* has come to be defined as conduct that an individual adopts on the basis of its intrinsic value, rather than for future benefits and contributions. Research findings indicate that identified regulation does not stem from internal motivations, and rather, it results in diminished levels of self-determination. (Jang et al., 2010; Baard et al., 2004; Alastair and Meng, 2024).

The next step on the ladder of motivational hierarchy of self-determination is the so-called *adopted or introjected regulation*, which is of a higher level and is essentially about the acceptance of behaviours from the environment that are not yet fully internalized in the personal value system. Findings indicate that this type of self-regulation occurs to avoid a sense of guilt.

Integrated regulation is the closest to intrinsic motivation on the continuum of self-regulation and is associated with positive outcomes such as pro-social development and psychological well-being (Ryan and Deci, 2000; Ryan et al., 2008). *Integrated regulation* refers to the behaviours that are consistent with the values of the individual for L2 learning and teaching and are considered the most existing in the system of students' self-regulation (Gojkov-Rajic et al., 2021a; Gojkov-Rajić et al. 2023; Wolters et al., 2023).

Intrinsic motivation, which contains the internal locus of control and promotes mastery, spontaneous interest, and research, is at the far right end of the self-regulation continuum and is essential for cognitive development (Deci, 1975; Deci and Ryan; Al-Hoorie, 2024). Valerand et al. (2003) hypothesized that *intrinsic motivation* consists of three dimensions that describe the natural inclination towards cognition, stimulation, and achievement, which is encouraging for further research to provide a clearer picture of the

possibilities for personalization of didactic instruction in L2 teaching.

Intrinsic motivation is doing things for yourself and enjoying them (Deci, 1975; Deci and Ryan, 1985; Vallerand et al., 1992). Intrinsic motivation is the pleasure of learning, discovering, or understanding something new (Oga-Baldwin et al., 2022). The pleasure of achieving or creating something is intrinsic motivation (Vallerand et al., 1992). People who are intrinsically motivated act spontaneously without pecuniary rewards or external limitations (Deci and Ryan, 1985; Oga-Baldwin et al., 2022). According to Deci and Ryan, intrinsic drive comes from a psychological demand for competence and self-determination. Intrinsic motivation drives actions that foster competence and self-determination, especially in independent learning contexts. This is the way that teachers accelerate progress towards higher levels of motivational self-regulation in L2 learning. Although most researchers claim that there is a global intrinsic motivation construct, there are opinions (Deci, 1975; White, 1959) that intrinsic motivation could differ in several specific motives, which is accepted as a three-sided taxonomy of intrinsic motivation examined on an independent basis (Vallerand et al., 1992; Reinders et al., 2023).

The essential motivation is to know something new. This inner motivation includes inquiry, curiosity, and learning goals. Epistemic knowledge and understanding are essential for intrinsic learning motivation. This involves engaging in activities you enjoy while learning, investigating, or attempting to understand something.

Internal achievement motivation is another intrinsic motivation, and it is recognized in pedagogical psychology and didactics as motivation for mastering, motivation for efficacy, and task orientation. Research indicates that individuals communicate with their environment to feel competent and attain distinct goals (Deci, 1975; Deci and Ryan, 1985, 1991; Mystkowska-Wiertelak and Bielak, 2023). Consequently, we define it as an orientation towards accomplishments, where individuals engage in activities driven by the joy and satisfaction they derive from striving to accomplish or create something novel. This, in turn, leads to a sense of personal satisfaction after mastery of complex training techniques (e.g., participating in scientific meetings, communicating in L2).

The third form of internal motivation, *internal motivation for experiencing stimulation*, is characterised by participation in an activity with the goal of experiencing stimulating sensations such as fun, aesthetic experiences, and excitement.

Amotivation	Extrinsic motivation				Intrinsic motivation
Non Regulation	*External Regulation*	*Introjected Regulation*	*Identified Regulation*	*Integrated Regulation*	*Intrinsic Regulation*
Least self-determinated	⟷				Most self-determinated
Amotivation = lack of motivation	Controlled motivation = low-quality motivation		Autonomous motivation = high-quality motivation		

Figure 2. An overview of the above outline of motivational orientations and types

Intrinsic motivation is characterized by a sense of satisfaction and originates from a sense of competence, autonomy, and connectedness (Ryan and Deci, 2000; Oga-Baldwin et al., 2022; Henry and Liu, 2023). Also, internal motivation is considered more self-determined than external motivation and refers to internal factors such as the sense of pleasure and satisfaction. Internally motivated activities are related to the emotions associated with the exploration of new ideas and the acquisition of abilities and fundamentals related to an attempt to overcome a task or achieve a goal.

The presented types of motivation are also important for research in L2 learning and teaching in order to perceive them more clearly and distinguish the ways in which the teacher can facilitate students in self-regulating their learning, i.e., stimulating their motivational potentials (Jandrić et al., 2018; Vallerand et al., 2021; Ramos and Habig, 2019; Crnjak, 2019; Mystkowska-Wiertelak and Bielak, 2023).

The advancement of technology has significantly altered the motivation of contemporary generations. A substantial proportion of the youth population exhibits a lack of motivation and fails to differentiate between their own actions and unanticipated outcomes. These individuals' motivations are neither intrinsic nor extrinsic. They attend classes with a lack of appreciation for the value of education and consider

it a futile investment of time and energy. In their study, Gillet (2012) examined the motivation of young individuals, identified effective strategies, and explored potential avenues for addressing the intricacies of education systems, learning, and assessing positive outcomes of educational endeavours. He suggested modifying existing pedagogical methods and offering a variety of learning environments to accommodate the requirements of the students. Neglect may prevent students from being academically motivated, according to one of his notes. Other authors have also arrived at similar conclusions, which they define as the necessity for increased autonomy in teaching and learning activities (Gojkov-Rajić et al., 2020).

Teachers' influence on student motivation and methods for fostering and sustaining motivation in the classroom were investigated in Mastoor Al Kaboodi's (2013) study. He encourages teachers to motivate students and keep them motivated throughout their learning. It is based on a meta-analysis of motivation studies he did to uncover classroom strategies and solutions for teachers.

A number of studies (Dörnyei, 2003; Dörnyei and Ushioda, 2011; Wolters et al., 2023). found that the integrative component has a significant part in the variance when it comes to motivational spirit and persistence in L2 learning, which in some sense led to upheaval on the scene of acceptance of the motivational model, i.e., transition from the socio-educational to the psychological model. The integrative nature of the multifactorial complexity of L2 learning is the focus of Gardner's model. However, practical L2 learning research show that instrumental orientation affects language learning more. Research suggests a need for a pragmatic approach to education, focused methodology, classroom investigation, and examining learning motivations (Dörnyei, 1990, 1994, 1997, 2001a, 2001b; Dörnyei and Ushioda, 2011; Williams, 1994; Gojkov-Rajić et al., 2021b; Wolters et al., 2023). A novel L2 learning method called "L2 motivational self-respect" has been promoted. Foreign language learning and personal identity impact self-maturity and motivation to master L2 (Šafranj et al., 2021; Oga-Baldwin et al., 2022; Henry and Liu, 2023).

Culture and identity also motivate L2 students, according to Cortazzi and Jin (1999).

The abovementioned studies rely on a theoretical orientation that also includes the dynamic dimension of motivation, and is relevant as a theoretical approach due to its possibility of being applied in didactic practice.

- In their research, Utvær and Gørill (2016) also started from the principles of Self-Determination Theory, distinguishing types of motivation according to the types of self-regulation along the continuum of internalization, which are also used as types of motivation related to quality and outcome. In the research, the following variables were identified as predictors of educational outcomes: learning, performance, engagement, and persistence. This leaves room for further research into the relationship between types of motivation and academic success, which is the basis of our research. Specifically, the previously mentioned findings raise the following question or issue:
- *The problem or research question* is whether there are differences in motivational orientations, or types of motivation, between the ESP and other students, which are indicators of self-regulation in L2 learning. What is the extent to which the types of motivation determine the achievements in L2 learning?
- *Objective*: The paper aims to reach the relationship between types of motivation for L2 learning and their effect on success in L2 learning as a measure of success in self-regulation for ESP students. The intention is to understand their influence on the success of L2 learning.
- *Hypothesis*: It is assumed that the types of motivation significantly affect L2 learning, that this will affect success as an indicator of self-regulated learning, and that this relation will be maintained even in the case of the introduction of moderator variables.
- *Working hypotheses*:The types of motivation are correlated with success in L2 and explain a significant part of the variance in learning self-regulation, resulting in learning outcomes, i.e., L2 achievement test L2 for ESP students in relation to others (grades on the L2 achievement test correspond to the types of motivation, which allows to make conclusions about self-regulation as a factor of academic achievement of ESP students; or grades on the L2 achievement test depend on the type of motivation).Age of starting L2 learning, years of L2 learning, and gender are insignificant factors in the relationship between the observed variables.
- *Variables*:

predictors: types of motivation (intrinsic motivations, extrinsic motivations, and amotivation; subclasses: amotivation, external incentives, integrated incentives, identified regulation, internal motivation-knowledge, internal motivation-fulfilment, internal motivation-stimulation);

criteria: success in the L2 achievement test

moderators: age of starting L2 learning; years of L2 learning; gender

Method

Sample

The convenience sampling was applied to 460 respondents who participated in the research, of whom 245 (53%) were male. The students were from the Faculty of Technical Sciences in Novi Sad. There were 205 ESP students and 255 other students. The research was organised based on a quantitative design and performed through systematic, non-experimental observation.

Tools

Foreign Language Learning Motivation Questionnaire (LLOS-IEA; Noels, Pelletier, Clement and Vallerand, 2000) The questionnaire consists of 21 items on a five-point Likert scale and measures seven types of motivation for L2 learning: Amotivation, External regulation, Introjected regulation, Identified regulation, Knowledge, Achievement and Stimulation. The reliability of the scales measured by Cronbach's alpha was as follows: Amotivation $\alpha = 0.87$, External regulation $\alpha = 0.69$, Introjected regulation $\alpha = 0.76$, Identified regulation $\alpha = 0.88$, Knowledge $\alpha = 0.89$, Achievement $\alpha = 0.79$, Stimulation $\alpha = 0.89$, indicating satisfactory scale reliability.

The authors of this paper created the L2 Achievement Test, which has 40 questions, 10 for each language skill. The general questionnaire refers to general data, such as the average grade at the study, gender, years of L2 learning, and age of starting L2 learning.

Data analysis

To make it easier to understand and compare the results, we found Pearson's correlation coefficient and average summation scores for the Foreign Language Learning Motivation Questionnaire scales. We also looked for links between different aspects of motivation and success on the L2 Achievement Test. We performed a multiple regression analysis to systematically examine the influence of motivation on success on the L2 Achievement Test. The criterion was success on the L2 Achievement Test, and the predictors included different types of motivation, the age at which the student started learning L2, how long they had been learning it, and gender.

By using the PROCESS macro for SPSS, moderator analyses were performed on gender, age of starting L2 learning, years of L2 learning, and gender to determine how they affected motivation and L2 Achievement Test success. The PROCESS macro analyses moderation using one predictor, one moderator, and one dependent variable per analysis.

We used logistic regression to examine the influence of different aspects of motivation on the prediction of ESP students. Various aspects of motivation were predicted, and whether someone was an ESP student or not was a criterion variable.

Results

Descriptive statistics

Table 1 displays the basic descriptive indicators for the study's variables. The skewness and kurtosis values for all variables are within the acceptable range of ± 2 (George and Mallery, 2010), indicating no substantial deviation from the univariate normal distribution. On average, students show relatively low

levels of amotivation, moderate levels of various aspects of motivation, and the highest scores for *identified regulation*. The average grade in L2 language is 8.69, indicating fine achievement in this teaching subject. On average, students started L2 learning at the age of 7, with the earliest beginning at the age of 2 and the latest at the age of 15. The average number of years of L2 learning is 12.08.

Table 1. *Research variable descriptive indicators*

	Minimum	Maximum	Arithmetic mean	Standard deviation	Skewness	Kurtosis
Amotivation	1.00	3.61	1.35	0.75	1.54	1.32
External regulation	1.00	5.00	3.08	1.09	-0.23	-0.35
Introjected regulation	1.00	5.00	2.47	1.09	0.35	-0.51
Identified regulation	1.00	5.00	3.72	1.24	-0.59	-0.62
Knowledge	1.00	5.00	3.26	1.17	-0.21	-1.00
Achievement	1.00	5.00	3.36	1.09	-0.09	-1.14
Stimulation	1.00	5.00	3.29	1.27	-0.19	-1.08
Age of beginning L2 learning	2	15	7.18	1.89	0.99	0.83
Years of L2 learning	3	20	12.08	3.79	-0.44	0.83
Grade in L2	6	10	8.69	1.31	-0.41	-0.89

Correlation of variables

Table 2 displays Pearson's correlation coefficient between research variables. A high correlation exists between the variables of motivation for knowledge, achievement, and stimulation, while the intensity of the correlation is around 0.70. The grade in L2 language is significantly related to all types of motivation except *external regulation*. It has a mild negative correlation with *amotivation*, while with other types of motivation it shows a mild to moderate positive correlation. Starting a foreign language later lowers grades, while more years of learning improves them.

Table 2. *Research variables' correlation*

	1	2	3	4	5	6	7	8	9	10
Amotivation (1)	1	0.00	.26**	-.37**	-.26**	-.20**	-.26**	.15**	-.28**	-.14**
External regulation (2)		1	.21**	.25**	-.22**	-.11*	-.18**	-.13**	.13**	0.06
Introjected regulation (3)			1	0.05	.20**	.18**	.21**	-0.06	-0.06	.13**
Identified regulation (4)				1	.32**	.38**	.35**	-.12**	.20**	.29**
Knowledge (5)					1	.72**	.71**	-.14**	.18**	.31**
Achievement (6)						1	.69**	-.13**	.23**	.33**
Stimulation (7)							1	-.22**	.25**	.34**
Age of starting L2 learning (8)								1	-.78**	-.29**
Years of L2 learning(9)									1	.35**
Grade in L2 and overall success (10)										1

Note: * - $p < 0.05$; ** - $p < 0.01$

Multiple regression

Table 3 shows how motivation, gender, age of starting L2 learning, and years of L2 study affect foreign language grades and success. The overall model was significant, $F(11, 447) = 13.01$, $p < 0.001$, where the predictors explained about 24% of the criterion variance ($R^2 = 0.24$, $R^2_{adjusted} = 0.22$). Since the VIF indicator did not exceed the value of 4 for any of the predictors, distinct multicollinearity was not present among the predictors. Years of L2 learning and identified regulation are strong indicators, showing that more years of learning and motivation through identified regulation lead to better L2 language grades and success.

Table 3. *Partial predictor contribution in the regression model*

Predictor	Beta	t	p	VIF
Gender	0.05	1.18	0.240	1.24
Age of starting L2 learning	-0.06	-0.80	0.425	3.27
Years of L2 learning	0.25	3.30	0.001	3.29
Amotivation	0.01	0.18	0.861	1.63
External regulation	0.04	0.73	0.469	1.51
Introjected regulation	0.07	1.40	0.163	1.40
Identified regulation	0.16	3.12	0.002	1.59
Knowledge	0.09	1.35	0.178	2.77
Achievement	0.04	0.63	0.531	2.71
Stimulation	0.09	1.27	0.205	2.70

Gender-based moderation analysis

The moderation role of gender in relation to different types of motivation and grade in a second language was examined by conducting a moderation analysis. In Table 4, interactions in models that investigated predictors and moderators (gender) on second language grade are shown. Gender moderated the association between identified regulation, knowledge, achievement, and stimulation and second language grade. To enhance the interpretation of the moderation effect, we present significant interaction effects as charts. Figure 3 shows moderation between identified regulations and gender. It is noticeable that female respondents have significantly higher grades at higher levels of identified regulation, while at lower levels of identified regulation, grades are similar for both male and female respondents. In a similar way, gender moderates the relationship between knowledge and grades in L2 language (Figure 4). Women receive higher L2 language grades at higher motivation for knowledge, but there are no differences at lesser motivation. At lesser motivation for achievement (Figure 5), female students get lower grades than male students, but at increased motivation for achievement, they get the best grades. A similar pattern of moderation but a milder level of interaction, is also present between stimulation and gender (Figure 6).

Table 4. *Contribution of introducing interaction of the types of motivation and gender in the model*

Interaction	F	df1, df2	p
Amotivation x gender	1.22	1. 456	0.270
External motivation x gender	0.30	1. 456	0.581
Introjected regulation x gender	1.02	1. 456	0.313
Identified regulation x gender	5.52	1. 456	0.011
Knowledge x gender	4.54	1. 456	0.033
Achievement x gender	15.31	1. 456	0.000
Stimulation x gender	4.35	1. 456	0.037

Figure 3. Moderation of gender and identified regulation by L2 grade

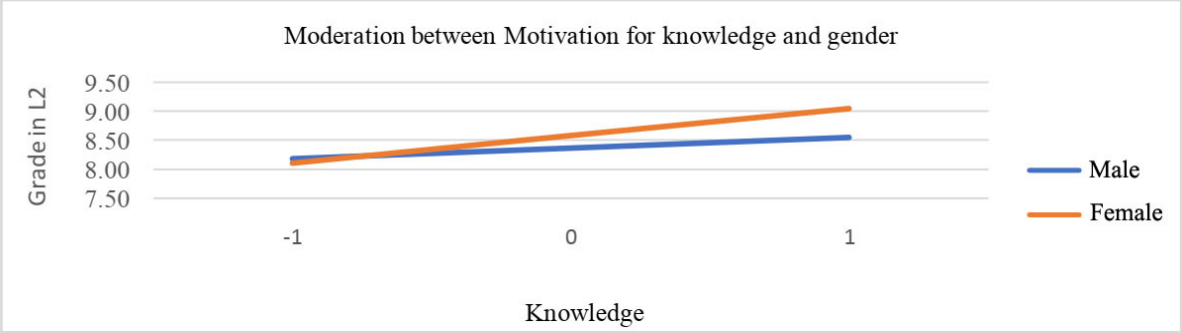

Figure 4. Moderation of knowledge motivation and gender by grade in L2

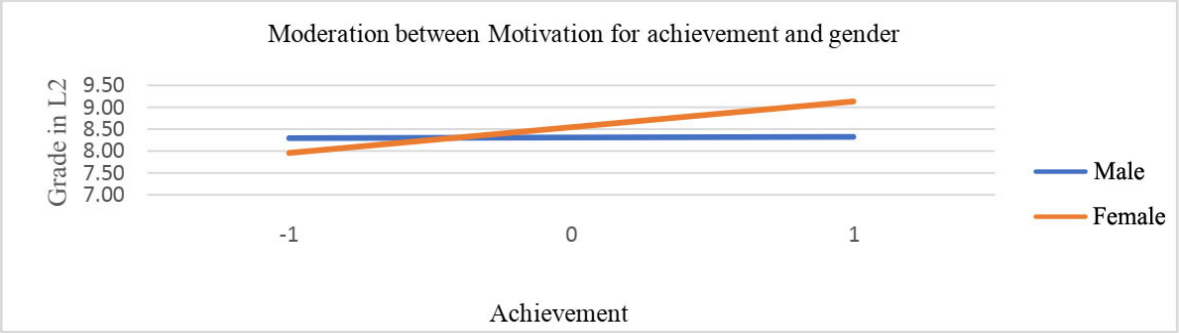

Figure 5. Moderation of achievement motivation and gender by grade in L2

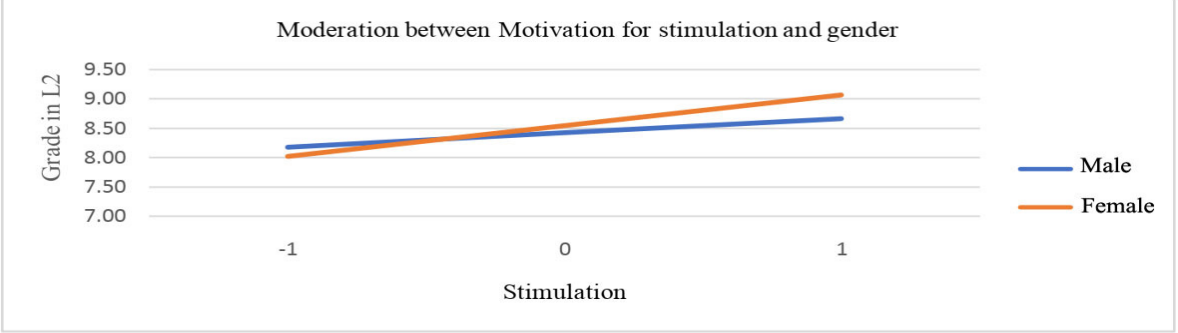

Figure 6. Moderation of stimulation motivation and gender by grade in L2

Moderation analysis – age of starting L2 learning as a moderator

The moderation role of the age when the respondent started L2 learning in relation to different types of motivation and grade in L2 language was examined by conducting moderation analysis. Table 5 shows the contribution of introducing interactions in the model that tested the influence of predictors and moderators (age of starting L2 learning) on the grade in L2 language. The age of starting L2 learning moderated effectively external regulation and grade and knowledge and grade. Figure 7 shows moderation between external regulation and the age of starting L2 learning. In general, those who started earlier have higher grades, but the achievement is most remarkable at higher levels of external regulation, while for those who started learning later, the relationship is reversed. Higher motivation for knowledge is important for L2 achievement, and those with higher motivation achieve high grades regardless of the age of starting L2 learning. At lower motivation, the age of starting L2 learning is more important (Figure 8).

Table 5. *Contribution of introducing motivation types and the age of starting L2 learning in the model*

Interaction	F	df1, df2	p
Amotivation x age of starting to learn L2	2.95	1. 456	0.086
External regulation x age of starting to learn L2	3.93	1. 456	0.048
Introjected regulation x age of starting to learn L2	1.21	1. 456	0.270
Identified regulation x age of starting to learn L2	3.61	1. 456	0.057
Knowledge x age of starting to learn L2	8.16	1. 456	0.004
Achievement x age of starting to learn L2	3.60	1. 456	0.058
Stimulation x age of starting to learn L2	1.36	1. 456	0.244

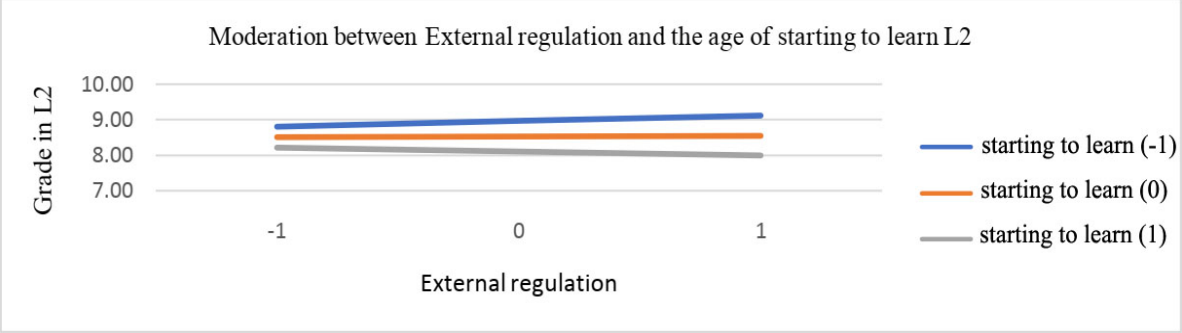

Figure 7. Moderation of External regulation and the age of starting to learn L2 by grade in L2

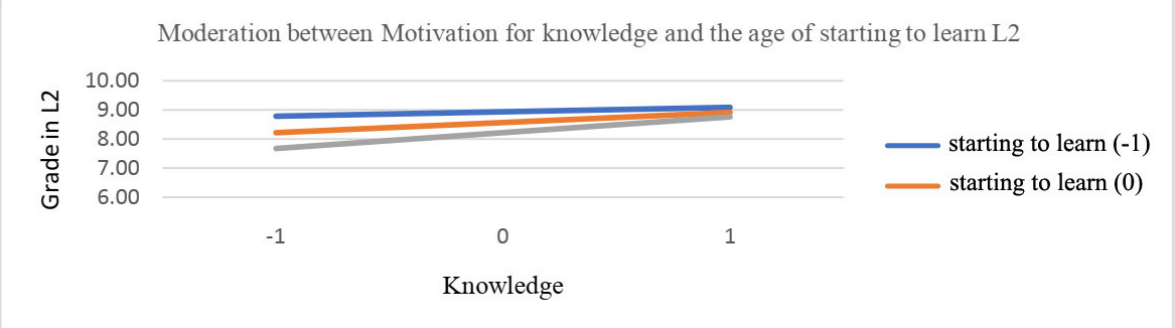

Figure 8. Moderation of knowledge motivation and the age of starting L2 learning by grade in L2

Moderation analysis - years of L2 learning as a moderator

The moderation role of years of L2 learning in relation to different types of motivation and grade in L2 language was examined by conducting moderation analysis. Table 6 shows the contribution of in-

troducing interactions in the model, which tested the influence of predictors and the moderator (years of L2 learning) on the grade in L2 language. The years of L2 learning prove to be a significant moderator of the influence of all types of motivation on the grade, except ***amotivation*** and ***identified regulation***. In the case of moderation between the years of L2 learning and ***external regulation***, it is noticeable that at higher levels of ***external regulation***, students with more years of learning achieve better results (Figure 9). At high levels of ***introjected regulation***, the grades achieved in L2 language are high regardless of the years of learning, while at lower levels of this motivation, the years of learning are more significant for achievement in L2 language (Figure 10). The pattern of relationship is similar in moderation between ***knowledge*** and years of L2 learning (Figure 11), achievement and years of L2 learning (Figure 12), and stimulation and years of L2 learning (Figure 13).

Table 6. *Contribution of introducing motivation types and the years of L2 learning in the model*

Interaction	F	df1, df2	p
Amotivation x years of L2 learning	0.35	1. 456	0.552
External regulation x years of L2 learning	8.30	1. 456	0.004
Introjected regulation x years of L2 learning	21.05	1. 456	0.000
Identified regulation x years of L2 learning	0.57	1. 456	0.448
Knowledge x years of L2 learning	40.24	1. 456	0.000
Achievement x years of L2 learning	4.74	1. 456	0.029
Stimulation x years of L2 learning	9.13	1. 456	0.002

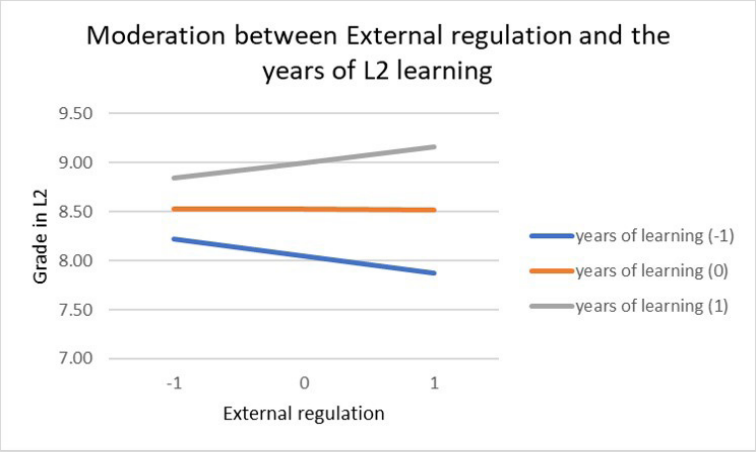

Figure 9. Moderation of External regulation and the years of L2 learning by grade in L2

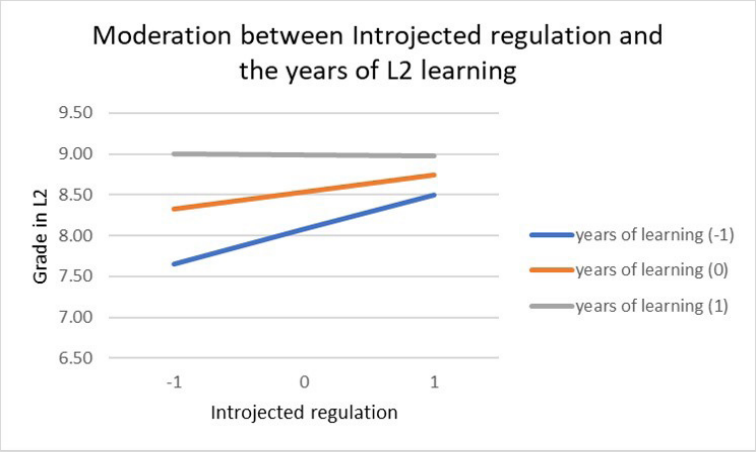

Figure 10. Moderation of Introjected regulation and the years of L2 learning by grade in L2

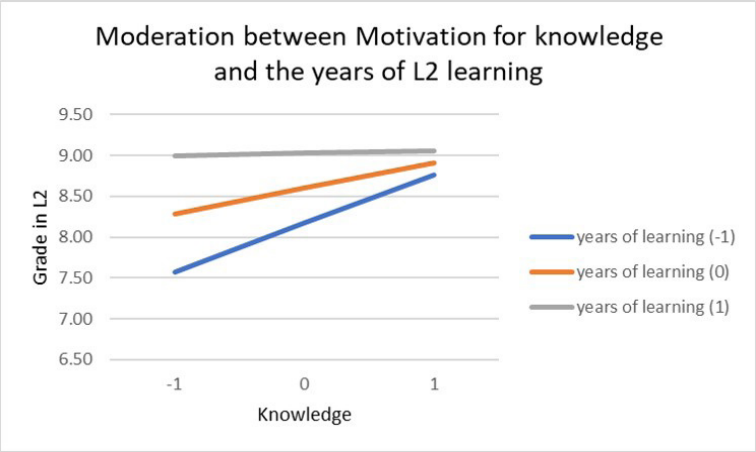

Figure 11. Moderation of knowledge motivation and the years of L2 learning by grade in L2

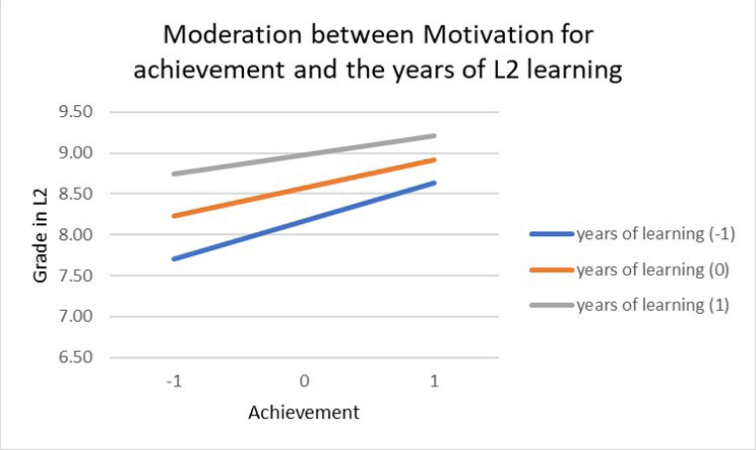

Figure 12. Moderation of achievement motivation and the years of L2 learning by grade in L2

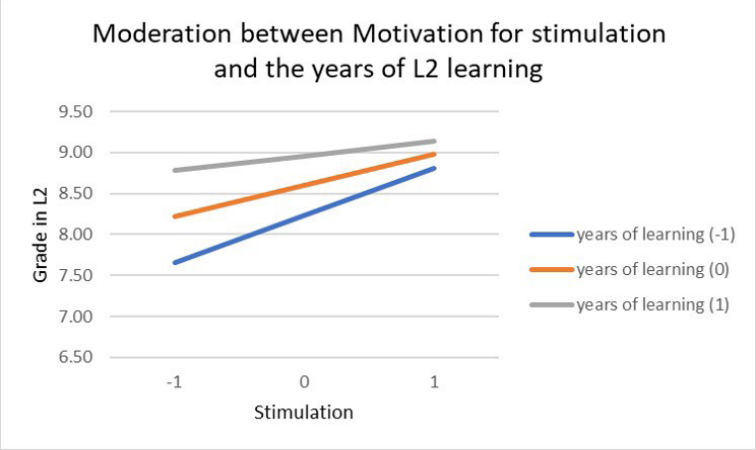

Figure 13. Moderation of stimulation motivation and the years of L2 learning by grade in L2

Logistic regression - influence of the types of motivation on learning ESP

The influence of different aspects of motivation on learning ESP was examined using binary logistic regression. After the introduction of predictors, the overall model was significant, χ^2 (7) = 111.49, p <0.001, with the types of motivation explaining about 29% of the criterion variance (Nagelkerke R^2 = 0.29). The influence of predictors is shown in Table 7. *Motivation for achievement and stimulation stand out as significant positive predictors. A unit increase on the scale of achievement increases the chance that a*

student will be in the group of learning ESP compared to other students by 66%, while this percentage is higher in the case of stimulation by 41%.External regulation stands out as a significant negative predictor, whereby a unit increase on this scale reduces the chances that someone will be in the group of ESP students by 31%.

Table7. Partial relationship of predictors in the binary logistic regression model

Predictor	Wald	p	Exp (B)
Amotivation	0.00	0.969	1.01
External regulation	4.85	0.028	0.76
Introjected regulation	1.88	0.170	1.17
Identified regulation	1.98	0.159	1.18
Knowledge	0.10	0.748	1.05
Achievement	13.66	0.000	1.66
Stimulation	6.35	0.012	1.41

Discussion

Findings in descriptive statistics are the first step in achieving the research goal, as they indicate the levels of motivational orientations in L2 learning and their influence on L2 learning achievement as a measure of the success of ESP students, which helps explain L2 learning motivation among the surveyed students. The results suggest that, on average, students show relatively low levels of *amotivation* and moderate levels of various aspects of motivation, with the highest scores received by *intrinsic motivation* (knowledge, achievement, and stimulation) and *identified regulation*. These findings conclude that students are highly motivated, i.e., with a good motivational orientation and types of motivation that are significant predictors of self-regulation. This is reflected as an indicator of success on the L2 achievement test and also in overall success, which was taken as an indicator of ESP students. Multiple regression also singled out *identified regulation* as a positive predictor, indicating that motivation through *identified regulation* is linked to better L2 grades and higher overall success. Thus, it is concluded that motivation, as a source of self-regulation, corresponded to the academic achievements of ESP students, and significant correlations between academic and linguistic achievements were obvious with motivation types, and the outcomes were apparent in self-regulation as a factor of academic achievement. The above conclusion could be the answer to the research question, given that the results suggest that there are differences in motivational orientations, or types of motivation, between ESP and other students. They are indicators of self-regulation in L2 learning, and the types of motivation determine achievements in L2 learning.

It is noted that *identified regulation*, as one of the external types of motivation, although the closest to intrinsic motivation, is closely related to the types of intrinsic motivation and to the high overall success and achievements in L2.

In addition, variables of motivation, especially between *motivation for knowledge, achievement,* and *stimulation* are highly correlated, where the intensity of the correlation is around 0.70, and the grade in L2 language is significantly associated with all types of motivation except *external regulation*. It has a slight negative correlation with *amotivation*, while with other types of motivation, it has a slight to moderate positive correlation. This confirms a part of the general hypothesis, given that types of motivation significantly affect L2 learning, which is reflected in success as an indicator of self-regulated learning. Consequently, it can be noted that success as an indicator of self-regulation is in line with motivational orientations and types of motivation, i.e., that types of motivation significantly affect L2 learning, and that this reflects on success as an indicator of self-regulated learning. This confirms the first working hypothesis regarding the correlation between the type of motivation and success in L2 learning.

The data obtained by binary logistic regression, used to determine the influence of motivation types on learning ESP, also contributes to the achievement of the research objective. They suggest that the whole seven-factor model, with all known aspects of motivation, was significant and explains about 29% of the criterion variance, which can be accepted as an important positive predictor for L2 learning and teaching. It can be seen from the data that *motivation for achievement and stimulatio*n, i.e., types of in-

trinsic motivation, stand out as significant positive predictors. *A unit increase on the scale of achievement increases the chance that the student will be in the group of ESP students compared to other students by 66%*, while this percentage is higher in the case of *stimulation by 41%*. External regulation stands out as a significant negative predictor. A unit increase on this scale reduces the chances that the student will be in the group of ESP students by close to 31%. Thus, the above findings confirm the assumption that the types of motivation are correlated with success in L2 learning, and explain a significant part of the variance in self-regulation in learning outcomes, i.e., the L2 achievement test, among ESP students compared to others. The results on the L2 achievement test correspond to the types of motivation, which points out self-regulation as a factor in the academic achievement of ESP students.

The previous findings are consistent with the conclusions of other research (Ramos and Habig, 2019; Utvær and Gørill (2016); Henry and Liu, 2023) that the construct of motivation is multidimensional. As a phenomenon, it cannot be considered appropriately by simplified divisions into basic motivational orientations, and it is necessary to delve deeper into the multidimensionality, complexity of the motivational construct and several motivational orientations, or types of motivation, which further confirm the concepts of Self-Determination Theory (Deci and Ryan, 1985; Baard et al., 2004). This important conclusion has practical pedagogical implications for teachers, administrators, and creators of educational policy. Students need accurate and precise information to direct themselves in self-regulation, and the contents of the curriculum should be more closely associated with their future careers. Consequently, it is more efficient in practice, because *identified regulation* appears as an important predictor, which is understood as behaviour that an individual accepts because of its importance and expected benefits in the future. This finding confirms the opinion stated in the introductory part of the paper, which emphasize that technological progress has changed the way today's generations are motivated. Many youth are amotivated and fail to see unexpected effects of their behaviour. As Gillet and his associates (2012) recommend, it is necessary to change didactic approaches and provide different learning environments to meet students' needs in order to avoid a sense of negligence. At the same time, the results indicate that strategies significantly facilitate the need for higher autonomy in learning and teaching (Gojkov-Rajić et al., 2021a; Reinders et al., 2023).

Moderation analyzes examine the moderation roles of *the age of starting L2 learning, years of L2 learning, and gender* as factors in the relationship between the observed variables of ESP students and self-regulation in the field of L2 learning and teaching. The previously presented contributions of introducing interactions in the model that tested the influence of predictors and a moderator (gender) on grade in L2 language refer to gender as a significant moderator in the case of the relationship between *identified regulation, knowledge, achievement, and stimulation* and *grade in L2 language*. Moderation between *identified regulation and gender* indicates that female students have significantly higher grades at higher levels of *identified regulation*, while grades are similar for both male and female students at lower levels of *identified regulation*. Similar to this, gender moderates the relationship between knowledge and grade in L2 language; we found no differences at lower levels of motivation for knowledge, but at lower levels, female students achieve higher grades on the L2 achievement test. In the case of motivation for achievement, at lower levels, female students achieve lower grades than male students, while at higher levels, female students achieve the highest grades. A similar pattern of moderation, but a milder level of interaction, is present between *stimulation* and gender. The abovementioned moderation role of gender seems to be stronger self-regulation for female students in types of motivation that directly affect achievements, and ultimately they are an indicator of higher motivation for female students, which indicates the importance of gender as a moderator in L2 learning.

Identified regulation and gender are closely related to success in L2 learning, since identified motivation has been understood as a behaviour that someone accepts due to its importance and the expected benefit in the future. Thus, female students have a more pronounced practical side in self-regulation because, as studies conclude, behaviour caused by *identified regulation* is not induced by internal need, so the outcome of this type of regulation is a lower level of self-determination (Baard et al., 2004; Jang et al., 2010; Alastair and Meng, 2024). Essential motivation is *intrinsic motivation* that involves research, curiosity, learning objectives, and performing activities for pleasure and satisfaction while learning, researching, or trying to understand something. It raises the question of the relationship between these types of motivation, and ultimately the seven-factor model of self-regulation, which is also confirmed in this research. The question arises as to whether Allport's (1950) understanding of autonomy of motives is essentially

identified here, which can logically explain these findings. Allport believes that the human dynamic system is unlimited, which explains the diversity and the large number of motives. He considers functional autonomy as the possibility that certain forms of behaviour, which served to satisfy some primary motive, may become a goal and acquire motivational properties over time. Thus, an activity that is originally related to satisfying some motive can eventually become autonomous and become the objective itself. If so, and there is a basis for such a claim, it is very important in L2 teaching because it confirms the path that can be followed from external to internal motivation, which is not only educationally more effective but has multiple psychological effects (sense of self-efficacy, self-esteem, emotional stability, absence of stress, etc.). This certainly requires a new research pattern with a focus on the above question.

Moderation analysis shows that the age of starting L2 learning moderates the relationship between *external regulation and grade, and knowledge and evaluation, so the types of extinct and intrinsic motivation are closely related*. It is also interesting that, in general, those who started earlier have higher grades in L2. However, *achievement* is the highest at higher levels of *external regulation* as motivation to learn, to be efficient, and to be task-oriented, which is characterized by learning due to the need to communicate with the environment in order to feel competent (Deci and Ryan, 1991), engage in activities out of pleasure, and find satisfaction in attempts at self-realisation after mastering complex training techniques and the like. A sense of personal satisfaction is created while communicating in L2 or participating in scientific meetings inEnglish for Specific Purposes, etc., which is essentially close to the intrinsic level of motivation. It can be understood because practical motives that fall into the domain of extrinsic motivation lead to self-realisation, and its consequence is a sense of satisfaction gained through achievement. Thus, it is the same pattern as in gender moderation.

The relationship is reversed in the case of those who started learning later. It considers moderation between *knowledge* and the age of starting L2 learning and indicates that levels of motivation *for knowledge are important for achievement* and that those with higher levels of motivation achieve high grades regardless of the age of starting L2 learning, while at lower levels of motivation, the age is more important. These types of motivation in this case are interrelated in a way that students who started learning later have clearer learning objectives, curiosity in discovering new elements and language structure, as well as other characteristics of motivation for knowledge that regulate intrinsic motivation for achievement, efficacy, and task orientation, which are realised in success in L2 learning. It could be concluded that these cases contributed to differences in motivational orientations or types of motivation between ESP and other students and the level of indicators of self-regulation in L2 learning, which answered the research question on the types and extent of differences between ESP and other students. This also indicates the importance of applying didactic instructions in practise based on the type of student motivation. The obtained data also confirm a part of the first hypothesis, which refers to expectations that grades on the L2 achievement test correspond to types of motivation. It confirms our hypothesis regarding the influence of self-regulation on the academic performance of ESP students, namely that the grades obtained on L2 achievement examinations are contingent upon the nature of the motivation.

Moderation analysis also evaluated the significance of the variable relating to the respondents' type of faculty, in addition to gender and years of L2 learning. Namely, part of the students studied engineering sciences, while the other part studied social sciences, which could be significant for motivation and relations between the observed variables. Pragmatism and self-regulation in studying engineering sciences are encouraged by learning strategies, task solving, while broadness, flexibility, freedom of choice, and greater autonomy are more pronounced in social sciences.

This failed to confirm the second hypothesis, which considered that the age of starting L2 learning, years of L2 learning, and gender were insignificant factors in the relationship between the observed variables. It shows that more variables should be included in the research in order to better understand the phenomenon.

Conclusion

After interpreting the statistical analyzes, several basic conclusions could be drawn. First, the findings confirm that, on average, students show relatively low levels of amotivation and moderate levels of various aspects of motivation, with the highest scores received by *intrinsic (knowledge, achievement, and stimulation) and identified regulation*, indicating that students are well motivationally oriented, i.e., with

good motivational orientation and types of motivation that are significant predictors of self-regulation. It is an indicator of success in the L2 achievement test, i.e., high achievements in L2 learning, as well as overall success.

It is concluded that *identified regulation* stands out as a positive predictor, which indicates that motivation through identified regulation is associated with higher grades in L2 language and higher overall success. Thus, motivation as a source of self-regulation corresponds to the academic achievements of ESP students, and significant correlations are observed between academic and linguistic achievements and the types of motivation. This is evident in outcomes and, thus, in self-regulation as a factor of academic achievement. There are differences in motivational orientations, or types of motivation, between ESP and other students, which are indicators of self-regulation in L2 learning, as well as that types of motivation in learning are crucial for achievements in L2 learning.

One of the conclusions considers *identifiedregulation* as one of the external types of motivation and the closest to the intrinsic, thus related to the types of intrinsic motivation and to high achievements in overall success and L2 achievements. This finding is in accordance with Allport's theory of functional motives. In addition, this is important for the didactic implications of the findings, as it directs L2 teachers where to look for sources of motivation and build strategies appropriately. This is a powerful tool in their hands. It is a particularly important finding, as respondents are students learning English for specific purposes, and it is expected that the *identified regulation* and the other ones similar to the types of extrinsic motivation will appear rather than the intrinsic type, which is more present in philological studies. Therefore, these findings provide L2 teachers with a clear path, and they can direct self-regulation of L2 learning to the right course.

The age of starting L2 learning, years of L2 learning, and gender were insignificant factors in the relations between the observed variables. The research should incorporate more variables to gain a more comprehensive understanding of the phenomenon's complexity.Thus, we should further look for other factors of motivation and self-determination, which are below the perceptual surface of personality, in the structure of understanding the sense, purpose, and philosophy of life, based on which an individual accustoms themselves in life and from which stems self-regulation and contributing motivation.

Acknowledgement

The research has been conducted within the project "Improving the teaching process in the English language in fundamental disciplines" developed at the Department for Fundamental Disciplines in Engineering, Faculty of Technical Sciences, University of Novi Sad, Serbia.

Conflict of interests

The authors declare no conflict of interest.

Author contributions

Conceptualization J.Š. and V.B.; Methodology D.G. and J.Š.; Writing - original draft preparation D.G., V.B. and J.Š.; Writing - review and editing V.B., J.Š. and D.G.; Analysis, discussion and conclusion J.Š., D.G. and V.B.; All authors have read and agreed to the published version of the manuscript.

References

Al-Hoorie, A. H. (2024). Metamotivation: Self-regulating task–motivation fit. *Porta Linguarum: revista internacional de didáctica de las lenguas extranjeras*, 2. https://doi.org/10.30827/portalin.viIX.29880

Alastair, H. & Meng L. (2024). L2 motivation and self regulated learning: An integrated model, System, Vol. 123, 103301. https://doi.org/10.1016/j.system.2024.103301

Allport, G.W. (1950): *The individual and his religion*, New York: Macmillan.

Baard, P. P., Deci, E. L., & Ryan, R. M. (2004). Intrinsic need satisfaction: a motivational basis of performance and weil-being in two work settings 1. *Journal of applied social psychology*, *34*(10), 2045-2068. https://doi.org/10.1111/j.1559-1816.2004.tb02690.x

Baumert, J., Lehmann, R., Lehrke, M., Clausen, M., Hosenfeld, I., & Neubrand, J. (Eds.) (1998). Testaufgaben Naturwissenschaften TIMSS 7./8. Klasse (Population 2) [TIMSS science items for 7th/8th grade (population 2)], Max-Planck-Institut für Bildungsforschung, Berlin

Crnjak, K. (2019). *Povezanost motivacije studenata s različitim aspektima prilagodbe na studij* (Doctoral dissertation, University of Zagreb. Department of Croatian Studies. Division of Psychology). https://repozitorij.hrstud.unizg.hr/islandora/object/hrstud:1902/datastream/PDF

Cortazzi, M., & Jin, L. X. (1999). Cultural mirrors: Materials and methods in the EFL classroom. In E. Hinkel (Ed.), *Culture in second language teaching and learning* (pp. 196-219). Cambridge: Cambridge University Press.

Deci, E. L. (1975). Intrinsic motivation Plenum Press. *New York, NY.* https://doi.org/10.1007/978-1-4613-4446-9

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic Motivation and Self-Determination in Human Behavior.* New York, NY: Plenum. https://doi.org/10.1007/978-1-4899-2271-7

Deci, E. L., & Ryan, R. M. (1991). A motivational approach to self: Integration in personality. In R. A. Dienstbier (Ed.), *Nebraska Symposium on Motivation, 1990: Perspectives on motivation (pp. 237–288). University of Nebraska Press.*

Dörnyei, Z. (1990). Conceptualizing motivation in foreign-language learning. *Language learning*, *40*(1), 45-78. https://doi.org/10.1111/j.1467-1770.1990.tb00954.x

Dörnyei, Z. (1994). Motivation and motivating in the foreign language classroom. *The modern language journal*, *78*(3), 273-284. https://doi.org/10.2307/330107

Dörnyei, Z. (1997). Psychological processes in cooperative language learning: Group dynamics and motivation. *The modern language journal*, *81*(4), 482-493. http://dx.doi.org/10.2307/328891

Dörnyei, Z. (1998). Motivation in second and foreign language learning. *Language teaching*, *31*(3), 117-135. http://dx.doi.org/10.1017/S026144480001315X

Dörnyei, Z. (2001a). Motivational Strategies in the Language Classroom. *Cambridge: Cambridge University Press.* http://dx.doi.org/10.1017/CBO9780511667343

Dörnyei, Z. (2001b). New themes and approaches in second language motivation research. *Annual Review of Applied Linguistics, 21*, 43-59. https://doi.org/10.1017/s0267190501000034

Dörnyei, Z. (2003). Attitudes, orientations, and motivations in language learning: Advances in theory, research, and applications. *Language learning*, *53*.

Dörnyei, Z. & Ushioda, E. (2011). *T*eaching and Researching Motivation. *2nd Edition*, *Pearson, Harlow*.

Gardner, R. C., Lalonde, R. N., & Moorcroft, R. (1985). The role of attitudes and motivation in second language learning: Correlational and experimental considerations. *Language learning*, *35*(2), 207-227. https://doi.org/10.1111/j.1467-1770.1985.tb01025.x

George, D. & Mallery, M. (2010). *SPSS for Windows Step by Step: A Simple Guide and Reference*, 7.0 update (10a ed.) B*oston: Pearson*. https://journals.sagepub.com/doi/10.1177/0013164492052004025

Gillet, N., Vallerand, R. J., & Lafrenière, M. A. K. (2012). Intrinsic and extrinsic school motivation as a function of age: The mediating role of autonomy support. *Social Psychology of Education*, *15*, 77-95.

Gojkov Rajić, A., Šafranj, J., Gojkov,G. & Stojanović, A., (2020). Motivacione strategije kao faktor uspeha akademski darovitih studenata, *Zbornik radova 26. okruglog stola o darovitima: Lična i socijalna perspektiva,* 26. jun 2020. Vršac. 26 (2021), p.38-81.

Gojkov-Rajić, A., Stojanović,A., Šafranj,J.&Gojkov,G. (2021a). *D*idaktički aspekti samoregulacije učenja darovitih*,* Monografija*, Srpska akademija obrazovanja, Beograd,* p.260.

Gojkov-Rajić, A., Šafranj, J.& Gojkov,G. (2021b). Relationship between didactic instructions and metacognition in foreign language learning. In: Herzog, J. (Ed.) *Giftedness in a Variaty of Educational Fields* (57-79). Verlag Dr. Kovač GmbH, Hamburg. ISBN 978-3-339-12195-0

Gojkov-Rajić, A., Šafranj, J., & Gak, D. (2023). Self-Confidence In Metacognitive Processes In L2 Learning, *International Journal of Cognitive Research in Science, Engineering and Education (IJCRSEE)*, 11(2), 1-13. https://doi.org/10.23947/2334-8496-2023-11-1-1-13

Hagger, M. S., & Chatzisarantis, N. L. D. (Eds.). (2007). Intrinsic motivation and self-determination in exercise and sport. *Human Kinetics.*

Henry, A. & Liu, M. (2023). Can L2 motivation be modelled as a self-system? A critical assessment *System*, 119, p. 103158. https://doi.org/10.1016/j.system.2023.103158

Henry, A., & Liu, M. (2024). L2 motivation and self regulated learning: An integrated model. *System*, *123*, 103301. https://doi.org/10.1016/j.system.2024.103301

Jandrić, D., Boras, K., & Šimić, Z. (2018). Rodne i dobne razlike u motivaciji i samoregulaciji učenja [Gender and age differences in motivation and self-regulated learning]. *Psihologijske Teme, 27*(2), 177–193. https://pt.ffri.hr/pt/article/view/384

Jang, H., Reeve, J., & Deci, E. L. (2010). Engaging students in learning activities: It is not autonomy support or structure but autonomy support and structure. *Journal of Educational Psychology, 102*(3), 588–600. https://doi.org/10.1037/a0019682

Mastoor, A. K. (2013). Second Language Motivation: The Role of Teachers in Learners' Motivation, *Journal of Academic and*

Applied Studies, 3(4) 45-54.

Mystkowska-Wiertelak, A., & Bielak, J. (2024). The link between learner engagement and self-regulation. A multiple case study. *International Journal of Applied Linguistics*, *34*(2), 709-727. pp. 1-19, https://doi.org/10.1111/ijal.12530

Niemiec, C. P., Ryan, R. M., & Deci, E. L. (2009). The path taken: Consequences of attaining intrinsic and extrinsic aspirations in post-college life. Journal of Research in Personality, 43(3), 291–306. https://doi.org/10.1016/j.jrp.2008.09.001

Noels, K. A., Pelletier, L. G., Clément, R., & Vallerand, R. J. (2000). Why are you learning a second language? Motivational orientations and self-determination theory. *Language learning*, *50*(1), 57-85. https://doi.org/10.1111/0023-8333.00111

Noels, K., Clément, R., & Pelletier, L. (2001). Intrinsic, extrinsic, and integrative orientations of French Canadian learners of English. *Canadian Modern Language Review*, *57*(3), 424-442. https://doi.org/10.3138/CMLR.57.3.424

Oga-Baldwin, W. L. Q., Parrish, A., & Noels, K. (2022). Taking root: Self-determination in language education. *Journal for the Psychology of Language Learning,* 4(1), 1–7. https://doi.org/10.52598/jpll/4/1/9

Ramos, D. P. R., & Habig, E. G. (2019). Measuring the academic motivation of selected first year nursing students: A preliminary study. *International Journal of Education and Research*, *7*(8), 173-182. https://www.ijern.com/journal/2019/August-2019/14.pdf

Reinders, H., Phung, L., Ryan, S. & Thomas, N. (2023). *The Key to Self-regulated Learning – a systematic approach to maximising its potential*, Oxford University Press.

Ryan, R. M., Connell, J. P., & Plant, R. W. (1990). *Emotions in nondirected text learning. Learning and Individual Differences, 2(1), 1–17.* https://doi.org/10.1016/1041-6080(90)90014-8

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*(1), 68–78. https://doi.org/10.1037/0003-066X.55.1.68

Ryan, R. M., Huta, V., & Deci, E. L. (2008). Living well: A self-determination theory perspective on eudaimonia. *Journal of Happiness Studies: An Interdisciplinary Forum on Subjective Well-Being, 9*(1), 139–170. https://doi.org/10.1007/s10902-006-9023-4

Sorić, I. (2014). Samoregulacija učenja: možemo li naučiti učiti [Self-regulation of learning: can we learn to learn], *Napredak*, 155(4) 467- 472.

Šafranj, J., Gojkov-Rajić, A., & Bogdanović, V. (2021). The ideal L2 self as a Factor of self-motivation in willingness to communicate, *International Journal of Cognitive Research in Science, Engineering and Education (IJCRSEE)*, 9(2), 189-202. https://doi.org/10.23947/2334-8496-2021-9-2-189-202

Utvær, B. K. S., & Haugan, G. (2016). The academic motivation scale: dimensionality, reliability, and construct validity among vocational students. *Nordic Journal of Vocational Education and Training*, *6*(2), 17-45. https://doi.org/10.3384/njvet.2242-458X.166217

Vallerand, R. J., Pelletier, L. G., Blais, M. R., Briere, N. M., Senecal, C., & Vallieres, E. F. (1992). The Academic Motivation Scale: A measure of intrinsic, extrinsic, and amotivation in education. *Educational and psychological measurement*, *52*(4), 1003-1017. https://doi.org/10.1177/0013164492052004025

Vallerand, R. J., Blanchard, C., Mageau, G. A., Koestner, R., Ratelle, C., Léonard, M., Gagne, M. &Marsolais, J. (2003). Les passions de l'âme: On obsessive and harmonious passion*. Journal of Personality and Social Psychology, 85(4), 756–767.* https://doi.org/10.1037/0022-3514.85.4.756

Vallerand, R. J. (2021). Reflections on the legacy of self-determination theory. *Motivation Science, 7*(2), 115–116. https://doi.org/10.1037/mot0000227

White, R. W. (1959). Motivation reconsidered: the concept of competence. *Psychological review*, *66*(5), 297. 297–333. https://doi.org/10.1037/h0040934

Williams, M. (1994). Motivation in foreign and second language learning: An interactive perspective. *Educational and Child Psychology,* 11,77-84.

Wolters, C. A., Iaconelli, R., Peri, J., Hensley, L. C., & Kim, M. (2023). Improving self-regulated learning and academic engagement: Evaluating a college learning to learn course. *Learning and Individual Differences*, *103*, 102282. https://doi.org/10.1016/j.lindif.2023.102282

Ziegler, A., Daunicht, T.M., &Quarda, A.K.(2021). Self-Regulation and Development of Potentials of the Gifted,27th Round Table on Giftedness Self-Regulation and Development of Potentials of the Gifted International Scientific Conference, Book of Abstracts, Vrsac. http://www.nauka.uskolavrsac.in.rs/wp-content/uploads/2021/06/Zbornik-rezimea-27-OS.pdf

Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory into practice*, *41*(2), 64-70. https://doi.org/10.1207/s15430421tip4102_2

Original scientific paper

Received: March 25, 2024.
Revised: July 12, 2024.
Accepted: July 30, 2024.

UDC:
378.147.091.32(597)
378-057.175
10.23947/2334-8496-2024-12-2-335-350

Check for updates

Building a Ranking System for Lecturers Based on Student Evaluations in Teaching a Specific Course: A Case Study at a University in Vietnam

Do Duc Trung[1], *Branislav Dudić*[2,3*], *Duong Van Duc*[1], *Nguyen Hoai Son*[1], *Alexandra Mittelman*[2]

[1] School of Mechanical and Automotive Engineering, Hanoi University of Industry, Hanoi, Vietnam,
e-mail: doductrung@haui.edu.vn, duongduc67@gmail.com, nguyenhoaison@haui.edu.vn
[2] Comenius University Bratislava, Faculty of Management, Slovakia,
e-mail: branislav.dudic@fm.uniba.sk, alexandra.mittelman@fm.uniba.sk
[3] Faculty of Economics and Engineering Management, Novi Sad, Serbia

Abstract: In the current landscape of higher education, the quality of teaching plays a crucial role in supporting the comprehensive development of students. To ensure the effectiveness of the learning process, evaluating lecturers based on student opinions is an essential means of providing feedback and optimizing the learning experience. This paper focuses on constructing a lecturer ranking system, particularly in the context of a specific course through the evaluation process from students. Four different methods were employed to assess lecturers, including the PSI method, SRP method, RAM method, and PIV method. The evaluation results using these four methods were compared with each other and also with the traditional evaluation approach currently utilized in the educational institution. The achieved results demonstrate that the approach outlined in this paper is highly suitable for determining the rankings of lecturers when teaching individual courses.

Keywords: *Lecturers ranking, MCDM, PSI, SRP, RAM, PIV*

Introduction

Ranking lecturers when multiple individuals teach a course plays a crucial role in ensuring the quality of education and the professional development of the teaching staff (Ventista and Brown, 2023; Ekinci et al., 2022). Each lecturer brings their own perspective and teaching style, and evaluating the quality of their teaching can help schools and students make more informed decisions about how they approach a specific course. Ranking lecturers not only helps identify the best teachers but also highlights issues that need addressing in the teaching process (Munna and Kalam, 2021). Highly rated lecturers may be considered for roles such as department heads, sharing effective teaching methods with colleagues, or even being invited to teach additional classes to expand their positive impact. Conversely, lecturers facing challenges may require support, additional training, or, in some cases, a reevaluation of their teaching abilities in that specific course. Ranking lecturers also aids schools in managing lecturer resources more effectively (Girvan et al., 2016). If any lecturer is assessed as unsuitable or not meeting the requirements for teaching a specific course, decisions to minimize or cease their teaching assignments may be made to optimize the quality of education. This not only helps avoid issues with teaching quality but also optimizes the professionalism and motivation of the teaching staff (Oliver and Reschly, 2017). In summary, ranking lecturers when multiple individuals teach a course is not only an assessment tool but also a means of managing and developing lecturer resources, ensuring diversity and quality in the teaching process.

If lecturer evaluations rely solely on the subjective opinions of managers or focus on specific criteria such as the number of published papers or participation in projects, important limitations may arise due to subjective managerial opinions and overlooking the complexity and diversity of lecturer roles. Some

*Corresponding author: branislav.dudic@fm.uniba.sk

universities in Vietnam have implemented lecturer evaluations based on students' evaluations of them. This approach is relatively novel, where lecturer evaluations are conducted within the university's education system, requiring each student to evaluate the lecturer who taught them if they wish to know their grades for that course. To clarify, students must evaluate their lecturers through a set of criteria provided by the management agency to access their grades for a specific course. Once all students have completed grading lecturers on each criterion, the education management system calculates the average value for each criterion for each lecturer and then computes the overall average score for the lecturer. However, calculating the overall average value for all criteria for each lecturer overlooks the importance of individual criteria. This means that not all criteria for evaluating lecturers are equally important; their significance varies depending on the characteristics of each course. For example, in practical courses, lecturers need good operational skills, while in theoretical courses, lecturers need extensive academic knowledge. To objectively evaluate lecturers based on multiple criteria, multi-criteria decision-making (MCDM) methods are considered, as they have been applied successfully in various fields (Kalyan and Pramanik, 2019; Malik et al., 2021; Ghorui et al., 2021).

MCDM is a technique for ranking available options to facilitate the selection of the best option and avoid the worst ones (Truong et al., 2023). With more than 200 existing MCDM methods, they have been applied to rank alternatives in various fields, from industry to transportation, healthcare, construction, and more (Trung and Tung, 2022). In the field of education, the application of MCDM methods has also been found in some studies. The PROMETHEE method has been used to rank teachers in a competition for excellent teaching (Monalisa and Kusnawi, 2017). Two methods, AHP and ARAS, have been used to rank lecturers based on criteria such as work experience, academic qualifications, etc. (Akmaludin et al., 2023). Ranking university departments using the RAPS method has been implemented. This research used criteria to describe each department, such as research productivity, total number of published chapters and articles in Scopus, total number of professors, total number of associate professors, etc. (Bafail et al., 2022). The TOPSIS method was used to select websites for online teaching during the Covid-19 period (Toan et al., 2021). The TOPSIS method has also been used to evaluate students' academic performance (Sirigiri et al., 2015). Applying the VIKOR method to rank universities based on student opinions has been carried out in (Ayyildiz et al., 2023), and so on.

This article employs MCDM methods to evaluate lecturers in each course based on student evaluations. The four MCDM methods used in this study include the PSI, SRP, RAM, and PIV methods, chosen for their distinct characteristics. The PSI method requires data normalization but does not require weighting for criteria (Maniya and Bhatt, 2010; Do et al., 2023). Recent studies have applied this method in various fields, such as ranking transportation companies (Ulutaş et al., 2021), selecting materials in mechanical manufacturing (Dua, 2024), developing decision systems for awarding student scholarships (Arifin and Saputro, 2022), and choosing plastic injection molding machines (Trung et al., 2024a). In contrast, the SRP method does not require data normalization but necessitates weighting for criteria (Zakeri et al., 2023), and is recommended for cases where the number of alternatives to be ranked is greater than 5 (Zakeri et al., 2024). Recent publications have successfully applied this method in selecting regression models for surface roughness in grinding (Thinh and Dua, 2024), choosing 3D printing materials (Mian et al., 2024), and evaluating the financial health of banks (Trung et al., 2024b).

RAM is a relatively new method, first introduced in September 2023, known for its ability to balance favorable and unfavorable criteria (Sotoudeh-Anvari, 2023). This method has been applied in various fields such as selecting cultivation methods for mushrooms (Trung et al., 2024c), choosing materials for gear manufacturing, materials for screw manufacturing, and lubricants for two-stroke engines (Dua et al., 2024), selecting options in mechanical manufacturing (Trung et al., 2024d), and ranking universities (Do, 2024). PIV is known for minimizing the phenomenon of rank reversal (Mufazzal and Muzakkir, 2018). Some of the most recent studies have successfully applied this method for selecting materials for crankshaft manufacturing (Nguyen et al., 2024), choosing materials for connecting rod manufacturing (Thinh and Mai, 2023), and comparing the impact of the Covid-19 pandemic on various countries (Komasi et al., 2024). When applying the RAM and PIV methods, both tasks of data normalization and weighting for criteria must be carried out. The normalization methods for data in RAM and PIV are different, and it's important to note that the data normalization method significantly affects the ranking of alternative options that need to be prioritized (Trung, 2022; Ha, 2023). The selection of the four methods, PSI, SRP, RAM, and PIV, takes advantage of their different characteristics and outstanding merits, aiming to rank lecturers accurately and objectively.

Materials and Methods

PSI Method

The application of the *PSI* method to rank alternatives is carried out in eight steps as follows (Maniya and Bhatt, 2010; Do et al., 2023).

Step 1: Construct a decision matrix with *m* rows and *n* columns, where *m* and *n* represent the number of alternatives to be ranked and the number of criteria for each alternative, respectively. Let x_{ij} denote the value of criterion *j* for alternative *i*, with *j = 1* to *n*, *i = 1* to *m*. The letters *B* and *C* are used to signify the benefit and cost criteria, respectively.

Step 2: Normalize the data using formulas (1) and (2).

$$n_{ij} = \frac{x_{ij}}{x_j^{max}} \; if \; j \epsilon B \tag{1}$$

$$n_{ij} = \frac{x_j^{min}}{x_{ij}} \; if \; j \epsilon C \tag{2}$$

Step 3: Calculate the average value of the normalized data using formula (3).

$$n = \frac{1}{m} \sum_{i=1}^{m} n_{ij} \tag{3}$$

Step 4: Determine the priority value from the average value using formula (4).

$$\varphi_j = \sum_{i=1}^{m} [n_{ij} - n]^2 \tag{4}$$

Step 5: Identify the deviation in priority values using formula (5).

$$\emptyset_j = 1 - \varphi_j \tag{5}$$

Step 6: Determine the overall priority value for criteria using formula (6).

$$\beta_j = \frac{\emptyset_j}{\sum_{j=1}^{n} \emptyset_j} \tag{6}$$

Step 7: Calculate the priority selection index for each alternative using formula (7).

$$\theta_i = \sum_{j=1}^{n} n_{ij} \cdot \beta_j \tag{7}$$

Step 8: Rank the alternatives based on the principle that the best alternative is the one with the highest θ_i.

SRP Method

To rank alternatives using the *SRP* method, four simple sequential steps need to be applied (Zakeri et al., 2023; Zakeri et al., 2024).

Step 1: Similar to Step 1 of the *PSI* method.

Step 2: Internally rank the alternatives for each criterion. For criterion *j*, the rank of alternative *i* is denoted as r_{ij}. Note that the internal ranking of alternatives uses only natural numbers, meaning r_{ij} □ *N*. This can be illustrated through a simple example. Suppose there are five alternatives to be ranked, namely A1, A2, A3, A4, and A5. There are three criteria describing each alternative, namely C1, C2, and C3. Among them, C1 and C2 are two benefit criteria, while C3 is a cost criterion. The illustrative data for this example is presented in Table 1.

Table 1. *Data to illustrate Step 2 of the SRP method*

Alternative	C1	C2	C3
A1	7	3	8
A2	5	6	2
A3	7.5	4	4
A4	5.4	6	2
A5	4.2	3	2

The internal ranking of alternatives is performed as follows.

- For C1 (B form): Since the values of this criterion for all five alternatives are different, the rankings of the alternatives are arranged in decreasing order of the criterion values in the alternatives, i.e., $r_{31} = 1$, $r_{11} = 2$, $r_{41} = 3$, $r_{21} = 4$, and $r_{51} = 5$.
- For C2 (B form): Since the criterion values at A2 and A4 are both equal to 6, $r_{22} = r_{42} = 1$, followed by $r_{32} = 2$. As the criterion values at A1 and A5 are also equal, $r_{12} = r_{52} = 3$.
- For C3 (C form): Since the criterion values at three alternatives A2, A4, and A5 are equal, $r_{23} = r_{43} = r_{53} = 1$, followed by $r_{33} = 2$ and $r_{13} = 3$.

Step 3: Calculate the score for each alternative using formula (8), where w_j is the weight of criterion j.

$$S_i = \sum_{j=1}^{n} r_{ij} \cdot w_j \tag{8}$$

Step 4: Rank the alternatives in ascending order based on their scores.

RAM Method

Ranking alternatives using the *RAM* method is performed in six steps as follows (Sotoudeh-Anvari, 2023).

Step 1: Similar to Step 1 of the *PSI* method.

Step 2: Normalize the data using formula (9).

$$r_{ij} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}} \tag{9}$$

Step 3: Calculate the normalized values considering the weights of the criteria according to (10).

$$y_{ij} = w_j \cdot r_{ij} \tag{10}$$

Step 4: Calculate the sum of normalized scores considering the weights of the criteria using (11) and (12).

$$S_{+i} = \sum_{j=1}^{n} y_{+ij} \quad if \quad j \in B \tag{11}$$

$$S_{-i} = \sum_{j=1}^{n} y_{-ij} \quad if \quad j \in C \tag{12}$$

Step 5: Calculate the score for each alternative using formula (13).

$$RI_i = \sqrt[2+S_{-i}]{2 + S_{+i}} \tag{13}$$

Step 6: Rank the alternatives in descending order based on their scores.

PIV Method

The *PIV* method employs six steps to rank alternatives (Mufazzal and Muzakkir, 2018).

Step 1: Similar to Step 1 of the *PSI* method.

Step 2: Calculate the normalized values using formula (14).

$$n_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \tag{14}$$

Step 3: Calculate the normalized values considering the weights of the criteria according to formula (15).

$$V_{ij} = w_j \times n_{ij} \tag{15}$$

Step 4: Evaluate the boundary weight index using formulas (16) and (17).

$$u_i = v_{\max} - v_i \quad if \quad j \in B \tag{16}$$

$$u_i = v_i - v_{\min} \quad if \quad j \in C \tag{17}$$

Step 5: Determine the overall neighboring value range using formula (18).

$$d_i = \sum_{j=1}^{n} u_i \tag{18}$$

Step 6: Rank the alternatives based on the principle that the best alternative is the one with the smallest deviation.

Based on the implementation steps of the four methods *PSI*, *SRP*, *RAM*, and *PIV* as described above, the block diagram illustrating the application of these four methods for ranking options is presented in Figure 1. Notably, when applying the *SRP*, *RAM*, and *PIV* methods, an additional task of calculating weights for the criteria is required, whereas the *PSI* method does not require the calculation of weights for the criteria.

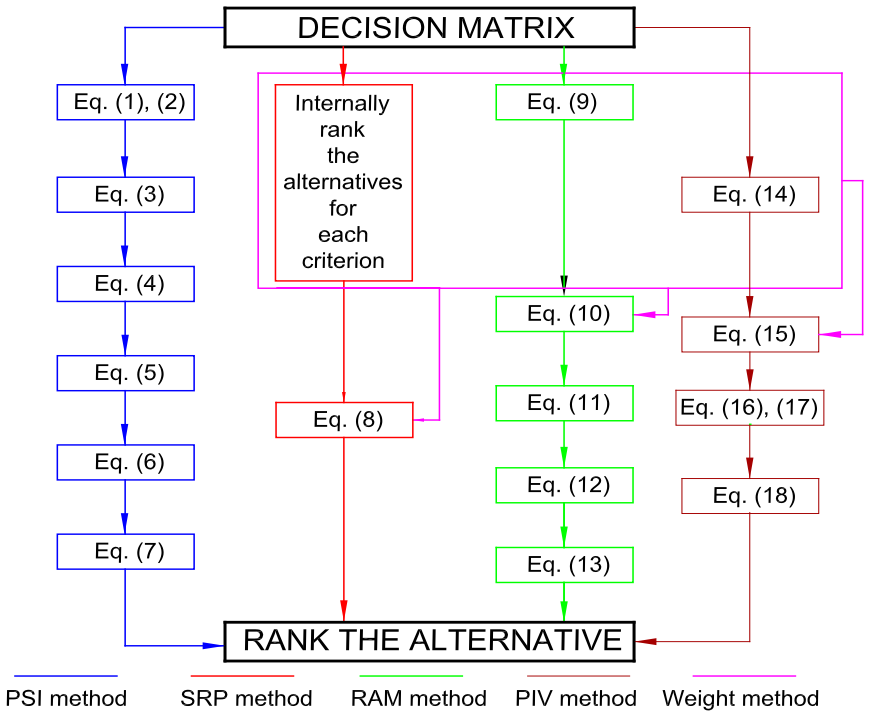

Figure 1. Block diagram for ranking options

Results

The selected course for this study is "Machine Manufacturing Technology Project" because it provides a flexible combination of direct classroom teaching and self-study at home. This allows students to directly interact with the fundamental knowledge conveyed by the lecturer, while also providing opportunities for in-depth research, application, and experimentation with the acquired knowledge. The course is appealing as students can apply learned knowledge to practical situations, showcasing their creativity and problem-solving skills. Additionally, lecturer guidance during project execution is crucial, helping students gain a deeper understanding of the machine manufacturing process and enhancing teamwork skills. Furthermore, the ability to ask questions through applications is a significant advantage, enabling quick access to information and problem-solving.

To view the grades of a course on the education system, each student needs to evaluate the lecturer who taught them based on seventeen established criteria. Evaluation scores for each criterion range from 0 to 5, where a higher score indicates better fulfillment of that criterion. This means that all seventeen criteria fall into the *B* category.

C1: The lecturer consistently prepares well for each class.

This criterion emphasizes the importance of preparation for the teaching process. When lecturers invest time and effort in thorough preparation for classes, they can create a quality learning environment, enhancing students' understanding and interest in the content. Preparation also helps lecturers be adaptable to unexpected situations and improves effective communication. Students perceive this preparation through clear and accurate lectures, playing a vital role in building trust and respect for the lecturer.

C2: Lessons are structured and organized systematically.

The importance of structuring and organizing lessons lies in helping students understand and absorb content in an organized and coherent manner. When lectures are systematically constructed, students can easily follow and organize information. Logical connections between teaching sections help students gain a deeper understanding and connect knowledge, forming a solid foundation. Lesson structure also helps students predict lesson content, providing reassurance and confidence while promoting focus and learning efficiency.

C3: The lecturer teaches with passion.

Passion in teaching is not only a powerful motivator but also creates a positive learning environment. When lecturers convey knowledge with enthusiasm, they inspire students and encourage creative thinking. The excitement of the lecturer can spread and stimulate curiosity and learning enthusiasm in students. Passion also helps lecturers overcome challenges in the teaching process, creating a positive environment that fosters students' comprehensive development.

C4: The lecturer motivates students to study this course.

This highlights the importance of lecturers playing a significant role in motivating students. When lecturers stimulate students' interest and desire to study, they create a positive environment, enhancing self-reliance and responsibility in the learning process. Motivation can arise from solving real-world problems, applying knowledge to practical situations, or even the recognition of the value of the course for personal and career development.

C5: Students are timely supported with the syllabus and official materials of the course.

The importance of supporting students in accessing the syllabus and learning materials is crucial to ensure they have the necessary information. Timely support helps students overcome difficulties and enhances their understanding and application of knowledge. Providing official materials ensures consistency in information transmission, making it easier for students to follow and review.

C6: Course materials are easily searchable and regularly updated.

The ease of searching and updating course materials plays a significant role in optimizing students' study time. When materials are well-organized and easy to search, students can quickly access the information they need, enhancing efficiency in the review and grasp of knowledge. Regular updates ensure that materials reflect the latest progress in the course field, helping students maintain continuity and apply knowledge to real-life situations.

C7: Lecturers provide sufficient, clear overall content information and distribute the course schedule before teaching.

Providing sufficient and clear information before class emphasizes the importance of preparation and transparency in the teaching process. Students can better prepare when they know the content and schedule of the course, allowing them to manage their study time more effectively. This transparency creates a collaborative learning environment, where lecturers and students can work together effectively.

C8: Lecturers provide sufficient, clear course outcomes before teaching.

Course outcomes are an essential indicator of the knowledge and skills students will acquire after completing the course. Clear communication about course outcomes helps students understand the course's objectives and shape an appropriate study plan. Simultaneously, lecturers can align expectations and evaluate learning outcomes fairly and transparently.

C9: Lecturers start class on time, ensuring the time and teaching volume follow the course syllabus.

Ensuring timeliness and the teaching volume not only creates a disciplined learning environment but also helps students manage their study time effectively. When lecturers start classes on time and adhere to the course syllabus, students can rely on the schedule to prepare and actively participate in classes. Accuracy and consistency in teaching contribute to the stability and quality of the learning process.

C10: Lecturers guide you on study methods when starting the course.

The importance of guiding students on study methods at the beginning of a course is to help them create a study plan that suits their learning style. This not only enhances students' autonomy in the learning process but also lays the foundation for developing self-learning skills, a crucial factor in their overall learning journey.

C11: The lecturer's teaching method is understandable and effective.

The effectiveness and clarity of teaching methods are decisive factors in students' understanding and absorption. When lecturers apply teaching methods appropriate to the target audience, information delivery becomes smooth and vibrant. This method helps students form a comprehensive view of the course and enhances the ability to apply knowledge to real-life situations, creating a tight connection between theory and practice.

C12: Lecturers create opportunities for you to actively participate in the learning process.

The importance of lecturers creating opportunities for students to actively participate lies in encouraging interaction and positivity in the learning process. When students have the opportunity to discuss, ask questions, and contribute opinions, they not only enhance understanding but also develop communication and critical thinking skills. Active participation helps students become confident and enjoy the learning process, creating a motivating and supportive learning environment.

C13: Student academic performance is evaluated through various forms and aligns with the course outcomes.

The diversity in evaluating academic performance and alignment with course outcomes is crucial to ensuring accuracy and fairness in the evaluation process. When lecturers use various assessment methods such as exams, projects, presentations, or group discussions, students have the opportunity to demonstrate their skills and knowledge from different perspectives. This not only strengthens the learning process but also creates conditions for the multidimensional development of subject competencies.

C14: Feedback from tests and evaluations helps you improve academic performance.

Feedback is an essential part of the learning process, helping students understand more about their level of success and areas for improvement. When lecturers provide detailed and constructive feedback, students can self-assess their abilities and performance, thereby seeking ways to improve. Accurate and constructive feedback not only supports the current learning process but also serves as a foundation for continuous development and lifelong learning.

C15: The lecturer's teaching method stimulates students' critical thinking and problem-solving abilities.

The importance of stimulating students' critical thinking and problem-solving abilities lies in helping them develop crucial skills for the real world. When lecturers create lectures and activities that encourage logical thinking, information analysis, and problem-solving, students not only learn a subject but also

develop essential skills for their careers and daily lives.

C16: I learned a lot about the course from the lecturer.

This statement reflects the success of conveying knowledge and creating a positive learning experience. When students perceive the learning and personal development through the lecturer, they tend to positively evaluate the learning process and consider the course as an essential part of their educational journey.

C17: General Evaluation - The lecturer is highly suitable for teaching this course.

The overall evaluation is the final and comprehensive result of the lecturer's success in teaching this course.

Data extraction from the university's training management system on the scores of the seventeen criteria for eight lecturers teaching the Machine Manufacturing Technology Project course is presented in Table 2.

Table 2. Synthesized comments from students for each lecturer (source: author's compilation)

Lecturers	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17
L1	4.67	4.7	4.7	4.7	4.7	4.73	4.67	4.7	4.73	4.73	4.67	4.67	4.7	4.7	4.7	4.67	4.67
L2	4.58	4.54	4.54	4.46	4.51	4.55	4.6	4.54	4.57	4.52	4.55	4.6	4.55	4.48	4.57	4.6	4.65
L3	4.66	4.63	4.68	4.63	4.76	4.71	4.68	4.74	4.76	4.68	4.74	4.74	4.74	4.74	4.76	4.76	4.76
L4	4.51	4.49	4.51	4.49	4.54	4.52	4.52	4.54	4.55	4.52	4.58	4.57	4.55	4.57	4.55	4.58	4.57
L5	4.82	4.77	4.88	4.85	4.86	4.92	5	4.85	5	5	5	5	5	5	5	4.98	4.97
L6	5	4.5	5	4.5	5	5	4.5	5	4.5	5	4.5	4.5	5	4.5	4.5	5	5
L7	4.76	4.68	4.76	4.68	4.72	4.76	4.8	4.72	4.8	4.76	4.76	4.8	4.72	4.64	4.76	4.72	4.76
L8	4.67	4.63	4.63	4.59	4.52	4.52	4.53	4.53	4.55	4.56	4.64	4.66	4.66	4.66	4.66	4.73	4.73

Currently, the university's management level relies on the data of the seventeen criteria in Table 2 to calculate the average scores for each lecturer and then rank the lecturers in Table 3. This result will be used for comparison with the lecturer rankings using the *MCDM* methods that this research is conducting.

Table 3. *Lecturer rankings using the traditional method*

Lecturers	Score	Rank
L1	4.69	5
L2	4.55	7
L3	4.72	4
L4	4.54	8
L5	4.94	1
L6	4.76	2
L7	4.74	3
L8	4.62	6

Applying the PSI method

Normalized values have been calculated using formulas (1) and (2), resulting in Table 4.

Table 4. *Normalized values in the PSI method*

Lecturers	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17
L1	0.9340	0.9853	0.9400	0.9691	0.9400	0.9460	0.9340	0.9400	0.9460	0.9460	0.9340	0.9340	0.9400	0.9400	0.9400	0.9340	0.9340
L2	0.9160	0.9518	0.9080	0.9196	0.9020	0.9100	0.9200	0.9080	0.9140	0.9040	0.9100	0.9200	0.9100	0.8960	0.9140	0.9200	0.9300
L3	0.9320	0.9706	0.9360	0.9546	0.9520	0.9420	0.9360	0.9480	0.9520	0.9360	0.9480	0.9480	0.9480	0.9480	0.9520	0.9520	0.9520
L4	0.9020	0.9413	0.9020	0.9258	0.9080	0.9040	0.9040	0.9080	0.9100	0.9040	0.9160	0.9140	0.9100	0.9140	0.9100	0.9160	0.9140
L5	0.9640	1.0000	0.9760	1.0000	0.9720	0.9840	1.0000	0.9700	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9960	0.9940
L6	1.0000	0.9434	1.0000	0.9278	1.0000	1.0000	0.9000	1.0000	0.9000	1.0000	0.9000	0.9000	1.0000	0.9000	0.9000	1.0000	1.0000
L7	0.9520	0.9811	0.9520	0.9649	0.9440	0.9520	0.9600	0.9440	0.9600	0.9520	0.9520	0.9600	0.9440	0.9280	0.9520	0.9440	0.9520
L8	0.9340	0.9706	0.9260	0.9464	0.9040	0.9040	0.9060	0.9060	0.9100	0.9120	0.9280	0.9320	0.9320	0.9320	0.9320	0.9460	0.9460

Applying formula (3) to calculate the average values of standardized data (n); priority values from the average values (φ_j) calculated using formula (4); deviation in priority values ($\varnothing_j$) calculated using formula (5); overall priority values for criteria calculated using formula (6). All calculated values have been summarized in Table 5.

Table 5. *Some parameters in PSI*

Par.	X1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17
n	0.9418	0.9680	0.9425	0.9510	0.9403	0.9428	0.9325	0.9405	0.9365	0.9443	0.9360	0.9385	0.9480	0.9323	0.9375	0.9510	0.9528
φ_j	0.0065	0.0031	0.0077	0.0051	0.0085	0.0092	0.0081	0.0078	0.0082	0.0106	0.0069	0.0068	0.0086	0.0076	0.0071	0.0070	0.0064
$\varnothing_j$	0.9935	0.9969	0.9923	0.9949	0.9915	0.9908	0.9919	0.9922	0.9918	0.9894	0.9931	0.9932	0.9914	0.9924	0.9929	0.9930	0.9936
β_j	0.0589	0.0591	0.0588	0.0590	0.0588	0.0587	0.0588	0.0588	0.0588	0.0586	0.0588	0.0589	0.0587	0.0588	0.0588	0.0588	0.0589

The preference selection index (q_i) for each lecturer has been calculated using formula (7), resulting in Table 6. The ranking of each lecturer has also been arranged based on their q_i values and has been placed in the last column of this table.

Table 6. *Preference selection index (q_i) and rankings of lecturers*

Lecturers	θi	Rank
L1	0.9433	5
L2	0.9149	7
L3	0.9475	4
L4	0.9120	8
L5	0.9915	1
L6	0.9571	2
L7	0.9526	3
L8	0.9275	6

Applying the SRP method

The internal ranking of lecturers has been carried out according to step 2, resulting in Table 7.

Table 7. *Internal rankings of lecturers using the SRP method*

Lecturers	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17
L1	4	2	4	2	5	4	4	5	4	3	4	4	4	3	3	6	5
L2	6	5	7	8	8	6	5	6	5	6	7	6	6	8	5	7	6
L3	5	4	5	4	3	5	3	3	3	4	3	3	2	2	2	3	3
L4	7	7	8	7	6	7	7	6	6	6	6	7	6	6	6	8	7
L5	2	1	2	1	2	2	1	2	1	1	1	1	1	1	1	2	2
L6	1	6	1	6	1	1	8	1	7	1	8	8	1	7	7	1	1
L7	3	3	3	3	4	3	2	4	2	2	2	2	3	5	2	5	3
L8	4	4	6	5	7	7	6	7	6	5	5	5	5	4	4	4	4

Individual scores (S_i) for each lecturer have been calculated using (8), where the weights of the criteria are chosen to be equal, meaning each criterion has a weight of 1/17. The scores and rankings of lecturers have been consolidated in Table 8.

Table 8. *Scores and rankings of lecturers*

Lecturers	S_i	Rank
L1	3.8824	5
L2	6.2941	7
L3	3.3529	3
L4	6.6471	8
L5	1.4118	1
L6	3.8824	4
L7	3.0000	2
L8	5.1765	6

Applying the RAM method

Normalized values have been calculated using (9), resulting in Table 9.

Table 9. *Normalized values in the RAM method*

Lecturers	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17
L1	0.1240	0.1272	0.1247	0.1274	0.1250	0.1254	0.1252	0.1249	0.1263	0.1252	0.1247	0.1244	0.1239	0.1260	0.1253	0.1228	0.1225
L2	0.1216	0.1229	0.1204	0.1209	0.1199	0.1207	0.1233	0.1207	0.1220	0.1197	0.1215	0.1225	0.1200	0.1201	0.1219	0.1209	0.1220
L3	0.1237	0.1253	0.1241	0.1255	0.1266	0.1249	0.1255	0.1260	0.1271	0.1239	0.1266	0.1263	0.1250	0.1271	0.1269	0.1251	0.1249
L4	0.1197	0.1215	0.1196	0.1217	0.1207	0.1199	0.1212	0.1207	0.1215	0.1197	0.1223	0.1217	0.1200	0.1226	0.1213	0.1204	0.1199
L5	0.1280	0.1291	0.1294	0.1314	0.1292	0.1305	0.1340	0.1289	0.1335	0.1324	0.1335	0.1332	0.1319	0.1341	0.1333	0.1309	0.1304
L6	0.1327	0.1218	0.1326	0.1220	0.1329	0.1326	0.1206	0.1329	0.1201	0.1324	0.1202	0.1199	0.1319	0.1207	0.1200	0.1314	0.1312
L7	0.1264	0.1267	0.1263	0.1268	0.1255	0.1262	0.1287	0.1255	0.1281	0.1260	0.1271	0.1279	0.1245	0.1244	0.1269	0.1241	0.1249
L8	0.1240	0.1253	0.1228	0.1244	0.1202	0.1199	0.1214	0.1204	0.1215	0.1207	0.1239	0.1241	0.1229	0.1250	0.1243	0.1243	0.1241

Normalized values, considering the weights of criteria, have been calculated using (10). Here, the weights of each criterion have also been chosen to be equal (1/17), resulting in Table 10.

Table 10. *Normalized values considering the weights of criteria (in the RAM method)*

Lecturers	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17
L1	0.0073	0.0075	0.0073	0.0075	0.0074	0.0074	0.0074	0.0073	0.0074	0.0074	0.0073	0.0073	0.0073	0.0074	0.0074	0.0072	0.0072
L2	0.0072	0.0072	0.0071	0.0071	0.0071	0.0071	0.0073	0.0071	0.0072	0.0070	0.0071	0.0072	0.0071	0.0071	0.0072	0.0071	0.0072
L3	0.0073	0.0074	0.0073	0.0074	0.0074	0.0073	0.0074	0.0074	0.0075	0.0073	0.0074	0.0074	0.0074	0.0075	0.0075	0.0074	0.0073
L4	0.0070	0.0071	0.0070	0.0072	0.0071	0.0071	0.0071	0.0071	0.0071	0.0070	0.0072	0.0072	0.0071	0.0072	0.0071	0.0071	0.0071
L5	0.0075	0.0076	0.0076	0.0077	0.0076	0.0077	0.0079	0.0076	0.0079	0.0078	0.0079	0.0078	0.0078	0.0079	0.0078	0.0077	0.0077
L6	0.0078	0.0072	0.0078	0.0072	0.0078	0.0078	0.0071	0.0078	0.0071	0.0078	0.0071	0.0071	0.0078	0.0071	0.0071	0.0077	0.0077
L7	0.0074	0.0075	0.0074	0.0075	0.0074	0.0074	0.0076	0.0074	0.0075	0.0074	0.0075	0.0075	0.0073	0.0073	0.0075	0.0073	0.0073
L8	0.0073	0.0074	0.0072	0.0073	0.0071	0.0071	0.0071	0.0071	0.0071	0.0071	0.0073	0.0073	0.0072	0.0074	0.0073	0.0073	0.0073

Total normalized scores, considering the weights of criteria, have been calculated using (11) and (12); Individual scores for each lecturer have been obtained according to (13). Table 11 synthesizes the calculated values and the rankings of lecturers based on their scores (RI_j).

Table 11. *Some parameters in the RAM method and rankings of lecturers*

Lecturers	S_{+i}	S_{-i}	RI_i	Rank
L1	0.125002	0	1.4577	5
L2	0.121237		1.4564	7
L3	0.125559		1.4579	4
L4	0.120848		1.4563	8
L5	0.131401		1.4599	1
L6	0.126821		1.4584	2
L7	0.126235		1.4582	3
L8	0.122897		1.4570	6

Applying the PIV method

Standardized values have been calculated using (14), consolidated in Table 12.

Table 12. *Standardized values in the PIV method*

Lecturers	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17
L1	0.3505	0.3598	0.3524	0.3601	0.3532	0.3545	0.3539	0.3532	0.3569	0.3539	0.3526	0.3517	0.3504	0.3563	0.3543	0.3471	0.3464
L2	0.3437	0.3475	0.3404	0.3417	0.3390	0.3411	0.3486	0.3411	0.3449	0.3382	0.3436	0.3464	0.3392	0.3396	0.3445	0.3419	0.3450
L3	0.3497	0.3544	0.3509	0.3548	0.3578	0.3530	0.3547	0.3562	0.3592	0.3502	0.3579	0.3570	0.3533	0.3593	0.3588	0.3538	0.3531
L4	0.3385	0.3437	0.3382	0.3440	0.3412	0.3388	0.3425	0.3411	0.3433	0.3382	0.3458	0.3442	0.3392	0.3464	0.3430	0.3404	0.3390
L5	0.3617	0.3652	0.3659	0.3716	0.3653	0.3688	0.3789	0.3644	0.3773	0.3741	0.3775	0.3765	0.3727	0.3790	0.3769	0.3701	0.3687
L6	0.3753	0.3445	0.3749	0.3448	0.3758	0.3748	0.3410	0.3757	0.3396	0.3741	0.3398	0.3389	0.3727	0.3411	0.3392	0.3716	0.3709
L7	0.3572	0.3583	0.3569	0.3586	0.3547	0.3568	0.3638	0.3547	0.3622	0.3562	0.3594	0.3615	0.3519	0.3517	0.3588	0.3508	0.3531
L8	0.3505	0.3544	0.3472	0.3517	0.3397	0.3388	0.3433	0.3404	0.3433	0.3412	0.3504	0.3509	0.3474	0.3533	0.3513	0.3515	0.3509

Standardized values, considering the weights of criteria, have been calculated using (15), resulting in Table 13. Here, the weights of each criterion have also been chosen to be equal (1/17).

Table 13. *Standardized values considering the weights of criteria (in the PIV method)*

Lecturers	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17
L1	0.0206	0.0212	0.0207	0.0212	0.0208	0.0209	0.0208	0.0208	0.0210	0.0208	0.0207	0.0207	0.0206	0.0210	0.0208	0.0204	0.0204
L2	0.0202	0.0204	0.0200	0.0201	0.0199	0.0201	0.0205	0.0201	0.0203	0.0199	0.0202	0.0204	0.0200	0.0200	0.0203	0.0201	0.0203
L3	0.0206	0.0208	0.0206	0.0209	0.0210	0.0208	0.0209	0.0210	0.0211	0.0206	0.0211	0.0210	0.0208	0.0211	0.0211	0.0208	0.0208
L4	0.0199	0.0202	0.0199	0.0202	0.0201	0.0199	0.0201	0.0201	0.0202	0.0199	0.0203	0.0202	0.0200	0.0204	0.0202	0.0200	0.0199
L5	0.0213	0.0215	0.0215	0.0219	0.0215	0.0217	0.0223	0.0214	0.0222	0.0220	0.0222	0.0221	0.0219	0.0223	0.0222	0.0218	0.0217
L6	0.0221	0.0203	0.0221	0.0203	0.0221	0.0220	0.0201	0.0221	0.0200	0.0220	0.0200	0.0199	0.0219	0.0201	0.0200	0.0219	0.0218
L7	0.0210	0.0211	0.0210	0.0211	0.0209	0.0210	0.0214	0.0209	0.0213	0.0210	0.0211	0.0213	0.0207	0.0207	0.0211	0.0206	0.0208
L8	0.0206	0.0208	0.0204	0.0207	0.0200	0.0199	0.0202	0.0200	0.0202	0.0201	0.0206	0.0206	0.0204	0.0208	0.0207	0.0207	0.0206

The weight proximity index has been calculated using (16) and (17), resulting in Table 14.

Table 14. *Weight proximity index values in the PIV method*

Lecturers	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17
L1	0.0015	0.0003	0.0013	0.0007	0.0013	0.0012	0.0015	0.0013	0.0012	0.0012	0.0015	0.0015	0.0013	0.0013	0.0013	0.0014	0.0014
L2	0.0019	0.0010	0.0020	0.0018	0.0022	0.0020	0.0018	0.0020	0.0019	0.0021	0.0020	0.0018	0.0020	0.0023	0.0019	0.0017	0.0015
L3	0.0015	0.0006	0.0014	0.0010	0.0011	0.0013	0.0014	0.0011	0.0011	0.0014	0.0012	0.0012	0.0011	0.0012	0.0011	0.0010	0.0010
L4	0.0022	0.0013	0.0022	0.0016	0.0020	0.0021	0.0021	0.0020	0.0020	0.0021	0.0019	0.0019	0.0020	0.0019	0.0020	0.0018	0.0019
L5	0.0008	0.0000	0.0005	0.0000	0.0006	0.0004	0.0000	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001
L6	0.0000	0.0012	0.0000	0.0016	0.0000	0.0000	0.0022	0.0000	0.0022	0.0000	0.0022	0.0022	0.0000	0.0022	0.0022	0.0000	0.0000
L7	0.0011	0.0004	0.0011	0.0008	0.0012	0.0011	0.0009	0.0012	0.0009	0.0011	0.0011	0.0009	0.0012	0.0016	0.0011	0.0012	0.0010
L8	0.0015	0.0006	0.0016	0.0012	0.0021	0.0021	0.0021	0.0021	0.0020	0.0019	0.0016	0.0015	0.0015	0.0015	0.0015	0.0012	0.0012

The overall nearness value (d_i) for each lecturer has been calculated according to (18), resulting in Table 15. The ranking of each lecturer has also been determined based on their d_i values and has been consolidated in the last column of this table.

Table 15. *The d_i values and rankings of each lecturer*

Lecturers	d_i	rank
L1	0.0213	5
L2	0.0319	7
L3	0.0197	4
L4	0.0330	8
L5	0.0032	1
L6	0.0161	2
L7	0.0178	3
L8	0.0272	6

Therefore, the ranking of lecturers using the *PSI, SRP, RAM*, and *PIV* methods has been completed. The results of the rankings using the traditional method that the university is currently using are also used for comparison with the rankings obtained using these four methods. Figure 2 shows the lecturer rankings using different methods when the weights of the criteria are equal.

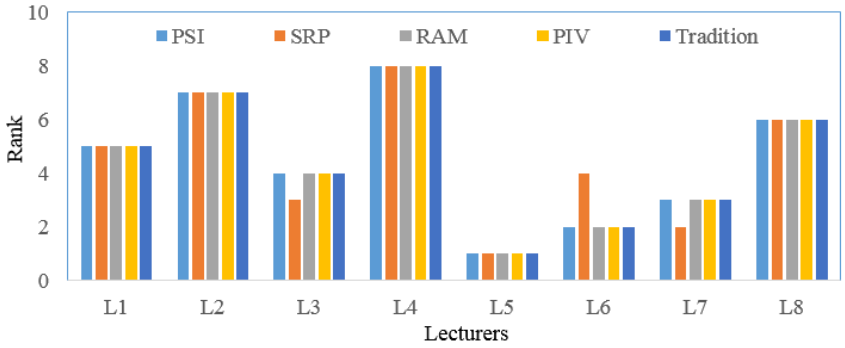

Figure 2. Rankings of lecturers using different methods when the weights of the criteria are equal

We observe that the rankings of lecturers when assessed by the *PSI, RAM*, and *PIV* methods are entirely identical and also completely match the rankings obtained through the traditional method used at the university. There is a slight difference in the rankings of lecturers when assessed by the *SRP* method compared to when using other methods. However, the lecturer rated as the best and the one rated as the worst when ranked by the *SRP* method always aligns with the rankings obtained using other ranking methods. The difference in rankings when using the *SRP* method compared to using other methods is explained by the fact that *SRP* only uses natural numbers for internal ranking of lecturers, reducing adaptability compared to normalizing data to generate real numbers (both natural and decimal) when using other methods.

The results achieved and the observations made apply when all selected criteria have equal weights (all equal to 1/17). However, to answer the question about the accuracy of results when weights of criteria are calculated using different methods, ranking of lecturers is necessary. Two methods, Entropy and *MEREC*, have been proposed with high accuracy in calculating weights for criteria (Trung and Thinh, 2021). They have also been widely used in recent studies (Hoang, 2023; Trung, 2021a; Trung, 2021b; Le et al., 2022), and they were selected for application in this research. The weights of each of the seventeen criteria for each lecturer, as determined by the Entropy and *MEREC* methods, can be found in Table 16.

Table 16. *Weights of criteria*

Weight method	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17
Entropy	0.0588	0.0591	0.0588	0.0591	0.0588	0.0588	0.0589	0.0588	0.0589	0.0587	0.0589	0.0588	0.0587	0.0589	0.0588	0.0587	0.0586
MEREC	0.0648	0.0422	0.0657	0.0503	0.0619	0.0624	0.0527	0.0556	0.0593	0.0645	0.0587	0.0628	0.0608	0.0592	0.0611	0.0559	0.0622

Ranking lecturers using the *SRP, RAM*, and *PIV* methods when the weights of criteria are calculated using the Entropy and *MEREC* methods has also been conducted similarly to when the weights of all criteria are equal, as we have previously performed. Figures 3 and 4 respectively represent the rankings of lecturers when the weights of criteria are calculated using the Entropy and *MEREC* methods. It is important to reiterate that since the *PSI* method is not related to the weights of criteria, the rankings of lecturers using this method are independent of the weights of criteria.

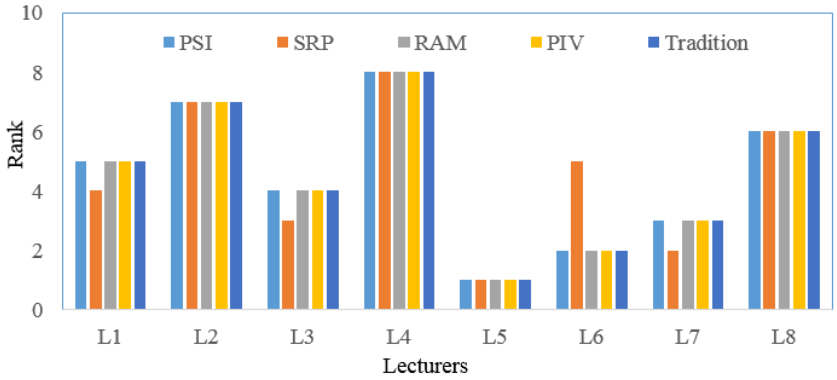

Figure 3. Rankings of lecturers using different methods when the weights of criteria are calculated using the Entropy method

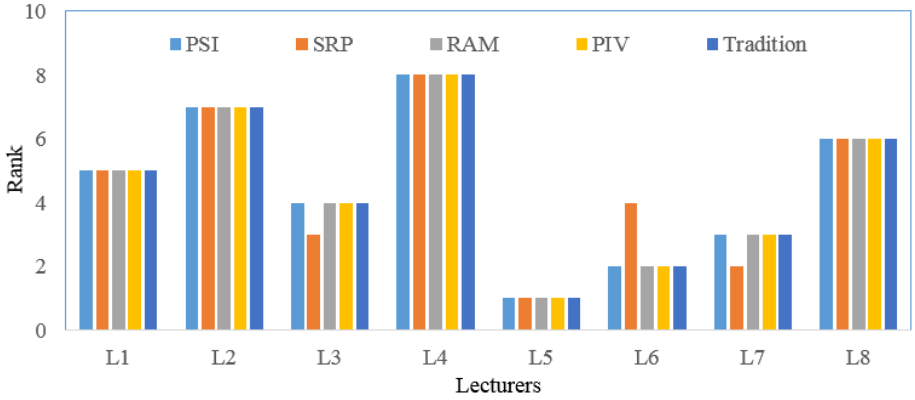

Figure 4. Rankings of lecturers using different methods when the weights of criteria are calculated using the MEREC method

From the observations in Figures 3 and 4, we also notice that the rankings of lecturers are entirely identical when ranked by the *PSI, RAM, PIV* methods, and the traditional method of the university, regardless of the weights of criteria. Furthermore, the ranking of each lecturer remains unchanged when the weights of criteria change (review all three Figures 2, 3, and 4). Moreover, the complete dissimilarity in rankings of lecturers when ranked by the *SRP* method compared to using other methods persists, as observed in Figure 2 above. However, the lecturer rated as Rank 1 and the lecturer rated as Rank 8 remain entirely identical when using different methods. All of these findings indicate that the application of the four methods *PSI, SRP, RAM*, and *PIV* is entirely appropriate for identifying the best lecturer for a course. The lecturer deemed least suitable for teaching a course will also be identified when applying these methods.

Discussions

The performance evaluation of university lecturers is a crucial issue in today's higher education system. Our study has demonstrated that methods such as *PSI, SRP, RAM*, and *PIV*, alongside traditional ranking methods, lead to comparable assessment outcomes for lecturers teaching mechanical engineering design projects. This consistency not only affirms the effectiveness of these methods but also underscores the reliability of the evaluation process.

We have identified that lecturers ranked as most and least suitable in teaching this course maintain their positions when different evaluation methods are applied throughout the academic year. This indicates the consistency and stability of the methods in assessing lecturer performance. The ability to expand the application of these evaluation methods from mechanical engineering design projects to other teaching fields not only enhances flexibility but also ensures the feasibility and effectiveness of the evaluation process.

In summary, our research not only addresses a specific issue but also opens avenues to explore and apply more effective teacher evaluation methods across different teaching domains, contributing to continuous improvement in the quality of higher education.

Conclusions

- ✓ The *PSI, RAM, PIV* methods, and the traditional ranking approach all lead to similar lecturer rankings, demonstrating consistency in evaluating their performance.
- ✓ The lecturer identified as the most suitable and least suitable for teaching the machine manufacturing technology project consistently maintains this position when using all four evaluation methods, including *PSI, SRP, RAM, PIV*, and the traditional ranking approach.
- ✓ There is potential to extend the application of the evaluation methods used in the machine manufacturing technology project to rank lecturers when teaching other courses, providing flexibility in the evaluation process.
- ✓ When determining the importance of different criteria, such as according to the opinions of university administrators, various methods for calculating weights, such as *PIPRECIA* (Dragisa et al., 2021), *LOPCOW* (Ecer and Pamucar, 2022), can be employed to ensure accuracy and adaptability to specific environments.
- ✓ In summary, the research has provided a comprehensive insight into the lecturer evaluation process in the machine manufacturing technology project and opens up opportunities to extend the application of these methods to other teaching areas.

Conflict of interests

The authors declare no conflict of interest.

Author Contributions

Do Duc Trung proposed the idea, Duong Van Duc and Nguyen Hoai Son contributed to data collection and analysis. Do Duc Trung and Alexandra Mittelman drafted the initial version. Branislav Dudić provided critical feedback on the work. All authors collaborated on revising the draft and reached consensus on the final version of the manuscript.

References

Akmaludin, A., Gernaria E., S., Rinawati, R., Arisawati, E., & Dewi, L., S. (2023). Decision Support for Selection of The Best Teachers Recommendations MCDM-AHP and ARAS Collaborative Methods. Sinkron: Jurnal dan Penelitian Teknik Informatika, 8(4), 2036-2048. https://doi.org/10.33395/sinkron.v8i4.12354

Arifin, N., & Saputro, P. H. (2022). Selection Index (PSI) Method in Developing a Student Scholarship Decision Support System. International Journal of Computer and Information System, 3(1), 12-16

Ayyildiz, E., Murat, M., Imamoglu, G., & Kose, Y. (2023). A novel hybrid MCDM approach to evaluate universities based on student perspective. Scientometrics, 128, 55-86. https://doi.org/10.1007/s11192-022-04534-z

Bafail, O., A., Abdulaal, R., M., S., & Kabli, M., R. (2022). AHP-RAPS Approach for Evaluating the Productivity of Engineering Departments at a Public University. *Systems*, 10(107). https://doi.org/10.3390/systems10040107

Do, D. T. (2024). Assessing the Impact of Criterion Weights on the Ranking of the Top Ten Universities in Vietnam. *Engineering, Technology & Applied Science Research*, 14(4), 14899-14903. https://doi.org/10.48084/etasr.7607

Do, D., T., Tran, V., D., Duong, V., D., & Nguyen, N., T. (2023). Investigation of the appropriate data normalization method for combination with Preference Selection Index method in MCDM. *Operational Research in Engineering Sciences: Theory and Applications*, 6(1), 44-64. https://oresta.org/menu-script/index.php/oresta/article/view/329

Dragisa, S., Darjan, K., & Gabrijela, P. (2021). Ranking alternatives using PIPRECIA method: A case of hotels' website evaluation. *Journal of Process Management and New Technologies*, 9(3-4), 62-68. https://doi.org/10.5937/jouproman2103062S

Dua, T. V. (2024). PSI-SAW and PSI-MARCOS Hybrid MCDM Methods. *Engineering, Technology & Applied Science Research*, 14(4), 15963-15968. https://doi.org/10.48084/etasr.7992

Dua, T. V., Duc, D. V., Bao, N. C., & Trung, D. D. (2024). Integration of objective weighting methods for criteria and MCDM methods: application in material selection. *EUREKA: Physics and Engineering*, 2, 131–148. https://doi.org/10.21303/2461-4262.2024.003171

Ecer, F., & Pamucar, D. (2022). A novel LOPCOW-DOBI multi-criteria sustainability performance assessment methodology: An application in developing country banking sector. *Omega*, 112, Art. No. 102690. https://doi.org/10.1016/j.omega.2022.102690

Ekinci, Y., Orbay, B.Z., & Karadayi, M. A. (2022). An MCDM-based game-theoretic approach for strategy selection in higher education. *Socio-Economic Planning Sciences*, 81, 101186. https://doi.org/10.1016/j.seps.2021.101186

Ghorui, N., Ghosh, A., Mondal, S. P., Kumari, S., Jana, S., & Das, A. (2021). Evaluation Of Performancefor School Teacher Recruitment Using MCDM Techniques With Interval Data. *Multicultural Education*, 7(5), 380-395. https://doi.org/10.5281/zenodo.4837226

Girvan, C. Conneely, C., & Tangney, B. (2016). Extending experiential learning in teacher professional development. *Teaching and Teacher Education*, 58, 129-139. https://doi.org/10.1016/j.tate.2016.04.009

Ha, L., D. (2023). Selection of Suitable Data Normalization Method to Combine With the CRADIS Method for Making Multi-Criteria Decision. *Applied Engineering Letters*, 8(1), 24-35. https://doi.org/10.18485/aeletters.2023.8.1.4

Hoang, X., T. (2023). Multi-objective optimization of turning process by FUCA method. *Strojnícky časopis - Journal of Mechanical Engineering*, 73(1), 55-66. https://doi.org/10.2478/scjme-2023-0005

Kalyan, M., & Pramanik. S. (2019). Multi-criteria Group Decision Making Approach for Teacher Recruitment in Higher Education under Simplified Neutrosophic Environment. *Neutrosophic Sets and Systems*, 6, 28-34.

Komasi, H., Nemati, A., Hashemkhani Zolfani, S., Williams, N. L., & Bazrafshan, R. (2024). Investigating the effects of COVID-19 on tourism in the G7 countries. *Technological and Economic Development of Economy*, 30(4), 1064–1086. https://doi.org/10.3846/tede.2024.20821

Le, H. A., Hoang, X. T., Trieu, Q. H., Pham, D. L., & Le, X. H. (2022). Determining the Best Dressing Parameters for External Cylindrical Grinding Using MABAC Method. *Applied scicences*, 12(16), 8287. https://doi.org/10.3390/app12168287

Malik, D. A. A., Yusof, Y., & Khalif, K. M. N. K. (2021). A view of MCDM application in education. *Journal of Physics: Conference Series*, 1988, 012063. https://doi.org/10.1088/1742-6596/1988/1/012063

Maniya, K., & Bhatt, M.G. (2010). A selection of material using a novel type decisionmaking method: Preference selection index method. *Materials & Design*, 31(4), 1785-1789. https://doi.org/10.1016/j.matdes.2009.11.020

Mian, S. H., Nasr, E. A., Moiduddin, K., Saleh, M., Abidi, M. H., & Alkhalefah, H. (2024). Assessment of consolidative multi-criteria decision making (C-MCDM) algorithms for optimal mapping of polymer materials in additive manufacturing: A case study of orthotic application. *Heliyon*, 10, Art. No. e30867. https://doi.org/10.1016/j.heliyon.2024.e30867

Monalisa, R., & Kusnawi, K. (2017). Decision support system of model teacher selection using PROMETHEE method. *International Conference on Innovative and Creative Information Technology (ICITech)*. https://doi.org/10.1109/INNOCIT.2017.8319147

Mufazzal, S., & Muzakkir, S., (2018). A New Multi-Criterion Decision Making (MCDM) Method Based on Proximity Indexed Value for Minimizing Rank Reversals. *Computers & Industrial Engineering*, 119, 427-438. https://doi.org/10.1016/j.cie.2018.03.045

Munna, A. S., & Kalam, M. A. (2021). Teaching and learning process to enhance teaching effectiveness: a literature review. *International Journal of Humanities and Innovation (IJHI)*, 4(1), 1-4. https://doi.org/10.33750/ijhi.v4i1.102

Nguyen, H. S., Hieu, T. T., Thang, N. M., Tan, H. N., Can, N. T., Thao, P. T., & Bao, N. C. (2024). Selection of Crankshaft Manufacturing Material by the PIV Method. *Engineering, Technology & Applied Science Research*, 14(4), 14848-14853. https://doi.org/10.48084/etasr.7514

Oliver, R. M., & Reschly, D. J. (2007). Effective Classroom Management: Teacher Preparation and Professional Development, *National Comprehensive Center for Teacher Quality*, Washington, USA.

Sirigiri, P., Hota, H.,S., & Sharma, L., K. (2015). Students Performance Evaluation using MCDM Methods through Customized Software. *International Journal of Computer Applications*, 130(15), 11-14. https://doi.org/10.5120/ijca2015907171

Sotoudeh-Anvari, A. (2023). Root Assessment Method (RAM): A novel multi-criteria decision making method and its applications in sustainability challenges. *Journal of Cleaner Production*, 423, Art. No. 138695. https://doi.org/10.1016/j.jclepro.2023.138695

Thinh, H. X., & Mai, N. T. (2023). Comparison of two methods in multi-criteria decision-making: application in transmission rod material selection. *EUREKA: Physics and Engineering*, 6, 59–68. https://doi.org/10.21303/2461-4262.2023.003046

Thinh, H., X. & Dua, T. V. (2024). Optimal Surface Grinding Regression Model Determination with the SRP Method. *Engineering, Technology & Applied Science Research*, 14(3), 14713-14718. https://doi.org/10.48084/etasr.7573

Toan, P., N., Dang, T., T., & Hong, L., T., T. (2021). E-Learning Platform Assessment and Selection Using Two-Stage Multi-Criteria Decision-Making Approach with Grey Theory: A Case Study in Vietnam. *Mathematics*, 9(23), Art.No. 3136. https://doi.org/10.3390/math9233136

Trung, D. D., & Tung, N. N. (2022). Applying COCOSO, MABAC, MAIRCA, EAMR, TOPSIS and weight determination methods for multi-criteria decision making in hole turning process. *Strojnícky časopis - Journal of Mechanical Engineering*, 72(2), 15-40. https://doi.org/10.2478/scjme-2022-0014

Trung, D. D., Dudić, B., Duc, D. V., Son, N. H. & Ašonja, A. (2024). Comparison of MCDM methods effectiveness in the selection of plastic injection molding machines. *Teknomekanik*, 7(1), 1-19. https://doi.org/10.24036/teknomekanik.v7i1.29272

Trung, D. D., Dudić, B., Dung, H. T., & Truong, N. X. (2024). Innovation in financial health assessment: Applying MCDM techniques to banks in VIETNAM. *ECONOMICS - Innovative and Economics Research Journal*, 12(2). https://doi.org/10.2478/eoik-2024-0011

Trung, D. D., Duc, D. V., Bao, N. C., & Thuy, D. T. T. (2024). Using the root assessment method to choose the optimal solution for mushroom cultivation. *Yugoslav Journal of Operations Research*. https://doi.org/10.2298/YJOR240115007T

Trung, D. D., Dudić, B., Nguyen, N. T., & Ašonja, A. (2024). Data Normalization for Root Assessment Methodology. *International Journal of Industrial Engineering and Management*, 15(2), 156-168. https://doi.org/10.24867/IJIEM-2024-2-354

Trung, D., D. (2021). A combination method for multi-criteria decision making problem in turning. *Manufacturing review*, 8, Art. No. 26. https://doi.org/10.1051/mfreview/2021024

Trung, D., D. (2021). Application of TOPSIS and PIV methods for multi-criteria decision making in hard turning process. *Journal of Machine Engineering*, 21(4), 57–71. https://doi.org/10.36897/jme/142599

Trung, D., D. (2022). Expanding Data Normalization Method to CODAS Method for Multi-Criteria Decision Making. *Applied Engineering Letters*, 7(2), 54-66, https://doi.org/10.18485/aeletters.2022.7.2.2

Trung, D.D, & Thinh, H.X. (2021). A multi-criteria decision-making in turning process using the MAIRCA, EAMR, MARCOS and TOPSIS methods: A comparative study. *Advances in Production Engineering & Management*, 16(4), 443-456, https://doi.org/10.14743/apem2021.4.412

Truong, N. X., Ašonja, A., & Trung, D. D. Enhancing Handheld Polishing Machine Selection: An Integrated Approach of MACROS Methods and Weight Determination Techniques. *Applied Engineering Letters*, 8(3), 2023: 131-138. https://doi.org/10.18485/aeletters.2023.8.3.5

Ulutaş, A., Popovic, G., Radanov, P., Stanujkic, D., & Karabasevic, D. (2021). A new hybrid fuzzy PSI-PIPRECIA-COCOSO MCDM based approach to solving the transportation company selection problem. *Technological and Economic Development of Economy*, 27(5), 1227–1249. https://doi.org/10.3846/tede.2021.15058

Ventista, O. M., & Brown, C. (2023). Teachers' professional learning and its impact on students' learning outcomes: Findings from a systematic review. *Social Sciences & Humanities Open*, 8(1), 100565. https://doi.org/10.1016/j.ssaho.2023.100565

Zakeri, S., Chatterjee, P., Konstantas, D., & Ecer, F. (2023). A decision analysis model for material selection using simple ranking process. *Scientifc Reports*, 13, Art. No. 8631. https://doi.org/10.1038/s41598-023-35405-z

Zakeri, S., Chatterjee, P., Konstantas, D., & Ecer, F. (2024). A comparative analysis of simple ranking process and faire un Choix Adéquat method. *Decision Analytics Journal*, 10, Art. No. 100380. https://doi.org/10.1016/j.dajour.2023.100380

Original scientific paper

Received: March 07, 2024.
Revised: June 22, 2024.
Accepted: July 06, 2024.

UDC:
159.942:575.1
159.922
10.23947/2334-8496-2024-12-2-351-356

Check for updates

Genetic Correlates of Behavioral Self-Control: COMT and DRD2 Associations With Self-Regulation, Reflection and Meaningfulness of Life in Women

Pavel N. Ermakov[1], *Anastasia S. Kolenova*[1], *Ekaterina G. Denisova*[1*], *Anna M. Kukular*[1]

[1] Regional Scientific Center of the Russian Academy of Education, Southern Federal University, Rostov-on-Don, Russian Federation,
e-mail: paver@sfedu.ru, askolenova@gmail.com, denisovakeith@gmail.com, vetkina-anna@mail.ru

Abstract: The objective of our study was to investigate the genetic predictors of self-regulation and related characteristics indicative of a higher level of rational behavior control. The study 107 female participants aged between 22 and 52 years, with an average age of 33.5 years (Russian Federation). In order to measure level of self-regulation and other characteristics corresponding to a higher level of rational behavioral control the following psychological tests were employed: the "Differential Type of Reflection" questionnaire (Leontyev D.A.), the "Style of Self-Regulation of Behavior" questionnaire (Morosanova, Kholopova, 1995), and the Test of Life-Meaning Orientations (D.A. Leontyeva, 1988). Genotyping was use to examine polymorphisms of the COMT, DRD2 genes. Our findings demonstrate significant differences in the level of systemic reflection among carriers of different genotypes of the DRD2 and COMT genes. The highest level of systemic reflection in carriers of the CC genotype for the DRD2 gene and a heterozygous variant of the COMT gene suggests a balance between the elevated dopaminergic activity characteristic of the CC DRD2 genotype and moderate COMT activity, fostering optimal dopamine metabolism.

Keywords: *behavioral self-control, rational behavior, self-regulation, reflection, gene polymorphism, COMT, DRD2, psychogenetics*

Introduction

In today's dynamic world, understanding the genetic factors influencing human self-regulation is essential. Exploring the interplay between personal choices, habits, and the pursuit of rationality has become a focal point of modern society. Codependent behavior, characterized by irrational attitudes, impulsiveness, and reactivity in decision-making (Artemtseva, Malkina, 2022; Faizova, 2020; Stebakova, 2023), can be considered a model behavior for studying rationality and behavioral control. Furthermore, the ability to construct and sustain healthy long-term interpersonal relationships is integral to sustainable behavior (Pardee, 1990).

The semantic content of the term "codependency" has evolved over years of addiction research. Presently, codependency is not only perceived as cohabitation with a dependent person but more broadly as "behavior motivated by dependence on other people" (Barone, Leedom, 2017; Askian, Krauss, Baba et al., 2021; Vederhus, Kristensen, Timko, 2019). Current research, including our own, indicates that women in relationships with or connected to addicts exhibit high levels of anxiety, decreased self-esteem, and a propensity for using pseudo-compensations and psychological defense mechanisms. These factors can impact their adaptive capabilities in conditions of health impairment (Kolenova, Denisova, Kukulyar, Ermakov, 2023; Ismailova, 2020; Tulebaeva, 2020).

*Corresponding author: denisovakeith@gmail.com

Literature presents some controversy concerning the relationship between self-regulation and codependency. Medvedeva O.L.'s (2020) research discovered a negative relationship between self-regulation and mental health participants with low emotional intelligence, lacking experience as mental health professionals. This negative correlation extended to emotional intelligence. Krasnyatova Yu.A. and Stoyanova I.Ya. (2018) identified a negative relationship between self-regulation and codependency in women. Kupchenko V.E. (2020) demonstrated that mothers of chemical addicts with moderate codependency exhibit higher self-control compared to those with severe codependency. The level of codependency in individuals associated with substance users hinges on their ability to effectively regulate emotions (Berdichevsky, Padun, Gagarina, Arkhipova, 2021).

The field of behavioral genetics recognizes that genetic factors may underlie individual differences in self-regulation, including stress responses and the ability to regulate emotions, maintain internal balance, and make rational choices effectively. In psychogenetic research, significant attention is directed towards genes within neurotransmitter systems, particularly the dopaminergic system responsible for endogenous reinforcement of behavior. Studies have demonstrated that the DRD4 gene, regulating dopamine receptors, is associated with interest in social stimuli, impacting attention to social events and sensitivity to social rewards (Golimbet et al., 2005). Associations of the DRD2 gene have been identified with various aspects of cognitive abilities, such as long-term memory, attention, and information processing (Li, Bäckman, Persson, 2019). Variations in genes linked to the serotonin system, like 5-HTTLPR, may influence social sensitivity and responses to stressful situations (Alfimova et al., 2017; Kosonogov et al., 2018). Genes regulating monoamine catabolism, such as MAOA and COMT, are linked to the level of cognitive decline. Variants of these genes influence individual sensitivity to neurotransmitters and impact a range of cognitive processes, including emotional and executive functions (Mueller et al., 2014; Cha et al., 2022).

In summary, despite increasing interest, a comprehensive theory on the psychological and genetic factors shaping sustainable behavior remains elusive. Our study aims to explore the genetic predictors of self-regulation and related characteristics indicative of a higher level of rational behavior control.

Materials and Methods

Participants

The study involved 107 female participants aged between 22 and 52 years, with an average age of 33.5 years. Among them, 60 women aged 22 to 52 years (average age 35.3 years) were included, all of whom were either in a relationship or had a connection with an individual struggling with addiction, including alcoholism, drug addiction, or non-chemical addictions.

Research methods

In order to study the self-regulation, reflection, and the meaningfulness of life, the following psychological tests were employed: the "Differential Type of Reflection" questionnaire (Leontyev D.A.), the "Style of Self-Regulation of Behavior" questionnaire (Morosanova, Kholopova, 1995), and the Test of Life-Meaning Orientations (D.A. Leontyev, 1988).

Genetic predictors were examined using the method of molecular genetic analysis, considering the genotypes of the dopamine receptor DRD2 (rs1800497) and the COMT enzyme gene (Val158Met) as candidate genes. Genetic material (buccal epithelium) was collected from participants immediately after the completion of psychological diagnostics, primarily in the first half of the day. DNA analysis employed allele-specific polymerase chain reaction (PCR) with real-time detection.

Procedure

The study was conducted in person in online format from September 13, 2022, to March 20, 2023. The participation of respondents was voluntary. Prior to the study, goals of the study was explained to the respondents. Personal data has been anonymized.

Statistical data analysis

Statistical analysis involved the use of the Shapiro-Wilk test to assess normal distribution. Differences among subgroups were examined through ANOVA analysis of variance, with pairwise comparisons conducted using Dunn's method as a post hoc analysis. The JASP 0.16 software package was utilized for statistical processing.

Results

At the initial stage of data analysis, the percentage distribution of various genotypes in the sample was computed (Table 1).

Table 1. Quantitative distribution of the representation of various genotypes of the COMT and DRD2 genes

Genotypes N		Entire sample (N=107)		Codependents (N = 60)		Control group (N=47)	
		Percent	N	Percent	N	Percent	
COMT	MM	31	29%	15	25%	16	34%
	VM	50	47%	31	52%	19	40%
	VV	26	24%	14	23%	12	26%
DRD2	CC	63	59%	31	52%	32	68%
	CT	40	37%	26	43%	14	30%
	TT	4	3,5%	3	5%	1	2%

For the COMT gene, the sample revealed the smallest number of carriers of the homozygous variant MM (29%) and the largest number of carriers of the heterozygous variant VM (47%). No deviations from the Hardy-Weinberg equilibrium were detected. Concerning the DRD2 gene, the majority of the sample consisted of CC homozygotes (59%), CT heterozygotes accounted for 37%, and TT homozygotes represented only 4 people (3.5%). Analyzing genotype distribution between the control and experimental groups, it was observed that the number of MM homozygotes for the COMT gene was higher in the control group, while VM heterozygotes were more prevalent in the group of women in a relationship or related to an addict. For the DRD2 gene, a slightly higher percentage of CC homozygotes was noted in the control group, and CT heterozygotes were more prominent in the codependent group. However, no significant differences in the representation of different genotypes between the groups were detected.

Table 2. ANOVA Results

Depended variable	Factors	Sum of Squares	Mean Square	F	p	η²
General level of self-regulation	DRD2	5.733	5.733	0.046	0.831	4.501e-4
	COMT	376.119	188.059	1.505	0.227	0.030
	DRD2 ✻ COMT	239.255	119.628	0.958	0.387	0.019
	Residuals	12116.796	124.915			
Systemic reflection	DRD2	6.019	6.019	0.279	0.598	0.003
	COMT	23.422	11.711	0.543	0.583	0.010
	DRD2 ✻ COMT	213.429	106.715	4.949	0.009	0.091
	Residuals	2091.467	21.562			
Meaningfulness of Life	DRD2	1140.345	1140.345	3.462	0.066	0.035
	COMT	825.431	412.715	1.253	0.291	0.025
	DRD2 ✻ COMT	1155.676	577.838	1.754	0.179	0.036
	Residuals	29314.376	329.375			

To examine the significance of the effect of the genotypes of the studied genes and their interac-

tions on the level of self-regulation and other characteristics corresponding to a higher level of rational behavioral control, an ANOVA analysis of variance was conducted (Table 2). Since no significant differences in genotype representation were found in the control and experimental groups, ANOVA was carried out on the entire sample, without dividing into subgroups. Additionally, carriers of the TT genotype for the DRD2 gene were excluded from further analysis due to their small number.

The obtained effects can be visually represented as shown in Figure 1.

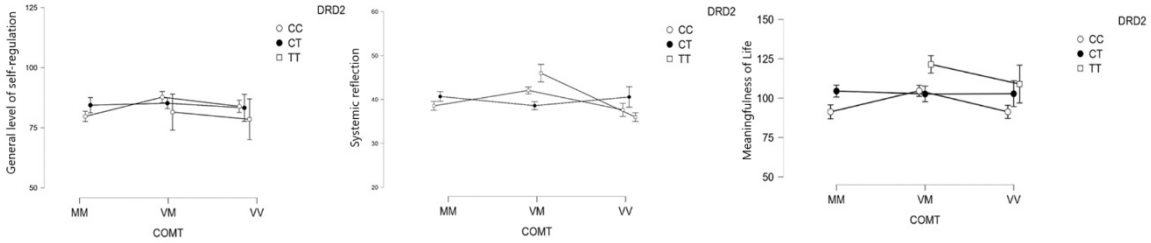

Figure 1. Graphic display of the levels of the studied variables in subgroups of carriers of different COMT and DRD2 genotypes

The obtained results reveal a significant average effect in the interaction between DRD2 ⁕ COMT genes and the level of systemic reflection (f = 4.9, p = 0.009, η^2 = 0.091). Specifically, carriers of the CC genotype for the DRD2 gene and the VM genotype for the COMT gene exhibit the highest level of systemic reflection (average score of 87.72 points), while the lowest level (average score of 79 points) was observed in carriers of the COMT MM and DRD2 CC genotypes. Additionally, small effects, as indicated by eta-square values, were observed between the level of meaningfulness of life and the genotypes of the DRD2 gene (η^2 = 0.035), genotypes of the COMT gene (η^2 = 0.025), and the interaction DRD2 ⁕ COMT ($\boldsymbol{\eta^2}$ = 0.036). Concerning the general level of self-regulation, a small effect was noted for COMT gene genotypes ($\boldsymbol{\eta^2}$ = 0.030).

Discussions

The described results of the study revealed significant differences in the level of systemic reflection among carriers of different genotypes of the DRD2 and COMT genes. Consistent with existing literature, these genes are associated with various aspects of behavior and cognitive function. Individuals with the CC genotype may exhibit more pronounced dopamine receptor activity, linked to characteristics such as increased speed of information processing and behavioral reactivity (Li, Bäckman, Persson, 2019). The COMT gene, responsible for catecholamine metabolism, including dopamine, displays different variants (VV, VM, and MM genotypes) reflecting enzyme activity levels. Carriers of the VM genotype, with intermediate enzyme activity, may demonstrate greater variability in regulation, including enhanced emotional and executive functions, contributing to more efficient neurotransmitter pathways (Mueller et al., 2014; Cha et al., 2022). The highest level of systemic reflection in carriers of the CC genotype for the DRD2 gene and a heterozygous variant of the COMT gene suggests a balance between the elevated dopaminergic activity characteristic of the CC DRD2 genotype and moderate COMT activity, fostering optimal dopamine metabolism. This reveals potential interpretations for the functioning of the brain's reinforcement system in consolidating dysfunctional behavioral patterns. The heightened dopaminergic activity associated with the CC genotype of the DRD2 gene may contribute to reinforcing specific behavioral responses, potentially amplifying reactivity and influencing information processing. This increased reinforcement could perpetuate and solidify certain dysfunctional patterns in behavior. Moreover, the interplay with the COMT gene, particularly in individuals with the VM genotype, introduces an intriguing dimension. The intermediate enzyme activity associated with the VM genotype might contribute to a nuanced balance in dopamine metabolism. This equilibrium could affect the reinforcement dynamics, potentially influencing the persistence of specific behavioral patterns. Further investigation into these potential interpretations is warranted to unravel the complex relationship between genetic factors, brain function, and behavioral outcomes.

Conclusions

The objective of this study was to explore the genetic predictors of self-regulation and related characteristics indicative of a higher level of rational behavior control.

This study aimed to identify genetic predictors of self-regulation and related characteristics indicative of a higher level of rational behavior control. The selected candidate genes were from the dopaminergic system, specifically the dopamine receptor type 2 gene DRD2 (polymorphic locus rs1800497) and the COMT enzyme gene (polymorphic locus Val158Met). The findings indicate significant differences in the level of systemic reflection among carriers of different genotypes of the DRD2 and COMT genes. Notably, carriers of the CC genotype for the DRD2 gene and a heterozygous variant of the COMT gene exhibited the highest level of systemic reflection.

While these findings contribute valuable insights into the genetic correlates of self-regulation, reflection, and meaningfulness of life, several limitations should be acknowledged. Firstly, the sample size of 107 participants, though providing meaningful data, might limit the generalizability of the findings. Secondly, the choice of candidate genes was based on the dopaminergic system, excluding potential influences from other genetic factors. Future research incorporating a broader range of genes could offer a more comprehensive understanding of the genetic underpinnings of behavioral self-control.

Acknowledgements

The study was carried out at the expense of a grant from the Russian Scientific Foundation No. 21-78-10139 (Psychological and genetic mechanisms of adaptive and maladaptive behavioral strategies and value-semantic predictors of codependency in women (alcohol, drug, gaming addictions)), https://rscf.ru/project/21-78-10139 / at the Southern Federal University.

Conflict of interests

The authors declare no conflict of interest.

Author Contributions

Conceptualization – P.N.E. and A.S.K.; Data curation – E.G.D.; Formal Analysis – E.G.D. and A.S.K.; Investigation – E.G.D., A.S.K. and A.M.K.; Methodology – E.G.D. and A.S.K.; Project administration – P.N.E.; Software – E.G.D.; Supervision – A.S.K.; Validation – E.G.D. and A.S.K.; Visualization – E.G.D. and A.M.K.; Writing – original draft – E.G.D., A.S.K. and A.M.K.; Writing – review & editing – P.N.E., E.G.D., A.S.K. and A.M.K. All authors have read and agreed to the published version of the manuscript.

References

Alfimova, M.V., Golimbet, V.E., Lezheiko, T.V. & Korovaitseva, G.I. (2017). A potential role of the 5-httlpr polymorphism in self-reported executive functioning. *Spanish Journal of Psychology*, *20*, e13. https://doi.org/10.1017/sjp.2017.6

Artemtseva, N. G. & Malkina S.A. (2022). Cognitive errors of codependents as a way to protect against uncertainty. *Bulletin of the Samara State Technical University. Series: Psychological and pedagogical sciences, 19 (1)*, 153-166. https://doi.org/10.17673/vsgtu-pps.2022.1.11

Askian, P., Krauss, S.E. & Baba, M. et al. (2021). Recovering from co-dependence: A study of iranian wives of persons with substance use disorder. *Current Psychology, 40*, 1234-1248. https://doi.org/10.1007/s12144-018-0038-x

Barone, M. & Leedom, L. (2017). *Social Construction of the Abuse Experience: Traumatic Bonding or Co-Dependency?* Department of Counseling University of Bridgeport, Bridgeport. CT.

Berdichevsky, A.A., Padun, M.A., Gagarina, M.A. & Arkhipova, M.V. (2021). Emotional regulation in persons in codependent relationships. *Clinical Psychology and Special Education, 10(4)*, 185-204. https://doi.org/10.17759/cpse.2021100409

Cha, E., Ahn, H.J., Kang, W., Jung, K.I., Ohn, S.H., Bashir, S. & Yoo, W.K. (2022). Correlations between COMT polymorphism and brain structure and cognition in elderly subjects: An observational study. *Medicine (Baltimore), 6,* 101(18):e29214. https://doi.org/10.1097/MD.0000000000029214

Faizova, V.A. (2019). The relationship of codependency with emotions. *School of Science, 1(12)*, 61-62.

Golimbet, V.E., Gritsenko, I.K., Alfimova, M.V. & Ebstein, R.P. (2005). Polymorphic markers of the promoter region of the D4 dopamine receptor gene and temperament in mentally healthy humans from the Russian population, Genetika, 41(7), 966–972. https://doi.org/10.1007/s11177-005-0161-2

Ismailova, N.I. (2018). Protective behavior and the meaningfulness of life in a difficult life situation (on the example of women and men). *Problems of modern pedagogical education, 58(3)*, 319-323.

Kolenova, A., Denisova, E., Kukulyar, A. & Ermakov, P. (2023). Personality Traits, Approval Motivation, and Empathy as Predictors of Cognitive Regulation of Emotions and Behavioral Self-Control in Codependent Women. *International Journal of Cognitive Research in Science, Engineering and Education, 11(2),* 187-197. https://doi.org/10.23947/2334-8496-2023-11-2-187-197

Krasnyatova, Yu.A. & Stoyanova, I.Ya. (2018). Characteristics of codependency and mental self-regulation in adolescent mothers with drug addiction. *Siberian Bulletin of Psychiatry and Narcology, 1(98)*, 42-48. https://doi.org/10.26617/1810-3111-2018-1(98)-42-48

Kupchenko, V.E. (2020). Features of irrational attitudes, volitional self-control, coping behavior in mothers of chemical addicts with varying degrees of codependency. *Bulletin of Omsk University. Series: Psychology, 3*, 26-32. https://doi.org/10.24147/2410-6364.2020.3.26-32

Li, X., Bäckman, L. & Persson, J. (2019). The relationship of age and DRD2 polymorphisms to frontostriatal brain activity and working memory performance, *Neurobiology of Aging, 84*, 189–199. https://doi.org/10.1016/j.neurobiolaging.2019.08.022

Medvedeva, O.L. (2020). Interrelationships of codependency and self-regulation style of participants in the psychological assistance group with different levels of emotional intelligence: abstract to the thesis. *EB BSU: SOCIAL SCIENCES: Psychology*. https://elib.bsu.by/handle/123456789/247495

Mueller, S.C., Cornwell, B.R., Grillon, C., Macintyre, J.E., Gorodetsky, Goldman, D., Pine, D.S. & Ernst M. (2014). Evidence of MAOA genotype involvement in spatial ability in males. *Behav Brain Res, 1*; 267:106-10. https://doi.org/10.1016/j.bbr.2014.03.025

Pardee, R.L. (1990). *Theories of motivation by Maslow, Herzberg, McGregor and McClelland*. A review of the literature on selected theories related to job satisfaction and motivation.

Stebakova, D.A. (2023). Features of emotional perception of stimuli by persons with codependency, depending on the modality of perception. *International Journal of Medicine and Psychology, 6* (5), 162-168.

Tulebayeva, A. B. (2017). The study of individual and psychological characteristics of codependent family members. *Bulletin of the Karaganda university. History. Philosophy Series, 86 (2)*, 148-152.

Vederhus, J., Kristensen, Ø., & Timko, C. (2019). How do psychological characteristics of family members affected by substance use influence quality of life? *Quality of Life Research*, *28*(8), 2161–2170. https://doi.org/10.1007/s11136-019-02169-x

Original scientific paper

Received: January 31, 2024.
Revised: May 21, 2024.
Accepted: Jun 20, 2024.

UDC:
159.923.33
159.95
10.23947/2334-8496-2024-12-2-357-372

Check for updates

Metacognitive Abilities and Socio-Psychological Adaptation of People of Mature Age: Features of Relationships

Irina A. Kibalchenko [1*] , *Tatiana V. Eksakusto* [2]

[1*] Federal State-Owned Educational Autonomy Establishment of Higher Education "Southern Federal University", Taganrog, Russian Federation, e-mail: kibalirina@sfedu.ru
[2] Southern Federal University", Taganrog, Russian Federation
e-mail: exakusto@sfedu.ru

Abstract: The analysis is aimed at determining characteristics of relationships between metacognitive abilities and socio-psychological adaptation in homogeneous cluster groups represented by people of mature age. The main research methods were: cluster analysis, which allows us to identify relatively homogeneous groups; "bootstrap" method to check the normality of the distribution. The study also used factor analysis to determine the relationship between the characteristics of metacognitive abilities and socio-psychological adaptation. The total following variance in the factor models (86.24%, 99.77%, and 100%) as well as the levels of predictive consistency ($p \leq 0.01$ to $p \leq 0.05$) reflect the reliability and significance of the results obtained. Data processing and interpretation were carried out using qualitative and quantitative statistical methods: Fisher's angular transformation criterion (φ^*) for comparing two samples according to the occurrence frequency of the effect which is interesting to the researcher; Kruskal-Wallis rank sum test (IBM SPSS Statistics).

The results of the study allow us to talk about ambivalence in the manifestation of metacognitive abilities formation in people of mature age: on the one hand, a general tendency towards a decrease in the development of metacognitive abilities was discovered, on the other hand, an increase in the degree of structural organization of the entire metacognitive system was revealed in the process of growing up, which generally compensates for the natural decline of potential resource capabilities of adults. This ambiguity in the manifestation of metacognitive abilities is reflected in their relationship with indicators of socio-psychological adaptation of adults. The identified features of the relationship in terms of harmony/inconsistency, integrity, and the content of crystallizing factors generally indicate a multidimensional structure of the relationship between metacognitive abilities and socio-psychological adaptation, when only in some cases can we talk about a direct correlation of these variables: a high level of development of metacognitive abilities determines high social-psychological adaptation.

Keywords: *metacognitive abilities, socio-psychological adaptation, structural organization of relationships*

Introduction

Socio-psychological adaptation as an indicator of the effectiveness and efficiency of assimilation of social experience and norms has always aroused the interest of psychologists, educators, sociologists, and philosophers. Adaptation is of particular interest in the modern period, which is characterized by high dynamism, emergence of new technologies, intensity of information flow, and an increase in the number of situations of uncertainty, which requires a prompt response to events and quick decision-making. These social challenges require the manifestation of flexibility, openness to new experiences, quick orientation in the information field, i.e. manifestation of a high level of socio-psychological adaptation. And if the younger generation quickly adapts to the challenges of our time, then adults, due to age-related, functional, mental and psychophysiological changes, find it difficult to integrate into a new information environment, avoid unusual forms of activity and social contacts, which leads to violations of socio-psychological adaptation (Artemenko, Shaiakhmetova and Lintvarev , 2021, Lukianchenko and Pronikova,

*Corresponding author: kibalirina@sfedu.ru

2017). However, the question still remains open as to whether metacognitive abilities can act as a kind of compensatory mechanism that promotes the adaptation of adults, which determined the direction and purpose of this study.

The semantic content of the concept of "adaptation" is presented in psychological literature in different ways: as a process, as a state and as a property (Bogdanov, Galimzianova, Kasianik, Romanova and Zavarzina, 2019). We will consider adaptation as a person's ability to adapt to various requirements and challenges without feeling internal discomfort and conflict with the environment, which ensures success and satisfaction in realizing oneself as a socially active subject (a subject actively involved in the system of social, informational, interpersonal, etc. relations) (Lukianchenko and Pronikova, 2017; Sanina, 2019). The instability of the environment and the polyvariability of changes "triggers" the process of adaptation of the individual, allowing it to "survive" in given circumstances. Taking into account the high intensity of the ongoing processes, adaptation of modern man does not stop and exists in a constant cyclicity of its stages: from awareness of the need (but not readiness) to change one's behavior and assimilation of the values of the new environment (new conditions) to tolerance to new values and behavior patterns and accommodation, i.e. their full recognition and acceptance (Vikhman, Romm and Vilberger, 2018). The criteria for the success of adaptation are external (performance results, intensity of communications, inclusion/integration of the individual into society, etc.) and internal (self-realization of the individual, his emotional comfort, self-attitude, etc.) markers (Volchanskaia, 2019).

It must be emphasized that the success of adaptation depends on many objective and subjective variables. Objective variables include material factors (for example, objects and tools of activity), technogenic factors (the degree of pollution of atmosphere and environment, presence of certain chemicals in the environment, etc.), social factors (the system of social connections and relationships, which includes a person) and others (Vikhman, Romm and Vilberger, 2018). Of particular interest in the context of this study are subjective factors, the spectrum of which ranges from anthropological and psychophysiological to personal and socio-psychological. An analysis of studies of this group of factors showed that the effectiveness of socio-psychological adaptation is influenced by the level of education and gender characteristics (Hsiao, Peng, Lee and Chen, 2023; Leaper and Spears Brown, 2014); emotional and functional states (shame, guilt, depression, feelings of loneliness) (Tangney, 2001), as well as the level of social stress (Vasilenko, 2019); social connections and support (Wickramaratne, Yangchen, Lepow, Patra, Glicksburg, Talati and et al., 2022) ; sovereignty and psychological space of an individual (Astakhova and Martynenko, 2021) ; activity level (Merkusheva, 2019); internal locus of control (Popinako and Goncharova, 2020); social and problem solving skills (Mueser, 1998) and others.

It is important to note that no matter what subjective variables are studied, most researchers agree that the success of social adaptation as a multifactorial process primarily depends on the individual characteristics of an individual, since each person has his own pace, rhythm, and speed of adaptation to the environment (Terziev, 2017). And in this sense, adults, older people a priori "lose" in the success of adaptation, despite their experience, the high level of their social and professional skills, which makes the age factor one of the most important in the study of socio-psychological adaptation.

A number of works note that for adults, due to age-related characteristics (and, above all, a decrease in cognitive functions), maladjustment is more characteristic. Thus, according to individual studies, maladjustment is found in more than 60% of older people (Lukianchenko and Pronikova, 2017). It was found that older people with low and average levels of self-esteem, with a predominance of external locus of control, have a low level of adaptation (Artemenko, Shaiakhmetova and Lintvarev , 2021). It was also revealed that a decrease in indicators of socio-psychological adaptation in adults occurs as the severity of their early maladaptive schemes increases (Bogdanov, Galimzianova, Kasianik, Romanova and Zavarzina, 2019; Aloi, Rania, Sacco, Basile and Segura - Garcia, 2020). Low socio-psychological adaptation is typical for older people with a weak nervous system, with a predominance of dysthymic and pedantic type of accentuation with pronounced introversion (Lukianchenko and Pronikova, 2017), as well as with high rates of loneliness (causing severe depression) (Lee, Pearce, Ajnakina, Johnson, Lewis, Mann and et al., 2021). In turn, successful social adaptation, its structural and functional correlates, prevent emotional and cognitive impairment and protect against the harmful effects of loneliness and depression (Franco - O'Byrne, Gonzalez - Gomez, Morales Sepúlveda, Vergara, Ibañez and Huepe, 2023). It has also been shown that a high level of socio-psychological adaptation, due to the influence of such demographic factors as marriage, self-rated health and a high level of education, is associated with a lower risk of cogni-

tive impairment (however, this relationship is gender specific). (Hsiao, Peng, Lee and Chen, 2023; Ren, Savadlou, Park, Siska, Epp and Sargin 2023). The data obtained suggest that cognitive abilities in general and metacognitive abilities in particular may be associated with the success of socio-psychological adaptation of older people.

Recently, metacognitive abilities and processes are increasingly becoming the subject of modern research, due to which the concept of cognition as a process of information processing is expanding. Describing metacognition as a person's system of knowledge about the features of his own cognitive sphere and the methods of its regulation, J. Flavell (Flavell, 1992) identified four components of metacognitive activity: metacognitive knowledge, experience, goals and strategies. From this position, metacognitive abilities are considered through categories such as metacognitive knowledge and metacognitive regulation, which are generalized into metacognitive involvement (awareness) (Karpov, 2016, Perikova and Byzova, 2022). Many studies of metacognitive abilities show their importance in solving various problems (cognitive and life): for example, the higher the level of metacognitive skills, the greater the tendency to correctly solve a problem, to use adequate strategies, to select logical arguments (Güner and Erbay, 2021). A connection has also been found between hierarchical levels of metacognition, mental health and adaptation of patients (with various psychiatric diagnoses) to social life (Seow, Rouault, Gillan, and Fleming, 2021).

In the context of this study, we are interested in the connection between metacognitive abilities and socio-psychological adaptation. It is noted that a subject with developed metacognitive abilities can correctly assess how well a particular problem has been solved, while developed metacognitions provide opportunities for identifying priority life tasks in such a way that their consistent solution will lead to greater adaptation (Karpov, 2018 (a)). Thus, it can be assumed that the more metacognitively gifted a subject is, the better socially adapted he is overall.

The significant role of metacognitive factors in the process of socio-psychological adaptation is confirmed, for example, by the study of cognitive styles as a structure that ensures involuntary regulation of cognitive activity. In particular, it was found that field dependence and impulsiveness, as cognitive styles, complicate the process of social adaptation of patients (Kulikova, 2014). In turn, cognitive styles such as field independence and cognitive complexity contribute to physiological resistance to stress, positive self-perception, acceptance of others, increase the success of social contacts and social status, and help reduce anxiety. And the cognitive style "rigidity" increases maladaptation: anxiety, lack of acceptance of oneself and others increases, self-esteem and emotional comfort decrease (Barysheva, Matiushichev, and Matiushicheva, 2021).

In general, a developed cognitive resource (including creativity, self-esteem, reflection, emotional intelligence) is positively correlated with the adaptive potential of the individual, ensuring the formation of productive forms and methods of interaction of an individual with the external environment, a formed system of values and attitudes and motives of behavior (Serafimovich and Egorova, 2020; Melnikova, Parfenova and Kholodkova, 2019). However, data were also found that reflect the inversion of individual indicators of cognitive resource in relation to adaptive capabilities (Serafimovich and Egorova, 2020).

It is worth noting that most of the described studies were carried out on samples of adolescence and youth, which makes the problem of ontogenetic development of metacognitive abilities and adaptation quite acute and relevant in terms of such age periods as adulthood and aging. For example, in a study by British scientists, metacognitive abilities were studied in an ontogenetic aspect: from adolescence to adulthood (respondents from 11 to 41 years old) (Seow, Rouault, Gillan and Fleming, 2021). Metacognitive abilities were found to improve significantly with age, being highest in late adolescence and plateauing in adulthood. Karpov A.A., Karpov A. A., Chemiakina A. V. (2022) in his experimental studies discovered the age-related dynamics of the structure of metacognitions, the transformation of which occurs in the direction of the implementation of two main functions - compensatory and resource. And if the compensatory function helps to minimize the influence of the negative age factor, then the resource function expands the potential of the individual and promotes his adaptation (Karpov, Karpov and Chemiakina, 2022).

Based on theoretical analysis, some problems can be identified: lack of systematicity in research on the relationship between metacognitive abilities and socio-psychological adaptation; poor development of aspects of monitoring age-related features, since they can act as predictors of an individual's adaptive capabilities at different periods of maturity; inconsistency of data indicating the possibility of inversion in indicators of metacognitive abilities and adaptive capabilities of the individual. Thus, the results of the theoretical analysis made it possible to formulate the purpose of the study: to study the content of

metacognitive abilities (the ability to perform tasks and confidence in the correctness of decisions, developed self-awareness, information processing styles, control and analysis strategies, openness to new experience, etc.) in their relationship with socio-psychological adaptation of people of mature age.

Materials and Methods

At the first stage (on a voluntary basis), 160 respondents aged 45-60 years (average age - 52.5 years) took part in the study. During the initial processing of the received diagnostic data, it was revealed that only 78 respondents gave complete answers and demonstrated readiness for the study. Accordingly, 82 people (51.2% of the total number of subjects) showed signs of leaving the diagnostic situation: they did not perform or only formally performed tests related to the diagnosis of the cognitive position. This fact indicates signs of a closed cognitive position in these respondents, that is, a cognitive strategy that is characterized by intolerance towards unusual information and unwillingness to engage in new situations. In this regard, at the second stage of the empirical study, the sample was further expanded (16 people) to 94 people (51 women, 43 men). All respondents are employed. The areas of their professional activity are: medicine, education, service sector (helping professions).

The study is designed as a deductive-correlational study and uses both quantitative and qualitative methods for data processing and interpreting. The applied cluster analysis makes it possible to group respondents into relatively homogeneous groups based on indicators of their socio-psychological adaptation in adulthood. To identify differences between groups in terms of metacognitive abilities and socio-psychological adaptation, comparative analysis ("cross-sectional method") and statistical criteria are used. Factor analysis is used to identify relationships between the characteristics of metacognitive abilities and socio-psychological adaptation of adults.

In order to identify indicators of metacognitive abilities and socio-psychological adaptation, the following methods and techniques were used: methods for diagnosing socio-psychological adaptation by K. Rogers and R. Dimon; "The ideal computer " (M. A. Kholodnaya and others) to study the cognitive position of respondents; "Constructing the world" (E. Yu. Savin) to study the cognitive position from the point of view of its openness to paradoxical, "impossible" situations, identifying abilities for cognitive decentration; "Cognitive styles of human individuality" (Rusalov V.M., Volkova E.V.) to study the preferred way of solving problems.

Results

The study used cluster analysis to identify homogeneous groups of mature adults. As a result, three groups were identified based on the relationships between diagnostic indicators: No. 1 - 66 people (70% of the total sample); No. 2 – 15 people (16% of the total sample); No. 3 - 13 people (14% of the total sample). According to the bootstrap method, the distribution is not normal (skewness - 1.281, kurtosis - 1.886), but has some tendency towards it.

During the study, significant differences were obtained between cluster groups 1, 2 and 3 according to the Kruskal-Wallis H criterion for the following characteristics: adaptation, self-acceptance, acceptance of others, emotional comfort, internality, desire for dominance (Table 1).

The value of such characteristics of socio-psychological adaptation as adaptation in cluster groups 1 and 2 are at a higher level (average values, respectively, 143.42 and 155.26) than in cluster group 3, which indicates a higher degree of adaptation in these groups to social conditions in compliance with one's own needs, motives, interests and requirements for oneself. Accordingly, respondents of groups 1 and 2 are distinguished by greater personal maturity and a more pronounced potential as a subject of adaptation when interacting with the external environment.

Based on the average values of adaptability and maladaptation, significant differences in maladaptiveness were obtained in all cluster groups. At the same time, the maladaptiveness values of group 3 respondents are in the zone of average/uncertain values (101.46) and are more pronounced in comparison with other groups.

Table 1. *Statistically significant differences in groups 1, 2 and 3 in diagnostic indicators of socio-psychological adaptation according to the Kruskal-Wallis H criterion*

No.	Variables	Empirical significance N empirical (emp.)	p – significance level
1.	Adaptation	59.0911	p ≤0.05
	Adaptability	19.9258	
	Maladaptation	50.0911	
2.	Self-acceptance	50.1593	p ≤0.05
	Self acceptance	32.4823	
	No self-acceptance	47.5659	
3.	Acceptance of others	19.8553	p ≤0.05
	Not accepting others	26.0366	
4.	Emotional comfort	55.0531	p ≤0.05
	Emotional comfort	8.6662	
	Emotional discomfort	56.7938	
5.	Internality	43.0562	p ≤0.05
	Internal control	1.4418	
	External control	46.2342	
6.	Desire for dominance	22.916	p ≤0.05
	Domination	38	p ≤0.01
	Subordinate	35.9228	p ≤0.05
	Escapism	28.7219	p ≤0.05

Respondents in cluster groups 1 and 2 are characterized by a higher degree of satisfaction with their personal characteristics (according to the results of the "Self-Acceptance" scale, 48.51 and 55.8, respectively). They showed a high degree of self-satisfaction, realism in assessing their qualities, abilities and capabilities, understanding and acceptance of the developed values and pressing needs, and agreement with themselves. In group 3, on the "Self-Acceptance" scale, the lowest, in comparison with other groups, indicators of self-acceptance (42.6) and the highest indicators of self-non-acceptance (18.38) were found. It should be noted that respondents in group 2 have very low scores on the "non-acceptance of self" scale (1.8).

Analysis of the indicators of the emotional comfort/emotional discomfort scales allowed us to conclude that in cluster groups 1 and 2 the indicators on the "Emotional Comfort" scale are in the zone of uncertainty (68.59 and 94.93, respectively), but with low values of emotional discomfort (11.13 and 1.46, respectively). Among respondents in group 3, indicators of emotional comfort (20.06) are also in the zone of average values (uncertainty), while their emotional discomfort (24.15) is significantly higher in comparison with other groups.

In the absence of significant differences on the "Acceptance of others" scale, significant differences were found in groups 1, 2 and 3 on the "non-acceptance of others" indicator. These differences are due to low scores in groups 1 (13.56), 2 (10.33) and the result in group 3 (20.84), which in terms of severity is in the zone of average values. We can say that mature people of all cluster groups do not have a pronounced need for communication, interaction, joint activities, however, respondents from cluster groups 1 and 2 are still ready to interact and are less negatively disposed towards others, understanding that people's belief systems and values may not match.

It is important to note that significant differences were found in the dominance indicator: the average values in group 2 (12.06) were significantly higher than in groups 1 (8.57) and 3 (8.84). Accordingly, respondents in groups 1 and 3 have average values for the diagnostic indicator "Subordinate" (15.66 and 22.07, respectively), in contrast to respondents in group 2, who have significantly lower values for the indicator of subordination and executive activity ("Subordinate" - 8.6).

A similar trend was revealed on the "Escapism" scale: cluster groups 1 and 3 are characterized by

average values (10.65 and 14.38, respectively), and group 2 – low, which characterizes respondents of this group as people capable of solving complex tasks and problems without avoiding them. At the same time, the values of the integral indicator of internality among respondents of all three groups have high values (55.01, 55.8, 55 46, respectively), they accept responsibility for the events occurring in their lives; The results of their activities are explained by their behavior, character, and abilities.

Thus, based on the analysis of the diagnostic values of the three cluster groups, we can conclude that the highest degree of socio-psychological adaptation is demonstrated by respondents of the second (2) cluster group, which can be conditionally called "Adapted and included in society," as they are active in solving various problems and situations. Quite a high socio-psychological adaptation is also characteristic of cluster group 1, which can be conditionally called "Adapted, but avoiding difficulties", due to their pronounced passive behavioral strategy in various life situations. The lowest socio-psychological adaptation is characteristic of cluster group 3, which can be called "Poorly adapted and passive" due to their avoidance of involvement in relationships, lack of readiness to overcome problematic situations, and subordinate position.

We can say that in the process of clustering the specifics of the socio-psychological adaptation of people of mature age were determined. This specificity in cluster groups was supplemented by diagnostic results of their metacognitive abilities: cognitive position, severity of decentration, profile of cognitive styles, studied in the second stage of the study.

In the process of comparative analysis of the results of the cognitive position (Table 2) of respondents from three cluster groups, significant differences were obtained (Table 3), characterizing the measure of openness of the cognitive position.

Table 2. *Results characterizing the measure of openness of the cognitive position (open - OPP, closed - ZPP, uncertain - NPP) in cluster groups of respondents with different degrees of adaptation*

1 group – 66 people	**%**	**Group 2 – 15 people**	**%**	**Group 3 – 13 people**	**%**
Quantity. /PP		**Quantity/PP**		**Quantity/PP**	
11 / ZPP	10.6	3 / ZPP	20	2 / ZPP	15.4
26/OPP	37.9	4/OPP	26.7	1/OPP	7.6
29 /NPP	48.5	8 / NPP	53.3	10 / NPP	77

In all groups (1, 2 and 3), an uncertain cognitive position dominates (48.5%, 53.3% and 77%, respectively), which indicates both the potential for openness of the cognitive position and some shortcomings of its formation.

Table 3. *Results of significant differences in the characteristics of the cognitive position (PP) in cluster groups of respondents with different degrees of adaptation (according to the criterion of Fisher's angular transformation - φ *)*

Comparison of PP characteristics in groups	**Coefficient value**	**Significance level**
Open PP (groups 1 and 3)	$\varphi^*_{em.} = 2.518$	p≤0.01
Open PP (groups 2 and 3)	$\varphi^*_{em} = 1.763$	p≤0.05
Uncertain PP (groups 2 and 3)	$\varphi^*_{em.} = 3.092$	p≤0.01

To clarify the results on the formation of openness of the cognitive position, the results of decentration in the identified cluster groups were determined (Table 4).

Table 4. *Results of the severity of decentration as a characteristic of a cognitive position in cluster groups of respondents with varying degrees of adaptation*

1 group - 66 people	%	Group 2 – 15 people	%	Group 3 - 13 people	%
Number/level of decentralization		Number/level of decentralization		Number/level of decentralization	
36 / below average	54.5	5 / below average	33.3	8 / below average	61.6
14/medium	25	8/medium	53.3	1/medium	7.7
16 / above average	20.5	2/above average	13.4	4 / above average	30.7

Basically, decentration was formed at a level below average among respondents of clusters 1 and 3, which indicates the overwhelming majority in these groups of respondents with a low ability to use different ways of describing and analyzing phenomena. The average level of decentration severity prevails in group 2 (in 53.3% of respondents), which may indicate a tendency towards the readiness of these respondents to accept paradoxical and contradictory information without subjective distortions. Decentration results reflecting a level above average are found significantly less frequently in groups. When studying the results, significant differences were obtained in the formation of decentration in cluster groups (Table 5).

Table 5. *Results of significant differences in the formation of decentration in cluster groups of respondents with different degrees of adaptation (according to the criterion of Fisher's angular transformation* - φ *)

Comparison of decentration values between groups	Coefficient value	Significance level
average decentration values between groups 1 and 3	φ*em. = 2.029	p≤0.05
average decentration values between groups 2 and 3	φ* em. = 2.955	p≤0.01
decentration values below average between groups 2 and 3	φ* em. = 2.837	p≤0.01

The results obtained reflect the shortcomings in the formation of decentration in groups of mature people. At the same time, for cluster group 2 "Adaptive and included in society," there is a tendency for a higher frequency of manifestation of average and above average levels of decentration (according to the percentage of respondents), which is a sign of a greater level of development of their conceptual and metacognitive experience, a higher level of intellectual abilities, the presence of a tendency to integrate concepts, an open cognitive position.

This picture is complemented by information about cognitive styles that reflect the development of metacognitive abilities in cluster groups of mature people (Table 6).

To detect the significance of differences in diagnostic indicators in different cluster groups, statistical processing of the results was carried out. Significant differences were found in low values of flexibility/rigidity in group 3 in relation to groups 1 (φ*emp = 2.1, p≤0.05) and 2 (φ*emp = 2.91, p≤0.01), as well as average values in groups 1 and 2 (φ*em = 3.19, p≤0.01). Such property as flexibility is a characteristic of a productive cognitive style, which, accordingly, distinguishes cluster groups 1 and 2 to a greater extent, reflecting the ability of respondents in these clusters to quickly change methods of processing information in a situation of cognitive conflict or problem solving.

The opposite of flexibility is an unproductive style such as rigidity of cognitive control, which reflects rigid adherence to the intended plan and instructions under any circumstances. It characterizes the degree of difficulties that a subject experiences when changing methods of processing information in a situation of solving complex ambiguous problems. This cognitive style, with an overall low expression in all clusters, in group 3 "Poorly adapted and passive" is significantly higher and differs from groups 1 (φ*emp = 2.31, p≤0.01) and 2 (φ*emp = 3.19, p≤0.01).

Table 6. *Diagnostic results characterizing the degree of expression of cognitive styles among respondents in cluster groups*

Style expressiveness	1 group (66 people)	Group 2 (15 people)	3 group (13 people)	1 group (66 people)	2nd group (15 people)	3 group (13 people)
	Quantity / %	Quantity / %	Quantity / %	Quantity / %	Quantity / %	Quantity / %
Cognitive styles						
"Flexibility"				"Rigidity"		
low	8/12.1	0 / 0	2 / 15.4	28 / 42.4	10/66.7	2 / 15.4
average	51 / 77.3	13 / 86.7	9 / 69.2	36 / 57.6	2 / 13.3	10 / 76.9
high	7 / 10.6	2 / 13.3	2 / 15.4	0 / 0	3 / 20	1 / 7.7
"Field independence"				"Field dependence"		
low	0 / 0	0 / 0	0 / 0	0 / 0	13 / 86.7	8 / 61.5
average	62 / 93.9	9 / 60	12 / 92.3	48 / 72.7	2 / 13.3	5 / 38.5
high	4 / 6.1	6 / 40	1 / 7.7	18 / 27.3	0 / 0	0 / 0
"Reflexivity"				"Impulsiveness"		
low	0 / 0	2 / 13.3	2 / 15.4	43 / 65.2	8 / 53.3	3 / 23.1
average	57 / 86.4	4 / 26.7	9 / 69.2	23 / 34.8	7/ 46.7	10 / 76.9
high	9/13.6	9 / 60	2 / 15.4	0 / 0	0 / 0	0 / 0
"Abstract Conceptualization"				"Concrete Conceptualization"		
low	2 / 3.05	0 / 0	0 / 0	4 / 6.1	0 / 0	0 / 0
average	58 / 87.8	9 / 60	12 / 92.3	58 / 87.8	14 / 93.3	8 / 61.5
high	6 / 9.15	6 / 40	1 / 7.6	4 / 6.1	1 / 6.7	5 / 38.5
"Tolerance of Uncertainty"				" Intolerance of Uncertainty "		
low	0 / 0	0 / 0	0 / 0	36 / 54.6	6 / 40	6 / 46.2
average	54 / 81.8	7 / 46.6	9 / 69.2	27 / 40.9	9 / 60	6 / 46.2
high	12 / 18.2	8 / 53.4	4 / 30.8	3 / 4.5	0 / 0	1 / 7.6

A style such as field dependence has average values in all three groups. However, in group 2 its severity is significantly lower in comparison with groups 1 ($\varphi^*emp = 4.52$, $p \leq 0.01$) and 3 ($\varphi^*emp = 3.19$, $p \leq 0.01$) at the level of medium and high values. These facts indicate a less pronounced orientation of respondents in the second cluster towards external signs when solving social problems. Accordingly, respondents in clusters 1 and 3 are characterized by greater trust in external (visual) impressions when assessing what is happening; they have difficulty overcoming its influence, which leads to unproductive processing of information. It should also be noted that in group 2 (40%) there were significantly more respondents, which have a high degree of expression of the property "field independence" as a characteristic of a productive cognitive style.

Impulsivity, as one of the unproductive cognitive styles, is significantly more common in group 3 compared to clusters 1 (φ^* emp. = 2.89, $p \leq 0.01$) and 2 (φ^* emp. = 1.67 $p \leq 0.05$). That is, the most impulsive are the respondents of group 3; they tend to react quickly in a multiple choice situation, while they put forward hypotheses without analyzing all possible alternatives. It was found that the most reflective (at a high level of expression) are the respondents of group 2 in comparison with groups 1 ($\varphi^*emp = 4.545$, $p \leq 0.01$) and 3 ($\varphi^*emp = 2.547$, $p \leq 0.01$).

When considering the individual characteristics of concreteness/abstractness in people of mature age, it is necessary to clarify that these cognitive styles are based on psychological processes such as differentiation and integration of concepts. Based on the research of M.A. Kholodnaya (2023), the pole of "concrete conceptualization" is characterized by insignificant differentiation and insufficient integration of concepts, and accordingly refers to unproductive cognitive styles. In contrast, the "abstract conceptualization" pole involves both high differentiation and high integration of concepts, and is characterized by productivity. Accordingly, mature people in group 2 (40% of respondents) with the highest degree of ad-

aptation are characterized by a high degree of expression of the cognitive style of abstract conceptualization (Table 6) in comparison with groups 1(φ* emp. = 2.64, p≤0.01) and 3(φ* em = 2.13, p≤0.05). These respondents are free from the immediate properties of the situation, are guided by internal experience in explaining the physical and social world, are independent, and creative. 38.5% of respondents in cluster group 3 ("Poorly adapted and passive") have high values of the "Concrete Conceptualization" style, which indicates their tendency towards cognitive simplicity ("black and white" thinking), dependence on status and authority, and intolerance to uncertainty, stereotyped decisions. Their behavior is situational (rather than systemic) in nature, and they are characterized by a low ability to think in terms of hypothetical situations.

The majority of respondents in group 2 (53.4%) have a higher degree of tolerance to unrealistic experience as a productive cognitive style in comparison with groups 1 (φ*em. = 2.64, p≤0.01) and 3 (φ* em. = 1.67, p≤0.05). This cognitive style assumes the possibility of accepting impressions that do not correspond or even contradict a person's ideas, which he evaluates as correct and obvious. Accordingly, respondents from cluster 2 ("Adapted and included in society") are more inclined (compared to other groups) to evaluate experience based on actual characteristics and minimize its formulation in terms of "usual," "expected," and "known."

At the third stage of the study, a factor analysis procedure (principal component method) was carried out. Since cluster groups 2 and 3 are represented by a small number of respondents, in the results of factor analysis we will focus only on the substantive features of the crystallizing factors.

As a result of factorization and rotation in groups 1, 2 and 3 of mature people, factor structures were obtained, containing, respectively, a different number of factors (Table 7)

Table 7. *Crystallizing factors of structural interrelations of characteristics of metacognitive abilities and socio-psychological adaptation in cluster groups (1 - respondents with high degree adaptations, 2 - with most high degree adaptations, 3 – with uncertain degree adaptations) of people pf mature age*

No.	Characteristics	Crystallizing factors in the structures of cluster groups		
		1	2	3
1	Field dependence	.153	.197	.050
2	Field independence	.110	.662 *	**.782 ***
3	Narrow equivalence range	-.128	.611 *	. 4 32
4	Wide equivalence range	.106	.229	-.223
5	Flexibility	-.002	.729 *	**.677 ***
6	Rigidity	-.401	-.302	.214
7	Impulsiveness	.140	.403	-. 4 34
8	Reflectivity	-.472	.189	**.754 ***
9	Specific conceptualization	.034	.719 *	. 4 69
10	Abstract conceptualization	-.119	.893 *	. 4 75
11	Tolerance	.068	.880 *	**.851 ***
12	Intolerance	.008	.031	-.092
13	Adaptability	-.027	.530 *	-.223
14	Maladaptation	-.194	.121	-.475
15	Self-acceptance	.075	.197	-.344
16	Self-rejection	-.212	.362	-.391
17	Acceptance of others	-.168	-.221	.073
18	Rejection of others	.111	-.306	.025
19	Emotional comfort	.140	.885 *	-.276
20	Emotional discomfort	.003	.394	-.168
21	Internal control	-.143	.495	-.378

No.	Characteristics	Crystallizing factors in the structures of cluster groups		
		1	2	3
22	External control	-.003	.105	.088
23	Domination	.361	-.104	.359
24	Stubordination	-.345	-.202	-.419
25	Escapism	.128	-.191	**-.823 ***
26	Adaptation	.179	.142	. 4 14
27	Self-acceptance	.248	-.323	.338
28	Acceptance of others	-.170	.153	-.102
29	Emotional comfort	.048	-.262	-.071
30	Internality	-.064	.160	-.172
31	Desire for dominance	.407	-.049	**.634 ***
32	Objectified cognitive orientation (CO)	**.563***	.000	**.958 ***
33	Subjective CO	.044	-.228	.110
34	Categorical CO	**.574***	.887 *	**.880 ***
35	Actual CO	.122	-.812 *	**.951 ***
36	Cognitive efficiency	.495	-.148	**.967 ***
37	Cognitive position	**.531***	.703 *	**.611 ***
38	Total number of “aspects of the world”	**.848***	.214	**.907 ***
39	Relevance	**.646***	.024	**.711 ***
40	Sophistication	**.757***	.083	**.874 ***
41	Decentration	**.850***	.228	**.889 ***
Factor loading / total variance (%)		12.02 / 86.24	19.68 / 99.78	31.96 / 100

Note: variables with the highest weight included in the crystallizing factor are highlighted in bold and an asterisk (***).** Highlighting the structure of group 1 in the crystallizing factor indicates the loss of variable No. 21 (internal control)

Factor structure in the group 1 (“Adapted but avoiding difficulties”) is significant (variance - 86.24%), but incomplete. The variable “Internal control” was dropped. This fact suggests that in this group the indicator of internal control is not consistent with the indicators of other characteristics. In comparison with the factor structures of other groups, it contains the largest number of factors (11), which reflects the greater differentiation of the results in the group; the presence of one variable in 10 and 11 factors also indicates its instability.

However, the variables of the crystallizing factor are consistent (are in direct relationship): categorical cognitive orientation (CO) (2 – level below average), objectified CO (3.56 – level below average), cognitive position (2.28 – tendency to an uncertain position), decentration (54.5% of respondents – below average), total number of “aspects of the world” (4 – average level), validity (1.25 – average), sophistication (0.65 – average level). It can be concluded that the crystallizing variables of this group reflect the uncertainty of the cognitive position, despite the presence of objectified and categorical signs (signs of an open cognitive position). The presence in the first factor of the variables “Objectified CO” and “Categorical CO”, as well as cognitive decentration of a level below the average against the background of the average severity of the indicators “Reasonableness” and “Sophistication”, characterize respondents of group 1 as people with underdeveloped metacognitive abilities.

In the process of factorization and rotation of the results of Group 2 with a high degree of adaptation a factor structure of 6 factors was received. This structure is significant (variance 99.78%), complete, and stable. The crystallizing factor included the following variables: field independence - (19.46 - tendency to high), narrow range of equivalence - (15 - medium), flexibility (17.13 - tendency to high), specific conceptualization (18.4 - high level), abstract conceptualization (17.53 - high level), tolerance (19.1 - average with a tendency to high), emotional comfort (25.26 - average), categorical CO (1 - low level), actual CO (negative orientation) (2 – low), cognitive position (2.06 – uncertain), adaptability (155.26 – high). There

is a relationship between ten variables, nine of which have a direct direction and one in the opposite direction. The variable "Actual CO" is inversely related to categorical questions (which is theoretically determined) and the type of cognitive position, which enhances the effect of an uncertain cognitive position among respondents in this group. However, the main emphasis, in our opinion, needs to be placed on the severity of the variable "Categorical cognitive orientation (CO)" as a sign of an open cognitive position.

At the same time, the developed cognitive potential of this group (identified on the basis of the prevailing productive cognitive styles) indicates the respondents' tendency to focus on signs that distinguish one object of activity from another; their high sensitivity to details, to nuances in activities; a tendency to clearly define boundaries and precise standards in assessing performance results.

In the process of factorization and rotation of the results of Group 3 "Poorly adapted and passive" a factor structure of 6 factors was obtained. The structure is significant (variance - 100%), complete, stable. This is a group with less pronounced adaptation, with a minimum number of people with an open cognitive position (6%) and a decentration rate below average (61.6% of respondents) in comparison with other groups. The crystallizing factor includes 15 variables: cognitive efficiency (3 - average level), objectified CO (2.69 - average), tolerance (17.77 - average level), cognitive position (uncertain - in 77%), decentration below the average level (61.6%), total number of "aspects of the world" (5 - average), relevance (0.98 - average), sophistication (0.6 - tendency towards average), actual CO (2.7 - average level), categorical CO (1 - low level), desire for dominance (44.15 - level of uncertainty), (-) escapism (14.38 - low level, theoretically determined), field independence (17 - average), flexibility (14.84 - average), reflexivity (15 – average level).

Thus, the crystallizing factor in group 3, including the characteristics of the cognitive position and decentration (the degree of its expression, the total number of "aspects of the world", relevance, sophistication) characterize the respondents of group 3 as people with a pronounced vague cognitive position and unformed decentration in conjunction with the most pronounced desire for dominance.

Discussions

Analyzing the existing structure of scientific knowledge, it was revealed that the socio-psychological adaptation of people of mature age, on the one hand, depends on their involvement in social activities. On the other hand, the basic mental function of a person's adaptation to the environment is intelligence, or rather, metacognitive abilities as stable ways of processing information and acquired experience (Kholodnaia, 2023), as components of metacognition - a particular version of mental self-regulation (Chernokova, 2011).

In the course of empirical research, we obtained significant results about the not always clear relationship between the characteristics of metacognitive abilities and the socio-psychological adaptation of people of mature age. Clustering of these results became the basis for identifying three cluster groups, differing in the degree of socio-psychological adaptation formation. It was found that in cluster group 1, which is the most represented in terms of quantitative composition, the level of adaptation is quite high; in group 2, the highest degree of adaptation was revealed; in group 3 – the least pronounced (uncertain) level of adaptation. The resulting distribution is not normal (skewness - 1.281, kurtosis - 1.886), but tends towards it. In this case, the results in group 1 can be designated as a certain conditional norm for the sample according to the adaptation criterion (in comparison with the greater severity of adaptation in group 2 and less in group 3). The identified trend confirms the existing data that people of adulthood and mature age have a fairly high level of socio-psychological adaptation, due to accumulated social experience and developed metacognitive abilities (Karpov, 2018 (b); Lukianchenko and Pronikova, 2017).

Supplementing the distribution obtained by the level of adaptation with other identified socio-psychological indicators, we can conclude that respondents in cluster group 1 "Adapted, but avoiding difficulties" with an optimally high degree of adaptation, readiness for social contacts, emotional comfort and readiness to accept responsibility for various situations, demonstrate a tendency to avoid difficulties (strategy - "hide and not notice"), to perform activities, i.e. to a rather passive behavioral strategy. This trend is probably due to age-related characteristics of socialization, when people's behavioral and social activity decreases, and "security" mechanisms are activated that help reduce the level of stress and strong emotional experiences (Barysheva, Matiushichev and Matiushicheva, 2021).

Cluster group 2. "Adapted and included in society" is characterized by highly expressed adapt-

ability, self-acceptance, emotional comfort, internality, but most importantly, they tend to show leadership and organizational qualities, taking an active position in decision-making and responsibility in difficult situations.

The lowest socio-psychological adaptation is typical for cluster group 3, "Poorly adapted and passive." They are distinguished by emotional dissatisfaction, lack of self-acceptance, uncertainty, passivity, a desire for isolation in relationships with others (rejection of others), a pronounced executive position and a desire to avoid problems rather than solve them. At the same time, we draw attention to the fact that the quantitative representation of these groups is quite low, which only indicates possible (uncharacteristic for the majority) trends in the socio-psychological adaptation of adults.

The identified features of the development of metacognitive abilities in adults in different cluster groups indicate significant differences in their cognitive attitude to the world, in the variability and variety of ways of understanding, in the ability to take into account different points of view and perspectives, in the methods of involuntary regulation and processing of information. The obtained differences (specifications) in cluster groups are partially consistent with the results of a number of studies. For example, in accordance with individual studies (Kulikova, 2014; Sofologi, M. et al. (2023)), it was found that people of mature age are characterized by such unproductive styles as field dependence, rigidity, impulsiveness, and specific conceptualization. This trend (within the framework of our study) is more typical for respondents in group 3. This group has the smallest number of people with an open cognitive position (7.6%) and the largest number of respondents with a low level of decentration (61.5%). However, a contradictory sign was also found: respondents in this group showed an average level of field independence (in 92.2% of respondents).

At the same time, it was revealed that respondents with the highest adaptation (group 2) are characterized by such productive styles that differ significantly from other groups, such as flexibility (a level with a tendency to high), field independence (40% have a high level and 60% have a medium level expressiveness), abstract conceptualization (40% high level of property expression, 60% average level of property expression), tolerance to unrealistic experience (53.3% - high level of manifestation). Thus, they show independence from the status and authority of the source of information, some differentiation and signs of integration of concepts, while being able to transcend the limits of direct contact with reality and move into the area of more distant temporal, spatial and semantic contexts; they can choose innovative ways to solve a problem. The result is consistent with the study by Serafimovich and Egorova, 2020, which notes that developed metacognitive abilities are associated with tacit knowledge strategies and determine the ability to interact effectively in socially heterogeneous groups (Sofologi, M. et al. (2023)).

Respondents of the largest group 1 are characterized by the greatest reflexivity (at an average level - 86.4% and a high level of expression - 13.6%) against the background of a fairly low level of decentralization (low ability to use different ways of describing and analyzing phenomena). And the predominance in the group of people with constructive cognitive styles (abstract conceptualization and tolerance of uncertainty) is conditionally "compensated" by the frequency of manifestations of such styles as "concrete conceptualization" and field dependence. These data reflect the characteristic tendency for most people of mature age towards inconsistency in the manifestation of metacognitive abilities, when, against the background of a high level of mental and intellectual development, limitations and difficulties in the use of cognitive resources (slowness, differentiation, etc.) can be observed (Karpov A. V., et al. (2022)).

Based on the research of Jiang, et al., 2023, as well as the analysis of the identified factor structures, in our opinion, it makes sense to talk about different signs of the compensatory and resource functions of metacognitive abilities among respondents in cluster groups. Thus, in group 1, the crystallizing galaxy is the coordinated relationship between the characteristics of the average level of cognitive position, decentration, the number of "aspects of the world," relevance and sophistication. This relationship reveals signs of the compensatory function of metacognitions and signs of deficiencies in their resource function (the "Internal control" variable was dropped).

In group 2, the crystallizing basis of the factor structure is field independence, a narrow range of equivalence, flexibility, concrete and abstract conceptualization, tolerance, emotional comfort, categorical cognitive orientation and cognitive position. Thanks to such a resource base, they are able to go beyond the limits of direct contact with reality, can choose non-standard ways to solve a problem, and easily establish various kinds of connections and relationships between objects of activity. In other words, we can talk about the manifestation of signs of creative thinking in them due to the developed convergent and

divergent thinking characteristic of people with developed metacognitive abilities (Saiz and Rivas, 2023).

In group 3, the crystallizing factor includes characteristics of an uncertain cognitive position, insufficiently formed decentration, relevance and sophistication, combined with the desire for dominance against the background of fairly pronounced indicators of field dependence, rigidity, and impulsivity. If they have escapism, emotional discomfort and rejection of others, we can conclude that the resource function of metacognitive abilities is practically not formed in this group, leading to low socio-psychological adaptation and a low level of psychological well-being (Saiz and Rivas, 2023).

Thus, the data obtained complement studies of the age aspect of the relationship metacognitive abilities and socio-psychological adaptation, revealing multidimensional and ambiguous signs, some of which, however, reflect a tendency towards a direct relationship: the higher the metacognitive abilities are developed, the higher the socio-psychological adaptation.

Conclusions

Thus, the relevance of studying the relationship between metacognitive abilities and socio-psychological adaptation of people of mature age is shown.

As a result of clustering of diagnostic data, three groups of respondents with different levels of adaptation were identified: quite high, the highest and uncertain (lower). The structure of relationships between the characteristics of socio-psychological adaptation and metacognitive abilities in group 1 is incomplete, unstable, and differentiated. Its main characteristic is the uncertainty of the cognitive position, the presence of signs of the compensatory function of metacognitions and signs of deficiencies in their resource function. The structure of relationships in group 2 (with the highest degree of socio-psychological adaptation) is significant, complete and stable. Its specificity is distinguished by the presence of a unique resource base, which ensures the ability to choose non-standard ways to solve a problem and easily establish various kinds of connections and relationships between objects of activity. The structure of relationships in group 3 (with a fairly low degree of socio-psychological adaptation) is also significant, complete, stable and quite specific in its content. It reflects the low level of development of the resource function of metacognitive abilities in this group, leading to lower socio-psychological adaptation compared to other groups.

The discovered invariant relationships between socio-psychological adaptation and meta-cognitive abilities of people of mature age give grounds to draw the following conclusions:

mature people are characterized by fairly high socio-psychological adaptation, which is due to their experience of socialization;

a tendency towards a decrease in the development of metacognitive abilities in people of mature age was discovered, which may be due to difficulties and limitations in the use of cognitive resources (slowness, differentiation, etc.);

A tendency has been revealed to increase in the process of growing up the degree of structural organization of the entire metacognitive system as a whole, which compensates for the natural decrease in the potential of a person's resource capabilities with age.

On the other hand, the data obtained reveal new ambiguous signs and relationships:

- closed cognitive position, low decentration and fairly pronounced cognitive field independence in people with an uncertain degree of adaptation;
- constructive cognitive styles (abstract conceptualization and tolerance of uncertainty), concrete conceptualization and field dependence among respondents who are adapted but avoid difficulties.

These data reflect the novelty and prospects of the research, as well as the characteristic tendency for most people of mature age towards inconsistency in the manifestation of metacognitive abilities, when, against the background of a high level of mental and intellectual development, restrictions and difficulties in the use of cognitive resources can be observed (slowness, differentiation and so on.). The results obtained, in our opinion, create the basis for further research, based on the results of which it is possible to develop highly effective psychotechnologies for the development of socio-psychological adaptation in connection with the metacognitive abilities of people of mature age. In particular, the data obtained in our study provide grounds for practical recommendations: organizing special educational and developmental classes in centers for the elderly (for example, in longevity centers that exist within the framework of special projects for working with people aged 55 years and older). They should be aimed at developing ideas

about metacognitive experience and socio-psychological adaptation, their relationship; promote the development of reflexivity, cognitive position and cognitive decentering; development of conceptual abilities. An important methodological basis for such work should be the principles of humanistic psychotherapy and a reflexive-integrative approach. You can maintain mental activity during classes in different ways: reading together and discussing what you read, learning new skills (from culinary to vocal), intellectual games, solving puzzles, participating in group discussions, etc., which will help maintain one's high quality of life in old age.

Acknowledgments

We greatly appreciate the International contribution of the Journal of Cognitive Research in Science, Engineering and Education (IJCRSEE) and contribution of the Psychology and Life Safety department staff as well as our colleagues from the Institute of Computer Technologies and Information Safety of the Southern Federal University in realizing the ideas pointed out in our article.

Conflict of interests

The authors declare no conflict of interest.

Author Contributions

Conceptualization, Kibalchenko Irina, Eksakusto Tatiana; formal analysis, Kibalchenko Irina, Eksakusto Tatiana; Data curation, Kibalchenko Irina; methodology, Kibalchenko Irina; writing – original draft preparation, Eksakusto Tatiana; writing – review and editing, Eksakusto Tatiana. All authors have read and agreed to the published version of the manuscript.

References

Aloi, M., Rania, M., Sacco, R., Basile, B. & Segura-Garcia, C. (2020). The Young Schema Questionnaire Short Form 3 (YSQ-S3): does the new four-domains model show the best fit? *Anales de Psicologia 36(2),* 254-261. http://dx.doi.org/10.6018/analesps.343461

Artemenko, E. P., Shaiakhmetova, E.H. & Lintvarev, A. L. (2021). Личностный ресурс социально-психологической адаптации на поздних этапах онтогенеза. [Personal Resource Of Socio-Psychological Adaptation In The Later Stages Of Ontogenesis] *Проблемы современного педагогического образования, 70(1),* 307-310. https://www.elibrary.ru/download/elibrary_45738792_22466409.pdf

Astakhova, A. A. & Martynenko, E. A. (2021). Результаты внедрения комплексной программы по социально-психологической адаптации, с учетом уровня суверенности психологического пространства личности. [Results Of The Implementation Of A Comprehensive Program For Socio-Psychological Adaptation Taking Into Account The Level Of Sovereignty Of The Psychological Space Of An Individual] *Азимут научных исследований: педагогика и психология 10, 2(35),* 345-349. http://doi.org/10.26140/anip-2021-1002-0087

Barysheva, T. A., Matiushichev, I. IU. & Matiushicheva, M. I. (2021). Взаимосвязь когнитивных стилей и социально-психологической адаптации в младшем школьном возрасте. [Relationship Between Cognitive Styles And Socio-Psychological Adaptation In Primary School Age] *Научное мнение,* 4, 62-69. http://doi.org/10.25807/22224378_2021_4_62

Bogdanov, E. N., Galimzianova, M. V., Kasianik, P. M., Romanova E.V. & Zavarzina A.A. (2019). Социально-психологическая адаптация взрослых в связи с ранними дезадаптивными схемами. [Socio-Psychological Adaptation Of Adults In Connection With Early Maladaptive Patterns] *Прикладная юридическая психология, 1(46),* 31-39. https://cyberleninka.ru/article/n/sotsialno-psihologicheskaya-adaptatsiya-vzroslyh-v-svyazi-s-rannimi-dezadaptivnymi-shemami/viewer

Chernokova T.E. (2011). Метакогнитивная психология: проблема предмета исследования. [Metacognitive Psychology: The Problem Of The Subject Of Research] *Вестник Северного (Арктического) федерального университета. Серия: Гуманитарные и социальные науки, 3,* 153-158.

Flavell, J. H. (1992). Cognitive development: Past, present, and future. *Developmental psychology, 28(6),* 998.

Franco-O´Byrne D, Gonzalez-Gomez R, Morales Sepúlveda JP, Vergara M, Ibañez A & Huepe D (2023) The impact of loneliness and social adaptation on depressive symptoms: Behavioral and brain measures evidence from a brain health perspective. *Frontiers in Psychology 14:1096178*. http://doi.org/10.3389/fpsyg.2023.1096178

Güner, P. & Erbay, H. N. (2021). Metacognitive skills and problem-solving. *International Journal of Research in Education and Science (IJRES), 7(3),* 715-734. https://doi.org/10.46328/ijres.1594

Hsiao F.-Y., Peng L.-N, Lee W.-J. & Chen L.-K. (2023). Sex-specific impacts of social isolation on loneliness, depressive

symptoms, cognitive impairment, and biomarkers: Results from the social environment and biomarker of aging study. *Archives of Gerontology and Geriatrics, 106,* 104872. http://doi.org/10.1016/j.archger.2022.104872.

Jiang, L., Yang, C., Pi, Z., Li, Y., Liu, S. & Yi, X. (2023). Individuals with High Metacognitive Ability Are Better at Divergent and Convergent Thinking. *Journal of Intelligence*, *11*, 162. https://doi.org/10.3390/jintelligence11080162

Karpov, A. A. (2016). Метакогнитивное направление в психологии: современное состояние и перспективы исследований. [Metacognitive Direction In Psychology: Current State And Prospects For Research] Ярославский психологический вестник, 35, 6-12. https://www.elibrary.ru/download/elibrary_28370792_59578225.pdf

Karpov, A. A. (2018) (a). *Структура метакогнитивной регуляции управленческой деятельности*. [The Structure Of Metacognitive Regulation Of Management Activities] Москва, PAO. Retrieved January 23, 2024. http://www.rd.uniyar.ac.ru/upload/iblock/15c/Dissertatsiya-Karpova-A.A..pdf?ysclid=lpxwrjwrhq184313121

Karpov, A. A. (2018) (b). Возрастная динамика структурной организации метакогнитивной сферы личности. [Age Dynamics Of The Structural Organization Of The Metacognitive Sphere Of Personality] *Российский психологический журнал, 15 (2),* 108-132. http://doi.org/10.21702/rpj.2018.2.5

Karpov, A. V., Karpov, A. A. & Chemiakina, A. V. (2022). Специфика структурной организации метакогнитивных компонентов рефлексивности. [Specificity Of The Structural Organization Of Metacognitive Components Of Reflexivity] *Российский психологический журнал, 19(1),* 127-142. http://doi.org/10.21702/rpj.2022.1.10

Kholodnaia, M. A. (2023). *Когнитивная психология. Когнитивные стили: учебное пособие для вузов*. [Cognitive Psychology. Cognitive Styles: a Textbook for Universities] Москва, Юрайт.

Kulikova, O. S. (2014). Когнитивные факторы социальной адаптации больных с параноидной формой шизофрении. [Cognitive Factors Of Social Adaptation Of Patients With Paranoid Schizophrenia] *Вестник Южно-Уральского государственного университета. Серия: Психология, 7 (2),* 109-115. https://elibrary.ru/download/elibrary_21682375_74816262.pdf

Leaper, C. & Spears Brown C. (2014). Chapter six – Sexism in Schools. *Advances in Child Development and Behavior, 47,* 189-223. https://doi.org/10.1016/bs.acdb.2014.04.001

Lee S. L., Pearce E., Ajnakina O., Johnson S., Lewis G., Mann F., et al. (2021). The association between loneliness and depressive symptoms among adults aged 50 years and older: a 12-year population-based cohort study. *The Lancet Psychiatry, 8,* 48–57. http://doi.org/10.1016/S2215-0366(20)30383-7

Lukianchenko N.V. & Pronikova M.M. (2017). Связь социально-психологической адаптации в пост трудовой период с индивидуально-психологическими особенностями. [The Connection Between Socio-Psychological Adaptation During The Post-Work Period And Individual Psychological Characteristics] Молодежь Сибири – науке России: международная научно-практическая конференция. Сибирский институт бизнеса, управления. Красноярск, 212 – 214. https://elibrary.ru/download/elibrary_29038560_98325631.pdf

Melnikova, IU. A., Parfenova, G. L. & Kholodkova, O. G. (2019). Социально-психологическая адаптация подростков с разным уровнем творческих способностей. [Socio-Psychological Adaptation Of Adolescents With Different Levels Of Creative Abilities] *Педагогическое образование на Алтае, 2,* 43-51. https://www.elibrary.ru/download/elibrary_41811241_64068887.pdf

Merkusheva, IU. S. (2019). Социально - психологическая адаптация студентов как психологическая проблема.[Social And Psychological Adaptation Of Students As A Psychological Problem] Наука на благо человечества: материалы Международной научной конференции молодых учёных. Москва: Московский государственный областной университет, 123-128. https://www.elibrary.ru/download/elibrary_41403372_18383614.pdf

Mueser Kim, T. (1998). Social Skills Training and Problem Solving. *Comprehensive Clinical Psychology 6,* 183-201. https://doi.org/10.1016/B0080-4270(73)00190-5

Perikova E. I. & Byzova, V. M. (2022). Факторная структура русскоязычной версии опросника «Метакогнитивная включенность в деятельность».[Factor Structure Of The Russian Version Of The "Metacognitive Involvement In Activity" Questionnaire] *Культурно-историческая психология, 18 (2),* 116–126. https://doi.org/10.17759/chp.2022180213

Popinako, E. A. & Goncharova, N. A. (2020). Психологические особенности социально-психологической адаптации сотрудников органов внутренних дел с различным уровнем личностного адаптационного потенциала. [Psychological Features Of Socio-Psychological Adaptation Of Employees Of Internal Affairs Bodies With Different Levels Of Personal Adaptation Potential] *Вестник Санкт-Петербургского университета МВД России, 3(87),* 234–240. https://doi.org/10.35750/2071-8284-2020-3-234-240

Ren, Y., Savadlou, A., Park, S., Siska, P., Epp, J.R. & Sargin, D. (2023). The impact of loneliness and social isolation on the development of cognitive decline and Alzheimer's Disease. *Front Neuroendocrinol, 69:101061*. https://doi.org/10.1016/j.yfrne.2023.101061

Saiz, C. & Rivas, S.F., (2023). Critical Thinking, Formation, and Change. *Journal of Intelligence*, *11*, 219. https://doi.org/10.3390/jintelligence11120219

Sanina, M. V. (2019). Социально-психологическая адаптация личности к изменяющимся условиям внешней среды в социуме.[Socio-Psychological Adaptation Of The Individual To Changing Environmental Conditions In Society] In Kotlyarova E`.V. (Ed.), *Современная образовательная психология в подготовке специалистов*

помогающих профессий: актуальные проблемы теории и практики оказания помощи другим. (Pp. 123-128). Могилев: Могилевский государственный университет имени А.А. Кулешова.

Seow, T. X. F., Rouault, M., Gillan, C. M., & Fleming, S. M. (2021). How Local and Global Metacognition Shape Mental Health. *Biological Psychiatry, 90 (7),* 436–446. https://doi.org/10.1016/j.biopsych.2021.05.013

Serafimovich, I. V. & Egorova, K. A. (2020). Интеллектуальные особенности личности как когнитивный ресурс и социально-психологическая адаптация педагогов в профессиональной деятельности.[Intellectual Characteristics Of The Individual As A Cognitive Resource And Socio-Psychological Adaptation Of Teachers In Professional Activities] *Baikal Research Journal, 11 (4),* 17. https://doi.org/10.17150/2411-6262.2020.11(4).17

Sofologi, M., Foutsitzi, E., Papantoniou, A., Kougioumtzis, G., Zaragas, H., Tsolaki, M. et al. (2023). The Effect of Secondary Education Teachers' Metacognitive Knowledge and Professional Development on Their Tacit Knowledge Strategies. *Journal of Intelligence*, *11*, 179. https://doi.org/10.3390/jintelligence11090179

Tangney, J.P. (2001). Self-conscious Emotions. In Smelser N. J. & Baltes P. B. (Ed.), *Psychology of. International Encyclopedia of the Social & Behavioral Sciences (*Pp. 13803-13807). Palo Alto and Berlin. https://doi.org/10.1016/B0-08-043076-7/01714-9

Terziev, V. (2017). Studying Different Aspects of Social Adaptation. *International Health,* 1352-1361. http://dx.doi.org/10.2139/ssrn.3143184

Vasilenko, E. A. (2019). Психологические механизмы воздействия социального стресса на социально-психологическую адаптацию личности. [Psychological Mechanisms Of The Impact Of Social Stress On Socio-Psychological Adaptation Of The Individual] *Вестник Южно-Уральского государственного гуманитарно-педагогического университета, 4,* 279-302. https://doi.org/10.25588/CSPU.2019.38.54.018

Vikhman, V. V., Romm, M. V. & Vilberger, M.E. (2018). Phenomenon of Social Adaptation in Modern Socio- Economic Changes in Society. Proceedings of the International Conference "Actual Issues of Mechanical Engineering" (AIME 2018). *Series Advances in Engineering Research*, 157, 612-617. https://doi.org/10.2991/aime-18.2018.117

Volchanskaia, V. O. (2019). Социально-психологическая адаптация в отечественной и зарубежной психологии. [Socio-Psychological Adaptation In Domestic And Foreign Psychology] *Человеческий капитал, 12 (132),* 108-114. DOI 10.25629/HC.2019.12.09.

Wickramaratne PJ., Yangchen T., Lepow L., Patra BG., Glicksburg B., Talati A., et al. (2022). Social connectedness as a determinant of mental health: A scoping review. *PLoS ONE 17(10): e0275004.* https://doi.org/10.1371/journal.pone.0275004

Original scientific paper

UDC: 001.891:004.7(497.11)

Received: March 24, 2024.
Revised: August 02, 2024.
Accepted: August 08, 2024.

10.23947/2334-8496-2024-12-2-373-385

Check for updates

Performances of the e-Nauka Portal in the Republic of Serbia and Its Significance for Researchers

Jelena Matijašević[1*], *Mara Despotov*[1], *Dejan Logarušić*[1]

[1]University Business Academy in Novi Sad, Faculty of Law for Commerce and Judiciary in Novi Sad, The Republic of Serbia, e-mail: jelena@pravni-fakultet.info, marad@pravni-fakultet.info, dejan.logarusic@pravni-fakultet.info

Abstract: In recent years, digitalization has been recognized as a significant and necessary process that leads to better results, both in the education and in the scientific research. The legal and strategic framework in the Republic of Serbia follows the modern trends of the concept of open science, open knowledge, digital transformation and a unique digital format of scientific production. The Ministry of science, technological development and innovation, in cooperation with the Office for information technology and electronic administration, created the necessary conditions for dynamic the development of the scientific research and innovation system, especially in relation to the digitalization process and the establishment of an information platform, in the form of a unified national information system of scientific research activities: eNauka [eScience]. The concept of eNauka is an innovative tool that improves the efficiency and transparency of scientific processes in Serbia. The eNauka portal in the Republic of Serbia is dedicated to promoting scientific research, innovation and academic achievements within the scientific community of the Republic of Serbia. This portal provides access to scientific articles, research papers and academic publications authored by researchers from Serbia, which enables the spread of knowledge and the encouragement of scientific cooperation within the country. The eNauka portal was opened in full capacity for all active researchers in Serbia on July 3, 2023, and contains data on scientific research organizations in the Republic of Serbia, researchers and their scientific results. The goal of this paper was to bring closer to the academic community the capabilities and performance of the eNauka portal, its structure, the way and importance of data editing, with special reference to issues related to researchers' profiles and their editing. The paper is methodologically based on a theoretical, preliminary desk analysis of relevant contemporary standpoints in domestic and foreign theory, a normative analysis of current legislative sources, an inductive and deductive approach in researching the operational performance and advantages of the eNauka portal, as well as the quantitative analysis of relevant statistical indicators of relevant parameters regarding the profile that each researcher has on the eNauka portal. The results include the analysis of data related to editing the researcher's profile and the opportunities offered by the eNauka portal. The conclusion refers to the importance and advantages of the eNauke portal. Finally, it should be noted that one of the key functions of eNauka is the evaluation of scientific results. More precisely, the system provides the possibility of monitoring and evaluating research results, which is of great importance for the academic community.

Keywords: *digitalization, scientific research organizations, scientific results, researchers, science, eNauka*

Introduction

Digitalization processes in modern work and business are a consequence of global technological changes. The generation of increasingly large amounts of data in various areas at the global level necessitated the transition to a digital format for data collection, storage and exchange.

In recent years, digitalization has been recognized as a significant and necessary process that leads to better results, both in the sphere of education and in the field of scientific research. The integration of digital technologies into scientific research work represents a key segment of its faster and better development, and as such, is a priority in relevant legal solutions, strategic documents and practical work of each individual scientific research organization [NIO – Naučno istraživačka organizacija] (Gorenšek and Kohont, 2019). Namely, "the acceptance of digitalization as an important and necessary element of

*Corresponding author: sofger@swu.bg

modernization is especially recognized in the domain of higher education, which is in closest contact with specific educational profiles and the labor market" (Kolarski, 2022, p. 50). According to Article 2 of the Law on Science and Research, science and research as an activity of special importance for the overall development of the Republic of Serbia, based on knowledge, experience and skills, together with higher education is the driver of economic and overall social development.

The processes of digitalization and digital transformation in various spheres of life and work of modern man are essentially not a choice, but an imperative to survive and function in an extremely competitive market, which no longer knows classical geographical boundaries, but operates in a cyber environment that is very particular regarding to both spatial and time dimension. Digital transformation, "by stimulating changes in the expectations of end users, simultaneously creates completely new user and business experiences" (Čelik, 2021, p. 5), which is an extremely important determinant in the sphere of scientific research work.

The degree of digitalization in modern work and business is most often assessed by monitoring the following parameters: "presence, accessibility, reliability, speed, usability and skill" (D'Souza and Williams, 2017, p. 6). It should also be said that innovations "which have increasingly expanded during the 21st century, showing the changeability and adaptability of people's lives and business around the world. There is an increasing demand for the commercialization of the results of scientific research and intellectual property, and close cooperation between scientific research institutions and the economy is recognized as a driving force for the further development of national economies. The relevance of innovation and the transfer of knowledge and technologies has been in national and EU strategic plans for years" (Stefanović et. al., 2021, p. 10).

According to authors in contemporary theory, "digitalization itself brings new opportunities and challenges" (Todosijević and Hristić, 2022, p. 197). If we take a closer look at the situation in science, in the last three decades, primarily as a reflection of the extremely rapid development of information and communication technologies, there have been significant changes in the way of preparation, publication and generally in the way of dissemination of scientific results. According to some authors, "the digitalization process enabled a technically simple and fast way of publishing, saving, searching and downloading publications, and scientific results became available to everyone" (Banović and Bradić Martinović, 2021, p. 397). According to the same authors, »globalization and the development of digital technologies in recent decades are transforming all fields of science, and information and data are becoming available to everyone, in a technically simple way. The development of digital technology has also significantly changed communication among researchers" (Banović and Bradić Martinović, 2021, p. 397).

Finally, the digital format of scientific results for modern researchers is an extremely important way of their storage and exchange, bearing in mind that "digitalization of information facilitates their storage, access, presentation and sharing" (Zdravković, 2022, p. 1).

According to the official data of the Ministry, "The Ministry of science, technological development and innovation, in cooperation with the Office for information technology and electronic administration, created the necessary conditions for the dynamic development of the scientific research and innovation system, especially in relation to the process of digitalization and the establishment of an information platform, in the form of a unified national information system of scientific research activity: eNauka [eScience]. Modernizing the management of the scientific research sector using information and communication technologies aims to connect all available data, record scientific results and, for the first time, implement the electronic business model in the implementation of relevant administrative procedures that lead to the development of scientific research personnel and the improvement of the quality of scientific research work of general interest" (eNauka, Ministry of science, technological development and innovation, 2024).

The end result of this project is of essential importance for the scientific community of the Republic of Serbia, as well as for society as a whole is the fully functional informational system eNauka, with the aim to unify complete scientific production at the one place and to enable verification of scientific results of institutions and researchers as well.

Also, the Strategy for scientific and technological development of the Republic of Serbia for the period from 2021 to 2025, "The Power of Knowledge" (hereinafter referred to as the Strategy), recognized the relevance of scientific research work, which can be seen from the defined general goal of the Strategy "to accelerate development of the Republic of Serbia through improving the quality and efficiency of science, technological development and innovation." The strategy envisages a series of measures that

will at the same time strengthen "1) institutions, 2) researchers and 3) research teams in the scientific research and innovation system". In this Strategy, science is recognized as "an important component of the development of the Republic of Serbia, just like any other society. Technological progress, health, safety, education and national identity rest on the power of science to create, expand and apply knowledge, which determines the overall quality of life of citizens. In the 21st century, the need for top science is even more pronounced, because the further development of the economy and society is increasingly based on knowledge as a key resource, while the number of social challenges that can only be solved with new knowledge is increasing."

The eNauka was opened in full capacity to all active researchers in Serbia on July 3, 2023. The goal of the work is to bring closer to the academic societythe capabilities and performance of the eNauka portal, its structure, the way and importance of data editing, with special reference to issues related to researchers' profiles and their editing.

The performances of the enauka portal and the importance of the unique digital format of scientific production

Digitalization of science is part of the overall process of digitalization of society and economy (Pleskach, et al., 2020). Many authors point to the fact that digitalization is one of the key, if not decisive, characteristics of the modern world (Wachal, 1971). It is emphasized that the scientific community is well on its way to achieving a unique communication infrastructure, and that digitalization - by reducing communication to its basic components - produces a *lingua franca* capable of facilitating universal communication (Dijk, 2006). The digital format and newer media as ways of their preservation and dissemination were recognized in theory even before the national scientific communities started implementing digital technologies (Sassen, 1998; Sanders, 1974). Regardless of omnipresence and visible longstanding influence of digital transformation, it should benoted that until recently, academic literature paid surprisingly little attention to this development. It has only recently begun to deal with the topics of digitalization and digital transformation (Venkatraman, 2017; Verhoef, et al., 2021). Research today points to the fact that digital media have already become the central pillar of global trends in the field of science at the global level (Gorenšek and Kohont, 2019). It is precisely the digital format of scientific production that is the foundation and support of the concept of open science, which can be defined in several ways; many theorists point out that it "actually represents the transformation of science - from closed and traditional learning, to opening, sharing and digital news" (Portal eNauka, 2024), and that "open science is much more than the application of new technologies in the classical process of scientific production" (Smederevac et al., 2020, p. 23). Open science primarily implies "open access to scientific publications, open access to primary data, transparency of scientific communication and methodologies and also a development of digital infrastructure" (Open Science and Open Data, 2024).

The legal and strategic framework in the Republic of Serbia follows the contemporary trends of the concept of open science, open knowledge, digital transformation and a unique digital format of scientific production.

According to Article 3 of the Law on science and research, "Science and research are systematic creative work undertaken for the purpose of creating new knowledge, with the aim of raising the general civilizational level of society and using that knowledge in all areas of social development". According to Article 4 of the same law, "science and research are based on the following principles: freedom and autonomy of scientific and research work; to the public access to scientific and research work and the results of that work, in accordance with the law; scientific and professional criticism; respecting the standards of science and profession; application of international standards and criteria in evaluating the quality of scientific and research work in each field separately, in relation to its specificity; competitiveness and excellence of scientific programs and projects; ethics of scientific and research work, in accordance with the principles of good scientific practice; gender equality in science and research, as well as in decision-making bodies; connections with the education system and especially with the higher education system; openness to international scientific and technological cooperation; conducting research in accordance with the principles of open science; concerns for sustainable development and environmental protection; originality and authenticity".

Article 6 of the Law on science and research regulates with its provisions that in order to increase the

quality and visibility of scientific work, "research should be conducted in accordance with the principles of open science, with optimal use of the scientific research infrastructure." The principle of open science and open access to scientific publications and primary data is based on the recommendations of the European Commission and international good practice. Scientific research infrastructure includes facilities, capital scientific equipment, machinery and objects, information within collections, archives and scientific data, e-infrastructures as well as databases, computer systems and communication networks, services and any other tools necessary to achieve excellence in science and research".

Pursuant to the provisions of Article 8 of the Law on science and research, the goals of the implementation of scientific research activity are: »creating new knowledge to encourage social, technological, cultural, artistic and economic development, increase the social product and raise the standard of citizens and the quality of life; preserving and improving the general fund of knowledge, as a condition for understanding, strengthening and contributing to world development processes; improvement of overall scientific research capacities (human resources and institutions); raising the general level of technologies in the economy and ensuring the competitiveness of goods and services on the domestic and world markets; strengthening of international scientific cooperation and contribution in the regional, European and global research area; support for the creation of innovations for the economy, the transfer of technologies and the strengthening of engineering capacities with the aim of creating comparative advantages on the global market and promoting entrepreneurship; improvement and expansion of the cultural and artistic environment and creative education, with the aim of preserving and affirming national identity as a part of civilizational heritage; systemic encouragement of cooperation between institutions, as well as the mobility of researchers, that is, research and administrative staff within the Serbian, regional, European and global research space".

Serbian scientists and researchers recently received a unique information system called e-Nauka, which represents a significant step forward in the digitalization of scientific processes. This system allows researchers to access all scientific works on the system in one place, which facilitates access to relevant information. "The portal was developed on the basis of the open-source software DSpace-CRIS optimized by 4SCIENCE, which enables maintaining profiles of researchers and scientific research organizations, collecting scientific production, monitoring citations and the like. The eNauka portal is aligned with international standards and practices to enable interoperability and data transfer" (eNauka - instructions, 2024).

The eNauka portal consists of two parts: administrative and scientific. The administrative part is not publicly visible, and contains detailed administrative data about scientific research organizations and researchers. A scientific research organization (NIO) is an accredited institute or higher education institution, as well as an institution of national importance, which meets the requirements for carrying out scientific research activities according to the provisions of the Law on science and research, and which is registered in the Register of scientific research organizations. A researcher is a person who is registered in the Register of researchers, according to the provisions of the Law on science and research. By registering in the Register of researchers, the researcher receives a profile on the eNauka portal, which is linked to their ORCID profile. Each researcher also has a Researcher Identification Number [IBI – Identifikacioni broj istraživača], which is assigned to him or her in the administrative software portal (Portal eNauka, 2024).

The NIO officer, the NIO editor and the researcher are responsible for the editing and accuracy of the data on the eNauka portal.

The NIO officer is a person authorized by the scientific research organization, in charge of editing basic data about the scientific research organization and its researchers (Register of researchers and Register of scientific research organizations in the Republic of Serbia - basic information, 2024).

The scientific part of the eNauka portal is publicly visible, it contains part of the basic data on scientific research organizations, it is edited by NIO editors and researchers, all with the aim of insight into the scientific results of both scientific research organizations and researchers in the Republic of Serbia. The NIO editor is responsible for the accuracy and quality of the data within his scientific research organization, including data on scientific results submitted by researchers. The name of the authorized

NIO editor is publicly available within the detailed data on the profile of the scientific research organization in eNauka. In most cases, the NIO editor is a librarian, less often a researcher. Each scientific research organization decides who would perform this function individually.

A researcher is a person in an active scientific or research title, registered by the NIO officer. Their responsibility is to edit their profile, as well as data on their scientific results.

Regarding the structure of the platform, the eNauka portal consists of four main segments: Scientific and research organizations, Researchers, Results and Statistics.

The results represent publications, technical solutions, patents and the like, which the researcher achieved in their scientific research work. All results are linked to researchers and their NIO (eNauka - instructions, 2024). The results »are displayed with available information (title, list of all authors, publisher, data source, etc.), including all internationally recognized permanent identifiers (e.g. DOI, WoS-ID, Scopus-ID, PubMed-ID). For the results that were downloaded from institutional repositories, a link indicating the original content in the original repository of the institution where the work was deposited is shown. The page for displaying an individual result also shows other data obtained through the normalization process, such as the proposed value of the scientific result (M category), more detailed data on the source of publication (ISSN, journal, ISBN...), as well as all established identifiers. This page is connected to all external sources, so it facilitates the verifiability of data, but also enables the counting of citations" (eNauka, Ministry of science, technological development and innovation, 2024).

On the statistics page, "one can gain insight into the number of publications, citations and the number of active researchers for each NIO" (Portal eNauka, 2024).

As of April 15, 2022, the eNauka portal has downloaded data on scientific results from the Register of researchers of Serbia, the so-called RIS system. Also, scientific results are deposited in eNauka through regular weekly downloads from COBISS, then the National repository of doctoral dissertations and compatible institutional repositories (eNauka - instructions, 2024). Researchers can transpose their scientific results from ORCID.

In addition to the automatic download of results from existing institutional repositories, the COBISS library system, the NaRDUS repository of doctoral dissertations defended, the "Naši u WoS" service, the National Library of Serbia, there is also a manual download of results, initiated by the researcher, from the following available sources: ORCID, by selecting the results taken from the researcher's ORCID profile; Scopus, by specifying the Scopus ID of the work; PubMed, by specifying the PubMed ID of the paper; CrossRef, citing the DOI of the paper. These results will be publicly visible only after verification and approval by the NIO editors (Register of researchers and Register of scientific research organizations in the Republic of Serbia - Basic Information, 2023).

ORCID (Open Researcher and Contributor ID) is an organization that maintains an open and independent database of researchers and their scientific work worldwide. Based on the entered personal and professional data, an alphanumeric code is generated that represents a unique tag for the identification of the researcher. In this way, the problem of recognition of the author is solved and his identifier in the scientific world is permanently defined, being expressed through the ID mark. "This database is interoperable, which means that metadata from other systems can be imported and exported to or from it. It is linked to WoS and Scopus – these two databases supply metadata to ORCID. On the other hand, Web of Science and Scopus use publicly available metadata from ORCID to improve the quality of data on authors (WoS), that is, the quality of author profiles (Scopus) within their systems. Thanks to this integration, both databases can be searched by author's ORCID identifier. If the works cannot be downloaded from any publicly available database, the metadata can be entered in ORCID manually, which means that it is possible to form a complete personal bibliography" (Albahari, 2017).

Nevertheless, the eNauka portal places special emphasis on institutional repositories where all scientific results are deposited in open access. Having said that, it should be also said that open access to scientific publications "implies the right of every Internet user to read, download, save, print and use the digital content of publications without financial expenses, with the obligation to correctly indicate the source of information, and use the content exclusively in accordance with the corresponding license" (Open Science Platform, 2018). Institutional repositories work on the dissemination and improvement of the preservation of the research results of an institution, they increase the visibility of the content whose influence affects potential research. Through their open platforms, they are in the true sense canceling the "one-sided attack" that commercial publishers are making on the research community (Bashir,

2022). Certain metadata about a certain scientific result (article, textbook, monograph, patent, etc.) are deposited in the repository, which are publicly visible even when the full text is not. The obligations of depositing scientific publications in the repository are also stipulated by the Open Science Platform (Open Science Platform, 2018). A special topic, we can even say a doubt, is the depositing of scientific results in repositories, as well as the issue of copyright (Šefkušić, 2018; Šefkušić, 2017).

Methodology and source of research data

The subject of the analysis in the paper is the researcher's profile on the eNauka portal, i.e. the structure and meaning of the tabs that make up the profile of a researcher, as well as ways to edit the profile. The authors of the paper decided to devote research to this topic, bearing in mind that eNauka is a relatively new concept of the Ministry of science, technological development and innovation of the Republic of Serbia, and certainly a new portal that technically supports this concept and operationally realizes it in practice, with the aim of creating unique digital format of scientific production of all researchers, from all scientific research institutions in the Republic of Serbia. Indisputably, in the practical realization of all the performances of the eNauka portal, the role of the NIO officer and the NIO editor is significant, but the key role in editing one's own profile on the eNauka portal is played by the researcher himself.

The paper is methodologically based on a theoretical, preliminary desk analysis of relevant contemporary standpoints in domestic and foreign theory, a normative analysis of current legislative sources, an inductive and deductive approach in researching the operational performance and advantages of the eNauka portal, whose founder and creator is the Ministry of science, technological development and innovation of the Republic of Serbia, as well as the quantitative analysis of relevant statistical indicators of relevant parameters regarding the profile that each researcher has on the eNauka portal, regardless of which scientific field they belong to and regardless of in which scientific research organization they are based and employed.

The research is based on the official data of the portal eNauka, Ministry of science, technological development and innovation, which are available to all registered researchers in the Republic of Serbia (eNauka, Ministry of science, technological development and innovation, 2024). The research includes an analysis of the parameters of all the tabs that make up the structure of the researcher's profile on the portal.

Editing the researcher's profile - opportunities offered by the eNauka portal and discussion

Every researcher who is active and/or employed in a scientific research institution has the opportunity to access or log in to their profile in eNauka. Data that researchers can add to their profile are variants of surname and first name, biography, interests, photos, as well as the addition of certain identifiers (Scopus ID, Researcher ID, Google Scholar ID). In addition to the above, every researcher has the possibility to download data about their scientific results from their ORCID profile, from CrossRef, Scopus and PubMed. When downloading this information, which is not on his profile in eNauka, and in order not to duplicate it, the researcher should first take a closer look at the record that he wants to send to the NIO editor for verification.

It should be noted here that the NIO editor is a person authorized by the NIO, in charge of editing the public profile of the NIO and verifying data on the scientific results of researchers, with possible changes or additions to these data, but not their entry (Register of researchers and Register of scientific research organizations in the Republic of Serbia - basic information, 2024).

The eNauka portal also provides an option for publications, that is, scientific results that already exist in eNauka, but are not attached to the researcher's profile, by using the «Add information to your profile» [Pridružite informacije svom profilu] option. By using this possibility, the researcher actually confirms the authorship, or permanently rejects (removes) it, depending on whether he is the author (or co-author) of a particular paper. The reason for introducing this option is the fact that there are researchers who have the same (or similar) last name and first name, and in this way researchers are involved in order to recognize their scientific results and add them to their profile.

Every researcher has the opportunity to see the list of edited and approved publications (scientific results) that they downloaded from external services and are verified by the NIO editor. Having in mind that certain scientific results are taken from other systems, the researcher can use the «Publications on my profile» [Publikacije na mom profilu] option. By using this option, the researcher has the possibility to view all the scientific results that are on his profile, which were edited and approved by the NIO editor. By using certain filters, the researcher can view the type of his results (conference paper, scientific article, chapter in a monograph, doctoral dissertation, textbook, monograph, etc.), which are numerically expressed for each type of the listed results. Also, the researcher has the possibility to look at how many scientific results there are in a certain period of time. In addition to the above options, by which the researcher can add certain scientific results to their profile and have insight into them, the researcher also has insight into information regarding his employment in a specific scientific research institution, the percentage of full-time employment, the beginning and end of employment, as well as the scientific title, date when theywere elected to the same and the completion of the election to the title, the name of the scientific research institution where he obtained it, as well as the scientific field, scientific branch and narrower scientific field in which they were elected. The researcher does not have the possibility to change the information concerning their scientific title, because it is edited by the NIO officer. However, if theynotice that certain information is incomplete or incorrect, they can contact the NIO officer, whose name is publicly available within the detailed data in the profile of the scientific research organization ueNauka.

Every researcher who is active, i.e. who is employed in a scientific research institution, has an open profile on the eNauka portal, which anyone who is interested (the so-called unregistered user) can have an insight into. The data available on the eNauka portal about each researcher comprise of the following options: profile, details, results, secondary authorships, indicators and statistics.

The profile of each researcher contains certain data about him or her, namely their name and surname, IBI (researcher identification number), their ORCID ID, information about the researcher's status (active or passive). If the researcher is passive, they do not have the possibility to access their profile. As of June 4, 2024, the number of passive researchers is 10,912, while the number of active researchers is 20,352 (eNauka, Researchers, 2024).

By looking at the second option, „detailed", there is an insight into the variants of the name of the researcher, the ID of the Scientific Record of the Autonomous Province of Vojvodina, the affiliation of the researcher and the eCris ID.

When it comes to the title, within this option we have data on the type of title, the title, the name of the scientific research institution where the title was obtained, the scientific field in which the researcher was elected, the scientific branch and the narrower scientific field.

Taking the social sciences as an example, the number of researchers in the field of teaching and associate professions will be listed below.

Table 1. *Teaching and scientific titles in social sciences*

Teachingtitles	Active	Passive	Total
Professor	855	18	873
Asociate professor	651	2	653
Assistant professor	695	6	701
Teaching assistant	399	1	400
Teaching associate	86	/	86
Total	2.686	27	2.713

Source: eNauka – researchers – social sciences, 2024.Accessed on June 4, 2024.

The Results tab contains specific information about the researcher's results. This tab is divided into five columns: year, title, authors, result type and mp-category. Table 2 shows the total number of scientific results by type of publication, expressed numerically. Based on these data, we find out which type of scientific results is represented to the greatest extent in the scientific production of researchers in the Republic of Serbia.

Table 2.*Scientific results by type of publications*

Type of publication	Number
Article	273.566
Conference paper	261.551
Book parts	59.145
Monograph	27.109
Doctoral thesis	21.218
Other*	16.588
Textbook	14.936
Reviews	3.304
Editorial work	13.305
Contribution to periodical	13.116
Encyclopedia entries	8.809
Technical reports	5.336
Arch works	3.539
Patent	2.771
Report works	1.316
Dataset	201
Public policies	156

* Includescritical reviews, abstracts etc.

Source: eNauka – Results, 2024. Accessed on June 16, 2024.

Based on the displayed information on the type of results, in Table 2 we see that researchers mostly publish scientific articles, followed by conference papers.

The Secondary authorship tab located on the researcher's profile also contains five columns; the result type field contains information about the editorial work or doctoral dissertation. This means that a particular researcher was the editor of a certain collection of papers or a magazine, or a mentor or committee member, for a certain candidate (whose name is visible in the column Authors), and the name of the dissertation is shown in the Title column. In order to have insight into whether the researcher was a mentor or a committee member, we need to «open» the record.

In the Indicators tab, the citations of each researcher's scientific results are shown separately in certain citation databases (Scopus, Web of science, Pub med, Open Citations and Dimensions). At this point, it should be emphasized that it is possible to check the citations of individual scientific research institutions, as well as of the entire University.

Evaluating an author's scientific performance is a very demanding and delicate job. A relevant indicator on the basis of which the author's scientific performance is evaluated is the fact of how many times a certain paper is cited, i.e. used as a source in another work, by another author, but with a similar topic. It is clear that we are referring to citations, which is an indicator of the author's scientific performance (Despotov and Ferizović, 2012).

The eNauka portal allows us to see for each researcher the total number of citations in the specified databases, the total number of results (articles) in those and the h-index. It is important to point out that the number of citations shows the citations achieved for works published in that year, and only for those works that are referenced in that (certain) service. The total number of citations in the service is higher in most cases, because it also includes works that are not referenced in that service.

In the next tab, Statistics, every researcher can see their scientific results according to the preliminary M categories, which are expressed numerically, but also in percentage. Also, the results are shown according to the openness of access, as well as according to the type of results in the last ten years, which are also expressed both numerically and as percentage. The abovementioned M categories are of great importance for researchers because they serve to evaluate the quality of scientific results and are relevant in the process of obtaining scientific and research titles, as well as in the process of

re-election to the title, which is regulated by the Rulebook on the procedure, method of valuation and quantitative presentation of scientific research results of the researchers (Official Gazette of RS, no. 24/2016 and 21/2016).

On the right-hand side, next to the mentioned tabs, there is a field called Cooperation. When the researcher «clicks» on this field, the name of the researcher is displayed in the centerof a round diagram, surrounded by the names of the researchers with whom they collaborated, that is, published the works. It is interesting that by clicking on any name of the researcher (from those offered), information about the affiliation of the researcher or co-author can be found. Also, at the very end, each researcher has a Contact field, through which it is possible to contact the researcher, that is, to send them an email.

The following is a statistical presentation of the results of the scientific performance of researchers in the Republic of Serbia, which are available on the eNauka portal and are relevant for the presentation and evaluation of scientific results.

Table 3 summarizes the citations in eNauka in certain databases, as well as the number of indexed works in those.

Table 3. *Cumulative citation of scientific results in eNauka*

Base	Total number of citations	Indexed works
SCOPUS	1.668.640	102.528
PubMed	301.000	61.380
Dimensions	1.361.060	107.126
OpenCitations	1.463.307	302.853

Source: eNauka – Statistics, 2024. Accessed on July 5, 2023

Based on the data from Table 3, we come to know that the largest number of citations is in the SCOPUS database, although the OpenCitations database contains almost three times the number of indexed works. At this point, it is necessary to emphasize that for precisely expressed citation it is necessary that each scientific result contains certain data. More precisely, if it is a scientific article found in the SCOPUS database, it is necessary that the same one found in eNauka contains the ScopusID in order to display its citations, if the work is cited. For a precise display of citations in the Dimensions and OpenCitations databases, it is necessary that the result contains the correct DOI number, while for citations in PubMed, the result must contain the PubMed Central Id.

Table 4 contains information on the total number of active scientific researchers containing certain identifiers, as well as on the number of male and female researchers.

Table 4. *Total number of active researchers - indicators*

Active researchers	Number	Percent
ORCID	18.256	89,49
eCrisID	19.026	93,27
ResarcherID in WOS	1.558	7.64
ScopusID (Scopus Author Identifier)	4.591	22,51
males	9.338	45,78
females	11.061	54,22

Source: eNauka – Statistics, 2024. Accessed on June 15, 2024.

Based on the data shown in Table 4, we see that the largest number of researchers have eCrisID, almost 94%, while almost 90% of researchers have ORCID. Although we can say that a large number of researchers have ORCID, we believe that it is insufficient because it is necessary for the researcher to have access to their profile and to be able to «log in» to the eNauka portal, so it is necessary that this percentage reach 100%. Also, a small number of researchers have a ScopusID. This is a unique permanent identifier assigned to an author who has published a work in journals that are indexed in the SCOPUS database. (Scopus ID and author profile). Since it is automatically assigned to the researcher, we can conclude that not even a quarter of researchers in the Republic of Serbia have published a work in a journal that is indexed in this database. On the other hand, researchers can register themselves in WOS and thus get their ResarcherID in WOS, but it is obvious that they did not use this possibility because

only 7.64% of researchers have this identifier, or researchers did not enter this information in their profile, which is therefore not visible here. When it comes to female and male researchers, we see that there are about 5% more female researchers in eNauka.

Table 5 contains the cumulative number of works by a certain PID, that is, the number and percentage of works containing a certain PID.

Table 5.*Cumulative number of works by specific PID*

PID number	Number of works	Percent
DOI number	179.326	24,7
WOS-UT	142.266	19,6
ScopusID	127.625	17,58
CobissID	223.545	30,79
PubMedID	23.331	3,21
PMCID	9.957	1.37
Unpaywall*	109.475	15.08

* Information available in open access

Source: eNauka – Statistics, 2024. Accessed on June 6, 2024

Based on the data shown in table 5, the largest number of works contain CobissID, based on which we can conclude that a large number of works have been entered into the COBIS database. A slightly smaller percentage, 24.7%, contains a DOI number, while the smallest number of papers contains a PMCID, which is the number assigned by the National Library of Medicine to papers indexed in PubMed (PMID vs PMCID: What's the Difference?). The reason for the, we can say, small presence of certain PIDs in the scientific results of researchers can be twofold. First, certain scientific results, such as e.g. scientific papers published in proceedings very rarely contain specific PIDs and are rarely in open access. Second, it is possible that a large number of scientific papers «accidentally» do not contain a particular PID because the researchers did not enter it. Therefore, it is necessary to appeal that each researcher examines their scientific results in detail and to contact the NIO editor if a certain PID is missing, because it is possible to supplement each scientific result. As far as availability in open access is concerned, there is a tendency of increasing it, with the introduction of a repository that will contain scientific results in open access.

Table 6 summarizes the data on certain identifiers, which are shown in numbers and percentages.

Table 6.*Summary of data on certain identifiers*

NIO that have a repository	123	59,13
NIO with included EC PIC*	166	79,18
NIO with NIO editor registered	202	97,12
NIO with NIO officer registered	204	98,08

*Unique identifier for legal entities included in European funding programmes

Source: eNauka – Statistics, 2024. Accessed on June 15, 2024.

Based on the data presented in Table 6, we see that almost all NIOs are active in eNauka, which is confirmed by the data that 97.12% of NIOs have a registered NIO editor, and 98.5% have a registered NIO officer. The situation is not perfect, but we believe that this percentage will soon reach 100%. When it comes to the number of repositories, we see that it exists in 123 NIOs, which in our opinion is insufficient, but it is necessary to take into account that this platform is still in its «infancy» and over time the situation will improve in this area as well.

Finally, it should be noted that one of the key functions of eNauka is the evaluation of scientific results. More precisely, the system provides the possibility of monitoring and evaluating research results, which is of great importance for the academic community. As it was said at the beginning of the paper, eNauka is based on the principles of open science, and all scientific results of researchers should, accordingly, be available, i.e. in open access. In this way, researchers can better understand the impact of their work and identify areas that require further research.

Conclusion

The eNauka concept is an innovative tool that improves the efficiency and transparency of scientific processes in Serbia. This system enables better monitoring of scientific works, evaluation of scientific research results and more efficient management of administrative affairs at faculties, which contributes to the development of the scientific community and encourages further progress in scientific research.

Every researcher who is active, that is, who is employed in a certain scientific research institution in Serbia, has an open profile on the eNauka portal, which anyone who is interested can have an insight into. The data available on the eNauka portal about each researcher are the following fields: profile, details, results, secondary authorships, indicators and statistics.

The aim of this paper was to bring the capabilities and performance of the eNauka portal closer to the academic public – its structure, method and importance of data editing, with special reference to questions concerning the profile of researchers and their editing. Taking into account that the eNauka portal has been «active» only about a year, as well as the engagement of NIO officers, NIO editors and researchers, as shown by the statistical presentation of the results of the scientific performance of researchers in the Republic of Serbia, shown on the eNauka portal and being relevant for the display and evaluation of scientific results, we conclude that the eNauka portal is of high quality, professionally and successfully set up the entire system, which is also constantly improving.

In order to improve this portal, we believe that it would be of great benefit to the entire scientific community to publish news from the world of science, and, accordingly, to inform the public about the latest scientific discoveries, events and happenings in academic circles. In addition to the above, information about upcoming scientific conferences, symposia, workshops and other events related to science in Serbia can be part of the portal, in order to encourage the exchange of ideas and cooperation among researchers. The portal could provide resources and information about funding for research projects, scholarship opportunities, access to laboratory equipment and everything needed for research work. Apart from the above, the portal could contain educational materials, tutorials and courses from various scientific disciplines, in order to support the continuous education of researchers in the country.

Finally, it should be emphasized once again that one of the key functions of eNauka is the evaluation of scientific results. More precisely, the system provides the possibility of monitoring and evaluating research results, which is of great importance for the academic community. As stated at the beginning of the paper, eNauka is based on the principles of open science, and all scientific results of researchers should, accordingly, be available, that is, they should be in open access. In this way, researchers can better understand the impact of their work and identify areas that require further research.

Conflict of interests

The authors declare no conflict of interest.

Author Contributions

Conceptualization, D.L. and M.D.; writing—original draft preparation, J.M.; writing—review and editing, J.M. and M.D.. All authors have read and agreed to the published version of the manuscript.

References

Albahari, B. (2017). Javno dostupne bibliografije istraživača Srbije – stanje i perspektive [Publicly available bibliographies of Serbian researchers: Conditions and perspectives]. *Čitalište : naučni časopis za teoriju i praksu bibliotekarstva*, 30, 80-94. https://doi.org/10.19090/cit.2017.30.80-94

Banović, J., & Bradić-Martinović, A. (2021). Digitalizacija u službi diseminacije naučnih publikacija u humanističkim i društvenim naukama u Srbiji (empirijski nalazi) [Digitization in the service of dissemination of scientific publications in the humanities and social sciences in Serbia (empirical findings)]. *Književna istorija*, 53(175), 397-419. https://doi.org/10.18485/kis.2021.53.175.17

Bashir, S., Gul, S., Bashir, S., Nisa, N. T., & Ganaie, S. A. (2022). Evolution of institutional repositories: Managing institutional research output to remove the gap of academic elitism. *Journal of Librarianship and Information Science*, *54*(3), 518-531. https://doi.org/10.1177/09610006211009592

Čelik, P. (2021). *Digitalna tranformacija* [*Digital transformation*]. Beograd, Akademska misao.

David, P. A. (2008). The Historical Origins of "Open Science: An Essay on Patronage, Reputation and Common Agency Contracting in the Scientific Revolution. Capitalism and Society. *Capitalism and Society*, 3(2), art. 5. https://doi.org/10.2202/1932-0213.1040

Despotov, M., & Ferizović, S. (2012). The quoting of pieces of work of Slavko Carić, PhD, in a citing basis of SCIndex. *Pravo - Teorija i Praksa*, *29*(4-6), 120–129. Retrieved from https://casopis.pravni-fakultet.edu.rs/index.php/ltp/article/view/224

D'souza, C., & Williams, D. (2017). The digital economy. *Bank of Canada Review*, *2017*(Spring), 5-18. https://ideas.repec.org/a/bca/bcarev/v2017y2017ispring17p5-18.html

eNauka, Ministarstvo nauke, tehnološkog razvoja i inovacija. 25.5.2024. [eScience, Ministry of Science, Technological Development and Innovation]. https://nitra.gov.rs/cir/nauka/enauka

eNauka – Uputstvo. 25.5.2024. [eNauka - Instruction]. https://enauka.gov.rs/help/index.html

eNauka, Istraživači. 4.6.2024. [eNauka, Researchers]. https://enauka.gov.rs/simple-search?query=&location=researcherprofiles&crisID=&relationName=&query=&rpp=50&order=ASC

eNauka – istraživači – društvene nauke. 4.6.2024. [eNauka - researchers - social sciences]. https://enauka.gov.rs/simple-search?query=&location=researcherprofiles&sort_by=null&order=asc&rpp=50&crisID=&relationName=&etal=0&filtername=rp_scifield&filterquery=%D0%94%D1%80%D1%83%D1%88%D1%82%D0%B2%D0%B5%D0%BD%D0%B5+%D0%BD%D0%B0%D1%83%D0%BA%D0%B5&filtertype=equals

Gorenšek, T., & Kohont, A. (2019). Conceptualization of digitalization: Opportunities and challenges for organizations in the Euro-Mediterranean area. *International journal of Euro-Mediterranean studies*, *12*(2), 93-115.

Kolarski, Lj. (2022). Digitalizacija u visokom obrazovanju: slučaj digitalizacije na univerzitetima u Tirani i Beogradu [Digitization in higher education: the case of digitization at universities in Tirana and Belgrade]. *Administracija i javne politike*, 8(2), 49-66. http://repozitorijumips.rs/id/eprint/320

Matijašević, J., Despotov, M. Jakovljević, M., & Bingulac, N. (2024). Portal eNauka – analiza zbirnih rezultata vidljivih svim istraživačima. [eNauka portal – analysis of aggregate results visible to all researchers]. U Dumnić, B. (ur.): *Nastavnici i saradnici kao centar promena u visokom obrazovanju*. Zbornik radova sa XXX skupa Trendovi razvoja, 52-55, Novi Sad, Fakultet tehničkih nauka.

Otvorena nauka i otvoreni podaci, Edukativni moduli o zaštiti intelektualnog vlasništva. 3.6.2024. [Open science and open data, Educational modules on intellectual property protection]. https://unibl.org/uploads/files/vesti/2020/09/vebinar/Open%20Science.pdf

Pleskach, V., Semenchenko, A., Gololobov, D., Kalmykov, O., & Krasnoshchok, V. (2020). Digitalization of Science as a Modern Trend of the Information Society Development*, EasyChair Preprint*, 4354, 1-13.

Portal eNauka. 25.5.2024. [eNauka Portal]. https://proref.rcub.bg.ac.rs/eNauka/eNauka_Uputstvo.pdf

Platforma za otvorenu nauku, Ministarstvo prosvete, nauke i tehnološkog razvoja. 27.05.2024. [Open Science Platform, Ministry of Education, Science and Technological Development] (2018). https://prosveta.gov.rs/wp-content/uploads/2018/07/Platforma-za-otvorenu-nauku.pdf

Pravilnik o postupku, načinu vrednovanja i kvantitativnom iskazivanju naučnoistraživačkih rezultata istraživača [Rulebook on the procedure, method of evaluation and quantitative expression of scientific research results of researchers]."*Sl. glasnik RS", br. 24/2016 i 21/2016*.

PMID vs PMCID: What's the Difference? 16.6.2024. https://nexus.od.nih.gov/all/2015/08/31/pmid-vs-pmcid-whats-the-difference/

Registar istraživača i Registar naučnoistraživačkih organizacija u Republici Srbiji – Osnovne informacije. 26.12.2023. [Register of researchers and Register of scientific research organizations in the Republic of Serbia - Basic information]. https://proref.rcub.bg.ac.rs/eNauka/eNauka_Izvori_podataka.pdf

Registar istraživača i Registar naučnoistraživačkih organizacija u Republici Srbiji - osnovne informacije. 3.6.2024. [Register of researchers and Register of scientific research organizations in the Republic of Serbia - basic information]. https://proref.rcub.bg.ac.rs/eNauka/eNauka_Izvori_podataka.pdf

Sanders, R. (1974). Technology transfer and détente, Police Studies Journal, 3(2), 178-181. https://doi.org/10.1111/j.1541-0072.1974.tb01302.x

Sassen, S. (1998). *Globalization and Its Discontents*. New York, New Press.

Smederevac, S., Pajić, D., Radovanović, S., Ghilezan, S., Čolović, P., & Milosavljević, B. (2020). O*tvorena nauka - praksa i perspektive* [Open science - practice and perspectives], Novi Sad, Univerzitet u Novom Sadu.

Stefanović, M., Đorđević, I., Milosavljević, N., & Đonović, A. (2021). *Analiza stanja inovacija i procesa digitalne tranformacije u Republici Srbiji* [*Analysis of the state of innovation and the process of digital transformation in the Republic of Serbia*,], Beograd, NALED, Beograd.

Strategija naučnog i tehnološkog razvoja Republike Srbije za period od 2021. do 2025. godine „Moć znanja" [The strategy of scientific and technological development of the Republic of Serbia for the period from 2021 to 2025 "Power of knowledge"]. *"Sl. glasnik RS", br. 10/2021*.

Scopus ID and author profile. 16.6.2024. https://research-hub.auckland.ac.nz/researcher-profiles-and-ids/scopus-ID

Šefkušić, M. (2017). Definisanje uređivačkih politika časopisa u otvorenom pristupu u Srbiji i uloga bibliotekara u tom procesu [Defining the editorial policies of open access journals in Serbia and the role of librarians in that process]. *Čitalište: naučni časopis za teoriju i praksu bibliotekarstva*, *30*, 13-26. https://doi.org/10.19090/cit.2017.30.13-26

Šefkušić, M. (2018). Autorska prava i politike samopohranjivanja, Šta smete da deponujete u repozitorijum. 29.05.2024. [Copyright and self-storage policies, What you may deposit in the repository]. https://unic.kg.ac.rs/files/samoarhiviranje.pdf?dff75118b1

Todosijević, B., & Hristić, Lj. (2022). Big data, digitalizacija i novi putevi razvoja istraživanja u društvenim i humanističkim naukama [Big data, digitization and new ways of research development in social sciences and humanities]. U Dokmanović, M. (ur.): *Društvene i humanističke nauke u Srbiji*. Edicija Zbornici, 194-219, Beograd, Srpska akademija nauka i umetnosti, Institut društvenih nauka, Beograd.

VanDijk,T.A.(2006).Discourseandmanipulation.*Discourse&Society*,17(3),359–383.https://doi.org/10.1177/0957926506060250

Venkatraman, V. (2017). The Digital Matrix: New Rules for Business Transformation Through Technology, Vancouver, Canada, Greystone Books.

Verhoef, P. C., Broekhuizen, T., Bart, Y., Bhattacharya, A., Dong, J. Q., Fabian, N., & Haenlein, M. (2021). Digital transformation: A multidisciplinary reflection and research agenda,*Journal of Business Research*, 122, 889-901. https://doi.org/10.1016/j.jbusres.2019.09.022

Wachal, R. (1971). Humanities and Computers: A Personal View, *The North American Review*, University of Northern Iowa. 256 (1), 30-33.

Zakon o nauci i istraživanjima [Law on Science and Research], *"Sl. glasnik RS", br. 49/2019*.

Zdravković, Z. (2022). Digitalizacija naučne građe – metode i rešenja [Digitization of scientific material - methods and solutions]. U Katić, V. (ur.): *Zbornik radova sa LXVI konferencija Etran - International Conference on Electrical, Electronic and Computing Engineering*, 1-6, Beograd, Društvo za ETRAN i Akademska misao.

Original scientific paper

UDC: 004.85:387.014.5(497.11)"2019"

Received: March 07, 2024.
Revised: June 22, 2024.
Accepted: July 06, 2024.

10.23947/2334-8496-2024-12-2-387-397

Check for updates

Students' Attitudes on The Role of Artificial Intelligence (Ai) In Personalized Learning

Radoslav Baltezarević[1*] , *Ivana Baltezarević*[2]

[1] Senior Research Fellow, Institute of International Politics and Economics, Belgrade, Serbia, e-mail: radoslav@diplomacy.bg.ac.rs
[2] Megatrend University, Faculty of Law, Belgrade, Serbia, e-mail: ivana.baltezarevic@gmail.com

Abstract: Educational institutions are increasingly incorporating new technologies into their classrooms, such as artificial intelligence (AI), enabling more innovative teaching methods and learning experiences. Unlike traditional teaching methods, where lecturers adapt their lectures to the needs of the average student, AI-powered educational platforms are more dynamic and productive, as they can be adapted to the preferences, learning styles and pace of each student, enabling personalized learning. The aim of this study is to gather information that will help educators, legislators, and AI developers optimize AI's role in education for increased student achievement by examining students' attitudes toward the implementation of AI in personalized learning. The findings of this study may have an immense effect on how AI is used in educational settings in the future, because they may provide better understanding that would enable students to receive more individualized instruction and autonomy while also increasing pedagogical opportunities and reducing an excessive amount of administrative work for educators. 219 students of Megatrend University in Belgrade participated in the research (all three study levels), to whom the questionnaire was sent by e-mail. The results indicate that students believe that: a) If the application of AI makes learning personalized, the greater the possibility for students to identify their abilities and creativity; b) If lecturers apply the most effective teaching methods using AI, they can significantly automate the monitoring of student progress; c) If innovative and interesting learning opportunities are applied in classes, the greater the interactivity of students in the teaching process; d) AI can examine past student performance to identify areas of difficulty and provide tailored assistance in those areas.

Keywords: *Artificial Intelligence (AI), Personalized Learning, Students, Machine Learning (ML), Intelligent Learning Systems*

Introduction

It is impossible to imagine functioning in today's society without access to Internet-based technologies. Digital interactions affect all aspects of society (Baltezarević, 2022), and they are becoming increasingly important in the education system as well. They improve students' motivation, their academic achievement, and most importantly, make learning enjoyable. They also facilitate communication, distance learning and group project collaboration (Baltezarević and Baltezarević, 2024). Around the world, educational institutions are integrating digital technology at different rates, and many developed nations continue to place a high priority on raising educational standards (Fahimirad and Kotamjani, 2018).

Among the new technologies, artificial intelligence (AI) certainly stands out, which represents the ability of machines or computers to think and act like humans. It shows the efforts of computerized systems to imitate the human mind and actions (Wartman and Combs, 2018). AI software is anticipated to soon outperform human intelligence (Baltezarević, 2022). AI finds use in nearly every sector, including robots, trade, economics, law enforcement, and health care. Additionally, because there is now a shortage

*Corresponding author: radoslav@diplomacy.bg.ac.rs

of qualified personnel in several educational fields, AI technology has an impact on the creation of new approaches to deliver improved teaching methods (Tuomi, 2018). AI has improved education since it has made it possible to build and apply more sophisticated pedagogical tools for online and web-based learning platforms (Mikropoulos and Natsis, 2011). AI in education refers to the use of artificial intelligence technologies, such as machine learning (ML) and natural language processing (NLP), to enhance the learning experience. This technology has the potential to revolutionize the way learning and teaching is done, making it more engaging and effective (Alneyadi et al., 2023). The growing number of students from various locations enrolling in online courses is one of the biggest arguments for the usage of AI in education (Popenici and Kerr, 2017). Even while it seems that active human participation is required for successful education, AI envisions improving education and quality at all levels (Grosz and Stone, 2018).

AI-powered personalized learning platforms are quickly emerging as crucial elements of the current educational revolution. These platforms provide tailored assessments and information by evaluating students' skills using ML algorithms. As students engage with the platform, the AI continuously enhances its understanding of their strengths and weaknesses, ensuring a personalized learning experience that evolves with time (Zohuri and Mossavar-Rahmani, 2024). Intelligent learning systems have a lot to offer instructors of distant learning courses. Digital tools have compelled the learning system to drastically change from in-person to remote delivery. AI in education can facilitate collaborative learning by allowing online group interactions, streamlining arguments, and enabling adaptive groupings based on student profiles (Zawacki-Richter et al., 2019). The ability to cater to different learning styles and individual requirements is one of the amazing features of AI-based personalized learning. Individualized AI-driven learning platforms can offer many learning modalities, including kinesthetic, auditory, and visual methods, because students learn and process information differently. The adaptability of the material allows students to engage with it in a way that best fits their preferred learning style, resulting in a more inclusive and effective learning experience as a whole (Luan and Tsai, 2021). Intelligent tutoring systems, chatbots, and automated grading and evaluation can increase efficiency, save time for instructors, and provide more accurate and consistent feedback. However, there are several drawbacks to adopting AI in the classroom. Privacy and security concerns, lack of trust, cost and potential bias are among the issues that must be addressed in the near future (Jarrah et al., 2022). To ensure that every student receives a personalized learning experience that optimizes their potential, AI algorithms can analyze individual student data, such as learning pace, strengths, and weaknesses, to customize educational content and activities. Global accessibility, increased efficiency, and the creation of cutting-edge instructional resources are unquestionably among the benefits of artificial intelligence in education. In contrast, obstacles encompass worries over data confidentiality, possible prejudices in artificial intelligence algorithms, and the possibility of educators losing their jobs. Maybe, the biggest drawback is that AI is devoid of real emotions, making it unable to truly comprehend and react to human feelings. Providing each student with personalized tutoring would be extremely expensive without AI. In the not-too-distant future, personalized learning experiences can be customized through the use of AI, improving academic achievement and easily meeting a range of learning requirements (Milberg, 2024).

Artificial intelligence (AI) and the education sector

Artificial intelligence (AI) relies on algorithms, which are sets of rules and instructions that computers follow to solve problems and do tasks. ML is based on statistical learning techniques and employs data and algorithms to carry out tasks that frequently call for human intelligence. ML algorithms first analyze the data to look for patterns, and then they build models that are used to predict values into the future (Akgun and Greenhow, 2022). ML based on artificial neural network is known as deep learning (DL). DL models outperform shallow ML models and conventional data analysis techniques in many applications (Janiesch et al., 2021).

AI is increasingly being integrated into teaching, learning and administration in the field of education (Chassignol et al., 2018) and can improve data analysis, allowing lecturers to make more appropriate decisions. It can also increase student participation by offering interactive and engaging learning opportunities (Wardat et al., 2022). AI may adjust the level of difficulty of learning exercises, suggest areas for development, and provide pertinent learning resources. One of the main advantages of personalized learning is that it guarantees that every student gets the support and instruction necessary

to realize their full potential. It also enables advanced students to be challenged at their own level while enabling lower-achieving students to catch up (Gningue et al., 2022). Also, AI can examine past student performance to identify areas of difficulty and provide tailored assistance in those areas (Alarabi and Wardat, 2021). However, given recent data breaches and cyberattacks, there are security and privacy issues regarding the acquisition and use of student data by AI-based systems (Pedro, F., Subosa et al., 2019). Cyberattacks on educational institutions put students' safety in danger in addition to causing disruptions and financial losses. In order to stop cyber security dangers from happening, schools and universities need to recognize them and put defenses in place (Colaco, 2024).

The multi-billion-dollar e-Learning sector is expanding globally. AI technology is one of the main drivers of this market. The education AI market is predicted to reach a whopping $80 billion by 2032, with the generative AI market growing at a projected annual rate of nearly 77% (Ames, 2023). The number of people using various AI tools, such as text, generative imaging, and more fundamental ML tools, will increase significantly over the next few years. There are currently just over 250 million users of AI tools, and that figure is predicted to triple to over 700 million by 2030 (Thormundsson, 2023). Less than half of the 1,000 students surveyed by BestColleges admitted to using AI for their studies. About half of those who have used AI report that they use it not only to gather information, but also to complete tasks or tests (Welding, 2023). In a study of more than 5,000 Swedish university students, 95% of participants indicated they had heard of artificial intelligence (AI), 56% stated they would use it in their studies, and 35% said they used it frequently. Sixty-eight percent of students who used AI reported that it improved their performance. However, almost half of instructors say they use generative AI when they plan their lessons. This entails doing pertinent research and creating engaging lesson plans (Balderson, 2023).

One of the main drawbacks of traditional education is that, despite having diverse knowledge bases, learning objectives, and needs, all students must follow the same learning sequence. Traditional educational resources suggest that students complete a set of learning procedures in order to improve their academic performance. Not every student must adhere to a predetermined course of study. One of the main goals of modern educational program designers is to create personalized learning pathways that include the needs, motivations, interests, behavior patterns, and talents of each student (Elshani and Nuçi, 2021). AI makes people aware of fresh technological options that give students choices and encourage creative methods of instruction. The development of this technology mimics human speech (speech synthesis, human-computer dialogue, machine translation, speech recognition), listening (machine translation), thinking (theorem proving), learning (machine learning, intelligent adaptive learning), and action (robotics), leading to the creation of personalized learning paths (Huang et al., 2021). AI in education will lessen lecturers' burden, tailor instruction, provide possibilities for successful learning, assist students in identifying their strengths, and foster creativity (Humble and Mozelius, 2019).

Multiple facets of education, including thinking and language abilities, can be impacted by advanced intelligence. For example: a) AI can administer continuous assessments to assess students' proficiency in different courses. These dynamic assessments provide a clear view of the progress made by the students. b) Based on assessments, AI is able to suggest or show the content that is best suited for each student. This procedure can incorporate text-based information, movies, interactive simulations, and more. c) AI is able to adjust the learning pace to the student's needs. Quick learners can advance to more challenging content, while slower learners can receive more instruction. d) By analyzing how students interact with the content, AI can identify the preferred learning style of each student (visual, auditory, kinesthetic, etc.) and adjust the content delivery to meet their needs. e) AI can give prompt feedback on homework and exams, assisting students in identifying areas for improvement by offering more details or explanation when necessary (Thinkful, 2024). Intelligent education systems can provide timely, personalized instruction and feedback to both instructors and students. Increasing the value and efficacy of learning is the goal of using a variety of computing technologies, particularly those associated with ML (Kahraman et al., 2010).

Artificial intelligence (AI) and personalized learning

Despite not being a novel concept, personalized learning is finding new applications as big data analytics and AI advance (Magomadov, 2020). By "personalization", we imply that every student receives customized instruction and evaluation. It is possible to identify appropriate content and evaluate stu-

dents' performance levels using an AI-based system. For instance, if a student struggles with a particular subject, the lesson may be repeated using a different approach to instruction (Rodrigues et al., 2019). Personalized learning systems and approaches motivate students to learn and improve academic performance (Zlatarov et al., 2021). However, calculating a personalized delivery system comes with a lot of challenges. For personalized systems to work, there must be a skilled and effective mechanism in place that allows for ongoing student assessments and the determination of their proper comprehension level. Models based on DL and ML can be used to find and match the appropriate amount of content for each learner (Panjaburee et al., 2022).

Educational institutions are quickly implementing chatbots, automated assessment systems, facial recognition software, personalized learning systems, and predictive analytics tools driven by ML algorithms to assure effective teaching. Intelligent learning systems, which provide instructors and students with access to a variety of instructional resources based on their particular learning requirements, are among the most well-liked and practical uses of AI (Akgun and Greenhow, 2022). The underlying idea of intelligent learning systems is that students use a responsive interface that adjusts learning according to the user's experience and academic standing. But the main benefit of AI-driven systems is their capacity to quickly decipher extraordinarily complex data streams. This implies that the future generation of intelligent learning systems will require user interfaces that gather historical data that can be utilized to generate student profiles and real-time behavioral patterns (European Commission et al., 2018).

With the use of state-of-the-art ML and AI technologies, Gradescope is a platform that assists educators in evaluating the progress of their students. The platform is helpful since it frees up lecturers' time that would be used to grade assignments. Through data collection, Gradescope identifies student needs and classroom trends (Skylight.science, 2023). Increased productivity and support for instructors in the classroom could come from an intelligent teaching assistant called Botty. This training application has a number of features that help, including online question answering, auto-correction, and intelligent assessment (Li et al., 2016). The educational platform Knowji is an audio-visual tool based on student development research. It arranges academic data and reflects typologies of cognitive categories. The program integrates the most effective techniques to make learning successful while maintaining enjoyment of the process by using an algorithm to create a psychological profile of each student (Web, 2023). An AI tool called Knewton Alta is designed to help instructors grade assignments and encourage learning. This educational software provides quick instructions, concise explanations, and a hands-on learning experience. Students can choose a customized path according to their individual goals and requirements. Technology monitors the development of students and responds instantly to enhance learning results (Nosenko, 2020). Lastly, AI software Cognii specializes on AI-powered evaluation instruments, particularly for assessing essays. It gives tutors fast, in-depth feedback on students' writing, enabling them to focus on particular areas that need improvement (Fullestop, 2023).

The adaptive transmission of information, which is primarily made possible by AI algorithms, is the cornerstone of personalized learning (Khonturaev, 2023). AI has revolutionized assessment procedures by going beyond traditional exam formats to more dynamic and adaptive strategies. Student performance data is analyzed by ML algorithms to uncover patterns, weaknesses, and strengths. Tests that are tailored to the individual learning paths of each student are developed using this data. Instructors may quickly and effectively address particular learning gaps and make modifications to their course plans with the help of AI-powered evaluation tools (Gardner et al., 2021). Personalized learning and student engagement go hand in hand by nature. The more personalized a lesson is, the more likely it is that a student will remain interested in it. Students are prone to disregard or pay insufficient attention to the lesson if nothing can capture their interest (Dahlberg, 2023). Personalized learning systems driven by AI have the potential to improve student performance by 30% (Solomons, 2023), on the other hand AI is capable of automating many tasks and keeping track of students' progress. It may also assist instructors in using the best teaching strategies while considering the academic performance and learning environment (Chaudhry and Kazim, 2022).

Objective of the research

This paper investigates the effects of the application of artificial intelligence on the personalized learning of students. Considering that artificial intelligence (AI) is a new concept and is not yet applied

to a sufficient extent in the education process, the aim of the research in this paper was to examine the attitudes of students on the application of new methods in learning, i.e. what are their attitudes concerning the kind of educational alterations that might occur if instructors include AI advancements in the teaching process.

In order to achieve the goal of the research, one general and three auxiliary hypotheses were formulated:

H_0: If learning is personalized through the application of AI, the possibility for students to identify their abilities and creativity is greater.

H_1: If lecturers apply the most effective teaching methods using AI, they can significantly automate the monitoring of student progress.

H_2: If innovative and interesting learning opportunities are applied in classes, the greater the interactivity of students in the teaching process.

H_3: AI can examine students' past performance to identify areas of difficulty and provide tailored help in those areas.

Materials and Methods

Pattern and procedure

The questionnaire used to examine students' attitudes was sent to the e-mail addresses of students at all three levels of study with a note that the research is being conducted exclusively for the purposes of scientific research. The sample on the basis of which the research was conducted includes 219 students of the Megatrend University in Belgrade, namely: 117 (53.4%) male and 102 (46.6%) female (M=1.47, SD=0.500), of which 142 (64.8%) undergraduate students, 55 (25.1%) master's students and 22 (10.0%) doctoral students (M=1.45, SD=0.671). The structure of respondents in relation to age shows that 149 (68.0%) students aged 18-25, 51 (23.3%) students aged 26-35 and 19 (8.7%) students participated in the research aged 36-45 (M=1.41, SD=0.645).

The questionnaire was created so that three questions were constructed with the purpose of determining the socio-democratic characteristics of the respondents: gender, age and professional education. Then, 18 statements were formulated that examined the attitudes of the participants about the use of artificial intelligence (AI) in education. Data were processed using a software package for data analysis and processing (IBM SPSS statistic). The analysis of the obtained data was processed using descriptive statistics (average value - M and standard deviation - SD) and statistical inference. To evaluate the obtained values of Spearman's rank correlation coefficient rho and Pearson's correlation r, we relied on the value scale according to which the correlation is weak when $r \geq 0.1$, moderately strong when $r \geq 0.3$ and strong when $r \geq 0.5$ (Field, 2009, p. 100).

Instruments

Out of a total of 18 variables, for further analysis of the specific research task set in this work, 8 were selected from which a subscale was composed. The reliability of the scale was measured by Cronbach's alpha coefficient, which showed that α =876. The mean values of the subscale range from 2.81 to 3.49, which shows a high value of the internal consistency of the scale (Briggs and Cheek, 1986, p.115).

Descriptive statistics, scale reliability analysis and correlation analysis were used in the analysis.

The format of responding to the stated statements was analyzed using a five-point Likert-type scale (from 1 = I do not agree at all to 5 = I completely agree).

Results

In order to check the validity of H_0 by correlation analysis, we compared the respondents' attitudes regarding the following statements: (T1) The application of AI enables the personalization of learning (M=3.38, SD=1.108) and (T2) Personalized learning systems and approaches motivate students (M=3, 49, SD=1.276).

Table 1. *Presentation of correlation results and coefficient of determination for H_0*

Symmetric Measures

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Gamma	.558	.063	7.788	.000
	Spearman Correlation	.506	.061	8.637	.000[c]
Interval by Interval	Pearson's R	.508	.061	8.688	.000[c]
N of Valid Cases		219			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on normal approximation.

The analysis of the results shown in Table 1 indicates that Chi square test of independence, which shows us the statistical significance of the impact on the result $\chi 2(16,1) = 261.497^a$, $p<0.01$. Significance ($p \leq .05$) indicates how certain can be that the relationship. $p<0.01$ shows that the intersection of variables is statistically significant. Spearman's rank correlation coefficient rho=0.506 and Pearson's linear correlation r = 0.508 indicates how strong the relationship is and in what direction, and in this case reflect a positive strong correlation and a direct connection between the application of AI that leads to the personalization of learning and motivation of students. Association measure Gamma shows how much of the variation in the changing variable (T1) is explained by the changing variable (T2). Gamma coefficient 0.558 means that knowing the level of acceptance of the first statement improves the prediction of acceptance of the second statement by 55.8%. H_0 was confirmed considering that a strong correlation was established between the statements offered and a high correlation was established between these two variables.

In order to verify the validity of H_1 by correlation analysis, we compared the views of the respondents regarding the statements made: (T3). The application of AI enables the most effective teaching methods (M=2.81, SD=1.259) and (T4) Automation of depositing and data analysis is necessary to monitor student progress. (M=3.33, SD=1.201).

Table 2. *Presentation of correlation results and coefficient of determination for H_1*

Symmetric Measures

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Gamma	.592	.063	7.842	.000
	Spearman Correlation	.543	.060	9.536	.000[c]
Interval by Interval	Pearson's R	.581	.049	10.528	.000[c]
N of Valid Cases		219			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on normal approximation.

The analysis of the results shown in Table 2 indicates that Chi square test of independence, which shows us the statistical significance of the impact on the result $\chi 2(16,1) = 303.201^a$, $p<0.01$. Significance ($p \leq .05$) indicates how certain can be that the relationship. $p<0.01$ shows that the intersection of variables is statistically significant. Spearman's rank correlation coefficient rho=0.543 and Pearson's linear correlation r = 0.581 reflects how strong the relationship is and in what direction, and in this case indicate a positive strong correlation and a direct connection between the application of AI as the most effective teaching methods, and automation of depositing and data analysis for monitoring student progress.

Association measure Gamma shows how much of the variation in the variable (T3) is explained by the variable (T4). Gamma coefficient 0.592 means that knowing the level of acceptance of the first statement improves the prediction of acceptance of the second statement by 59.2%. H_1 was confirmed considering that a strong correlation was established between the statements offered, and a high correlation was established between these two variables.

In order to verify the validity of H_2 by correlation analysis, we compared the respondents' attitudes regarding the following statements: (T5) Teaching should provide students with innovative and interesting learning opportunities (M=3.43, SD=1.226) and (T6) Students' interactivity in the teaching process depends on interesting aspects of the teaching process (M=3.35, SD=1.062).

Table 3. *Presentation of correlation results and coefficient of determination for H_2*

Symmetric Measures

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Gamma	.458	.072	5.845	.000
	Spearman Correlation	.394	.065	6.306	.000[c]
Interval by Interval	Pearson's R	.430	.062	7.008	.000[c]
N of Valid Cases		219			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on normal approximation.

The analysis of the results shown in Table 3 indicates that Chi square test of independence, which shows us the statistical significance of the impact on the result $\chi 2(16,1) = 104.031^a$, $p<0.01$. Significance ($p \leq .05$) indicates how certain can be that the relationship. $p<0.01$ shows that the intersection of variables is statistically significant. Spearman's rank correlation coefficient rho=0.394 and Pearson's linear correlation r =0.430 reflects how strong the relationship is and in what direction, and in this case indicate a positive strong correlation and a direct connection that indicates that innovative and interesting learning opportunities in the teaching process depends on interesting aspects of the teaching process.

Association measure Gamma shows how much of the variation in the variable (T5) is explained by the variable (T6). Gamma coefficient 0.458 means that knowing the level of acceptance of the first statement improves the prediction of acceptance of the second statement by 45,8%. H_2 was confirmed considering that a strong correlation was established between the statements offered and a high correlation was established between these two variables.

In order to verify the validity of H_3 by means of a correlation analysis, we compared the respondents' attitudes regarding the following statements: (T7) The application of AI should be focused on the analysis of difficulties that affected the slow progress of students (M=3.21, SD=1.153) and (T8) Determination of the factors that led to the slowing down of students' progress is the basis for finding methods for providing adapted help to students (M=3.13, SD=1.085).

Table 4. *Presentation of correlation results and coefficient of determination for H_3*

Symmetric Measures

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Gamma	.682	.058	10.638	.000
	Spearman Correlation	.613	.054	11.438	.000[c]
Interval by Interval	Pearson's R	.614	.053	11.446	.000[c]
N of Valid Cases		219			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on normal approximation.

The analysis of the results shown in Table 4 indicates that Chi square test of independence, which shows us the statistical significance of the impact on the result $\chi 2(16,1) = 192.760^a$, $p<0.01$. Significance ($p \leq .05$) shows how certain can be that the relationship. $p<0.01$ indicates that the intersection of variables is statistically significant. Spearman's rank correlation coefficient rho=0.613 and Pearson's linear correlation r =0.614 reflects how strong the relationship is and in what direction, and in this case indicate a positive strong correlation and a direct connection that shows that the application of AI should be focused on the analysis of difficulties that affected the slow progress of students and determination of the factors that led

to the slowing down of students' progress is the basis for finding methods for providing adapted help to students.

Association measure Gamma shows how much of the variation of the dependent variable (T7) is explained by the dependent variable (T8). Gamma coefficient 0.682 means that knowing the level of acceptance of the first statement improves the prediction of acceptance of the second statement by 68,2%. H_3 was confirmed considering that a strong correlation was established between the statements offered and a high correlation was established between these two variables.

Discussion

The incorporation of contemporary technologies into the classroom is a logical progression of teaching approaches. The impact of new technology on education encourages lecturers and educational institutions to reconsider their existing methods because it is nearly impossible to envisage creating engaging learning experiences and drawing in new students without innovation. Programs to determine each student's strengths and weaknesses are widely available today, while artificial intelligence (AI) can significantly contribute to making learning more personal. Artificial intelligence (AI) solutions for education use complex algorithms to evaluate large data sets with the goal of modifying curriculum based on this data (student progress) so that students can advance at their own speed and get support when they need it.

Every student has a unique way of responding to information. Some people take in the information immediately, while others require more time. AI makes ensuring that educational software is customized for each user in the realm of education. Furthermore, the system leverages auxiliary technologies like machine learning (ML) to support the way students comprehend different topics and adjusts to that process to minimize effort. Educators and researchers can also generate creative content for easy teaching and learning using AI and ML. They devote a lot of time to administrative tasks like test grading and classroom organization. But a lot of these tasks can be completed by AI, giving lecturers more time to focus on instructing and interacting with students. Additionally, AI can identify patterns in student performance and notify instructors of any issues before they become unmanageable. Since students can access online material from anywhere at any time, AI-assisted education is not restricted by space or time. But even with all the potential benefits, there are drawbacks and ethical quandaries associated with using AI in the classroom. This kind of AI-powered learning offers accessibility and flexibility, which is especially important for those students who find it difficult to attend classes in person due to barriers related to their location or their jobs. In order to address common issues like algorithm transparency, equal access to technology, and student data protection, more time and effort must be put into developing new hardware and software as well as providing students with sufficient digital education. In any case, AI will be fully integrated into the education sector in the near future. As a society we must embrace this transformation and work together to ensure that education remains a source of progress and opportunity in an ever-evolving world.

For the purposes of research, in this paper, students presented their views and the role of artificial intelligence in the education sector, with a special emphasis on the role of AI in personalized learning. According to the results, it can be concluded that if learning is personalized through the application of artificial intelligence (AI), the greater the possibility that students will identify their abilities and creativity. This is consistent with a prior study that found that integrating AI into the classroom could reduce the workload for instructors, offer opportunities for effective learning, help students discover their strengths, and foster creativity (Humble and Mozelius, 2019). Students believe that if lecturers apply the most effective teaching methods using AI, they will be able to significantly automate the monitoring of student progress. This result is in line with Chaudhry and Kazim's study findings, which show that AI can automate a variety of tasks and monitor students' academic development. Additionally, by taking academic performance and the learning environment into account, it could help instructors implement the most successful methods of teaching (Chaudhry and Kazim, 2022). Also, the majority of students believe that if innovative and interesting learning opportunities are applied in classes, the more interactive the students will be in the teaching process. Wardat and his coauthors reached the same conclusion in their research, which is that AI can boost student interactions by providing dynamic and entertaining learning opportunities (Wardat et al., 2022).

Conclusions

The aim of this study was to investigate students' perspectives regarding the use of AI in personalized learning in order to obtain data that will assist legislators, educators, and AI developers in optimizing AI's role in education for higher student accomplishment. This study shows that students accept the claim that AI can examine students' past performance to identify areas of difficulty and provide tailored help in those areas. Given that AI technology is still in the early stages of development, more time is needed for its further development and elimination of all existing problems. Also, additional studies would more precisely examine the impact of AI on lecturers, students and the education sector as a whole and offer a more adequate understanding of all the advantages and disadvantages of intelligent learning systems in relation to uniform traditional teaching methods.

The study makes a valuable contribution to the field of educational technology and AI, with a strong foundation for future research and practical applications. The findings of this empirical study have the potential to be extended through additional research involving different populations of respondents, implementation and evaluation contexts, and evaluation methods. In light of our findings, we recommend that future research concentrate on a thorough investigation of the implications of artificial intelligence (AI) in education and closely look at the ways in which these applications enhance students' creativity, interaction, and learning outcomes. In addition to making lecturers' administrative tasks easier by enabling the automation of student progress tracking, special attention should be given to how AI pedagogical methods might increase student interest and engagement.

Acknowledgements

The paper presents findings of the study developed as a part of the research project "Serbia and challenges in international relations in 2024", financed by the Ministry of Education, Science, and Technological Development of the Republic of Serbia, and conducted by Institute of International Politics and Economics, Belgrade.

Conflict of interests

The authors declare no conflict of interest.

Author Contributions

Conceptualization, B.R., and B.I.; methodology, B.R.; software, B.R.; formal analysis, B.R.; writing—original draft preparation, B.R. and B.I.; writing—review and editing, B.R. and B.I. All authors have read and agreed to the published version of the manuscript.

References

Akgun, S., & Greenhow, C. (2022). Artificial intelligence in education: Addressing ethical challenges in K-12 settings. *AI Ethics* 2, 431–440. https://doi.org/10.1007/s43681-021-00096-7

Alarabi, K., & Wardat, Y. (2021). UAE-based teachers' hindsight judgments on physics education during the COVID-19 pandemic. *Psychology and Education Journal, 58*(3), 2497–2511. https://doi.org/10.17762/pae.v58i3.4283

Alneyadi, S., Wardat, Y., Alshannag, Q., & Abu-Al-Aish, A. (2023). The effect of using smart e-learning app on the academic achievement of eighth-grade students. *EURASIA Journal of Mathematics, Science and Technology Education*, *19*(4), em2248. https://doi.org/10.29333/ejmste/13067

Ames, S. (2023). AI Technology in Education Statistics 2023: Report and 300+ Audience Survey. https://www.rask.ai/research/ai-in-education

Balderson, K. (2023). 27 AI In Education Statistics You Should Know. https://mspoweruser.com/ai-in-education-statistics

Baltezarević, R. (2022). Digitalna pismenost kao sredstvo prevencije protiv sajber kriminala. *Baština,* 32(57), 131-139. https://doi.org/10.5937/bastina32-38103

Baltezarević, R. (2023). Uticaj veštačke inteligencije na globalnu ekonomiju. *Megatrend revija, 20*(3), 13–24. https://doi.org/10.5937/MegRev2303013B

Baltezarević, I., & Baltezarević, R. (2024). The effect of new technology on improving student motivation in the learning process. In M. Mollaoğlu & H. Çiftçi (Eds.), *5. International Mediterranean Congress: Proceedings: IKSAD - Congress Book,* Full Papers, January 13-14, 2024, Mersin, Türkiye (pp. 677 – 681). Ankara: Institute of economic development and social researches.

Briggs, Stephen R., and Jonathan M. Cheek. "The role of factor analysis in the development and evaluation of personality scales." *Journal of personality* 54.1 (1986): 106-148. https://doi.org/10.1111/j.1467-6494.1986.tb00391.x

Chassignol, M., Khoroshavin, A., Klimova, A., & Bilyatdinova, A. (2018). Artificial intelligence trends in education: A narrative overview. *Procedia Computer Science, 136*, 16–24. https://doi.org/10.1016/j.procs.2018.08.233

Chaudhry, M., & Kazim, E. (2022). Artificial Intelligence in Education (Aied) a high-level academic and industry note 2021. *AI and Ethics*, *2*(1), 157-165. https://doi.org/10.1007/s43681-021-00074-z

Colaco, S. (2024). How Can Educational Institutions Mitigate Cybersecurity Threats in Education? https://kitaboo.com/how-educational-institutions-mitigate-cybersecurity-threats-in-education/

Dahlberg, E. (2023). A New Way to Personalize Learning, Thanks to AI. https://www.edsurge.com/news/2023-08-14-a-new-way-to-personalize-learning-thanks-to-ai

Elshani, L., & Nuçi, K.P. (2021). Constructing a personalized learning path using genetic algorithms approach. ArXiv, abs/2104.11276

Fahimirad, M., & Kotamjani, S.S. (2018). A review on application of artificial intelligence in teaching and learning in educational contexts. *International Journal of Learning and Development, 8*(4), 106-118. https://doi.org/10.5296/ijld.v8i4.14057

Field, A. (2009). *Discovering statistics using SPSS: Book plus code for E version of text* (Vol. 896). London, UK: SAGE Publications Limited.

Fullestop (2023). Personalized Learning: How AI Is Shaping the Future of Education. https://www.fullestop.com/blog/personalized-learning-how-ai-is-shaping-the-future-of-education

Pedro, F., Subosa, M., Rivas, A., & Valverde, P. (2019). Artificial intelligence in education: Challenges and opportunities for sustainable development. Working papers on Education Policy,UNESCO Published by the United Nations Educational, Scientific and Cultural Organization, 7, place de Fontenoy, 75352 Paris 07 SP, France. http://repositorio.minedu.gob.pe/bitstream/handle/20.500.12799/6533/Artificial%20intelligence%20in%20education%20challenges%20and%20opportunities%20for%20sustainable%20development.pdf

Gardner, J., O'Leary, M., & Yuan, L. (2021). Artificial intelligence in educational assessment:'Breakthrough? Or buncombe and ballyhoo?'. *Journal of Computer Assisted Learning, 37*(5), 1207-1216. https://doi.org/10.1111/jcal.12577

Gningue, S. M., Peach, R., Jarrah, A. M., & Wardat, Y. (2022). The Relationship between Teacher Leadership and School Climate: Findings from a Teacher-Leadership Project. *Educ. Sci., 12*(11), 749. https://doi.org/10.3390/educsci12110749

Grosz, B. J., & Stone, P. (2018). A century-long commitment to assessing artificial intelligence and its impact on society. *Communications of the ACM, 61*(12), 68–73. https://doi.org/10.1145/3198470

Huang, J., Saleh, S. & Liu, Y. (2021). A review on artificial intelligence in education. *Academic Journal of Interdisciplinary Studies, 10*(3), 206–206. https://doi.org/10.36941/ajis-2021-0077.

Humble, N., & Mozelius, P. (2019). Artificial Intelligence in Education-a Promise, a Threat or a Hype?. In P. Griffiths & M. N. Kabir (Eds.), *European Conference on the Impact of Artificial Intelligence and Robotics 2019 (ECIAIR 2019)*, Full Papers, October 31st - November 1st, 2019, Oxford, UK (pp. 149–156). Manchester, Academic Conferences and Publishing International Limited. http://urn.kb.se/resolve?urn=urn:nbn:se:miun:diva-37620

Janiesch, C., Zschech, P. & Heinrich, K. (2021). Machine learning and deep learning. *Electronic Markets,* 31, pp. 685–695. https://doi.org/10.1007/s12525-021-00475-2

Jarrah, A.M., Wardat, Y., & Gningue, S. (2022). Misconception on addition and subtraction of fractions in seventh-grade middle school students. *Eurasia Journal of Mathematics, Science and Technology Education*, *18*(6), em2115. https://doi.org/10.29333/ejmste/12070

Kahraman, H. T., Sağiroğlu, Ş., & Colak, I. (2010). Development of adaptive and intelligent Web-based educational systems, in T. Bourtir & R. Neji (Eds) Proceedings: *4th International Conference on Application of Information and Communication Technologies, AICT2010*, Full Papers, October 12 – 14, 2010, Tashkent, Uzbekistan (pp. 1–5). New York City, Institute of Electrical and Electronics Engineers. https://doi.org/10.1109/ICAICT.2010.5612054

Khonturaev, S. I. (2023). The Evolution Of Artificial Intelligence: A Comprehensive Exploration For Higher Education. *Best Journal of Innovation in Science, Research and Development*, *2*(11), 700-706. http://www.bjisrd.com/index.php/bjisrd/article/view/939

Li, Z., Jin, H., & Yue, L. (2016). Artificial intelligence brings the newpattern of "Internet + Education". *Telecommunications Network Technology*, *12*, 6-10. http://open.oriprobe.com/issues/1725366/toc.htm

Luan, H., & Tsai, C. C. (2021). A review of using machine learning approaches for precision education. *Educational Technology & Society*, *24*(1), 250-266. http://index.j-ets.net/Published/24_1/ETS_24_1_19.pdf

Magomadov, V.S. (2020). The application of artificial intelligence and Big Data analytics in personalized learning. *Journal of Physics: Conference Series, 1691*(1), 012169. https://doi.org/10.1088/1742-6596/1691/1/012169

Mikropoulos, T., & Natsis, A. (2011). Educational Virtual Environments: A Ten-Year Review of Empirical Research (1999-2009). *Computers & Education, 56*(3), 769-780. http://dx.doi.org/10.1016/j.compedu.2010.10.020

Milberg, T. (2024). The future of learning: How AI is revolutionizing education 4.0. https://www.weforum.org/agenda/2024/04/future-learning-ai-revolutionizing-education-4-0/

Nosenko, Y. (2020). Alta solution from knewton as a tool of support for adaptive learning in mathematics. *Educational Discourse: collection of scientific papers*. *28*(11), 69-81. https://doi.org/10.33930/ed.2019.5007.28(11)-6

Popenici, S. A. D., & Kerr, S. (2017). Exploring the impact of artificial intelligence on teaching and learning in higher education. *Research and Practice in Technology Enhanced Learning*, *12*(1), 22. https://doi.org/10.1186/s41039-017-0062-8

Panjaburee, P., Komalawardhana, N., & Ingkavara, T. (2022). Acceptance of personalized e-learning systems: A case study of concept-effect relationship approach on science, technology, and mathematics courses. *Journal of Computers in Education, 4*, 681-705, https://doi.org/10.1007/s40692-021-00216-6

Rodrigues, H., Almeida, F., Figueiredo, V. & Lopes, S. L. (2019). Tracking e-learning through published papers: A systematic review. *Computers & Education, 136*(1), pp. 87–98. https://doi.org/10.1016/j.compedu.2019.03.007

Skylight.science (2023). Gradescope. https://skylight.science.ubc.ca/lt/guides/gradescope

Solomons, M. (2023). 90 AI statistics: applications, design principles, and challenges. https://www.linearity.io/blog/ai-statistics/

Thinkful (2024). AI and Education: Personalized Learning and Adaptive Curriculum. https://www.thinkful.com/blog/ai-and-education-personalized-learning-and-adaptive-curriculum/

Thormundsson, B. (2023). Worldwide AI tool user growth 2020-2030. https://www.statista.com/forecasts/1425996/ai-tool-user-amount

Tuomi, I. (2018). The Impact of Artificial Intelligence on Learning, Teaching, and Education, Cabrera Giraldez, M., Vuorikari, R. and Punie, Y. editor(s), EUR 29442 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-97257-7, https://doi.org/10.2760/12297 , JRC113226.

Tuomi, I., Punie, Y. & Vuorikari, R. (2018). *The impact of Artificial Intelligence on learning, teaching, and education*, Luxembourg: European Commission, Joint Research Centre, Publications Office. https://doi.org/https://doi.org/10.2760/12297

Wardat, Y., Belbase, S., & Tairab, H. (2022). Mathematics teachers' perceptions of trends in international mathematics and science study (TIMSS)-related practices in Abu Dhabi Emirate schools. *Sustainability*, *14*(9), 5436. https://doi.org/10.3390/su14095436

Wartman, S. A., & Combs, C. D. (2018). Medical education must move from the information age to the age of artificial intelligence. *Academic Medicine*, *93*(8), 1107–1109. https://doi.org/10.1097/ACM.0000000000002044

Web, B. (2023). Knowji AI Tool For Education Review: Pro Or Cons 2023 New Updated. https://aistoryland.com/knowji/

Welding, L. (2023). Half of College Students Say Using AI on Schoolwork Is Cheating or Plagiarism. https://www.bestcolleges.com/research/college-students-ai-tools-survey/

Zawacki-Richter, O., Marín, V.I., Bond, M. & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education–where are the educators? *International Journal of Educational Technology in Higher Education*, *16*(1), 39. https://doi.org/10.1186/s41239-019-0171-0

Zlatarov, P., Ivanova, E., Ivanova, G., & Doncheva, J. (2021). Design and development of a web-based student screening module as part of a personalized learning system. *TEM Journal, 10*(3), 1454–1460. https://doi.org/10.18421/TEM103-58

Zohuri, B., & Mossavar-Rahmani, F. (2024). Revolutionizing Education: The Dynamic Synergy of Personalized Learning and Artificial Intelligence. *International Journal of Advanced Engineering and Management Research, 9*(1), 143 - 153. http://dx.doi.org/10.51505/ijaemr.2024.9111

Original scientific paper

Received: February 23, 2024.
Revised: August 05, 2024.
Accepted: August 23, 2024.

UDC:
004.738.5:316.624-053.4/.6(497.11)
316.624-053.4/.6:004.738.5
10.23947/2334-8496-2024-12-2-399-406

Check for updates

The Impact of Peer and Cyberbullying on Elementary School Children in the Republic of Serbia

Lazar Stošić[1*], *Irena Stošić*[2], *Aleksandra Janković*[3]

[1] Faculty of Management, Sremski Karlovci, University UNION Nikola Tesla, Belgrade; Don State Technical University, Rostov-on-Don, Russian Federation, e-mail: lazar.stosic@famns.edu.rs
[2] Primary School Dositej Obradović, Vranje, Serbia, e-mail: irenastosic@yahoo.com
[3] Academy of Professional studies South Serbia – Leskovac, Department of Preschool Teacher Training School Bujanovac, Serbia, e-mail: aleksandra.j78@gmail.com

Abstract: This study examines the prevalence of various forms of peer bullying among elementary school children, with a particular focus on the rising issue of cyberbullying. Utilizing a specially constructed Likert scale, the research gathered data from a sample of 98 children, composed of 51 boys and 47 girls, across grades five to eight. The findings reveal that verbal abuse, such as name-calling, mocking, and insulting, is the most common form of bullying experienced by children. Physical bullying behaviors like hitting, pushing, and kicking are also prevalent. Furthermore, the study highlights the significant presence of cyberbullying, characterized by malicious online messaging and social media interactions, which often result in emotional distress and withdrawal from social activities. The reliability and internal consistency of the measurement scale were confirmed by a Cronbach's Alpha coefficient of 0.775. The results underscore the importance of addressing both traditional and cyber forms of bullying to ensure a safer school environment. The study advocates for comprehensive educational programs that promote digital literacy and empathy among children to mitigate the negative impacts of bullying. Additionally, the research suggests implementing effective intervention strategies that include prompt responses to reported bullying incidents and providing support to victims. This study contributes to the growing body of literature on bullying by offering insights into the dynamics of peer and cyberbullying, emphasizing the need for continuous monitoring and preventive measures within educational settings.

Keywords: *Peer bullying, Cyberbullying, Verbal abuse, Physical violence, Elementary school*

Introduction

Each of us experiences some form of violence during childhood, whether as a perpetrators of violence, a victim, or merely a witness to violence against others. Violence has always existed, but it did not receive as much attention in the media as it does today. Nowadays, our television screens are filled with numerous images and films depicting violence. Wherever we are—at school or on the streets—we encounter an increase in violent behavior and a rise in juvenile delinquency, which has naturally become a societal problem. Violence encompasses any behavior aimed at intentionally causing harm or inflicting pain, whether psychological or physical.

According to the Rules on the protocol of procedures in institutions in response to violence, abuse and neglect (2024), "violence is defined as any form of verbal or non-verbal behavior, whether it occurs once or repeatedly, that results in actual or potential harm to the health, development, and dignity of children/pupils."

There are numerous definitions of violence because each author strives to provide a comprehensive definition; however, no one has yet succeeded due to the complex nature of the concept itself. Violence or abuse among children can be categorized into direct and indirect violence based on its form. Direct violence refers to situations where the victim is consistently attacked through direct harm, such as physical injury, verbal abuse, theft of money, etc. Indirect violence refers to situations where the victim is

*Corresponding author: lazar.stosic@famns.edu.rs

consistently attacked through indirect harm, such as spreading rumors and falsehoods about a child to their peers, persuading peers to avoid befriending a particular child, etc. (Baldry, 2003).

There are various classifications of violence based on its form, intensity, and duration. The types of violence are challenging to clearly distinguish as they often overlap and combine. Stajić, Miljković, and Stanarević (2006) emphasize that violence can be passive or active. They consider passive violence to be neglect and abuse, while active violence includes physical, psychological, or sexual abuse of varying intensities.

According to the Special Protocol for the Protection of Children and Pupils from Violence, Abuse, and Neglect in Educational Institutions (2009), there are various forms of violence, including:

- Physical violence: hitting, kicking, pushing, slapping, hair-pulling, choking, throwing, attacking with a weapon, etc.
- Emotional/Psychological violence: belittling, labeling, ignoring, insulting, blackmailing, name-calling, gossiping, mocking, ridiculing, excluding, extorting, manipulating, and other forms of hostile behavior.
- Sexual violence: sexual harassment, inducing or forcing pupils to participate in sexual activities, using pupils for prostitution, pornography, etc.
- Electronic violence: messages sent via email, SMS, and MMS that often contain threats, insults, sexual harassment, and similar content.

In a study conducted in 2004, 24% of children confirmed that they had experienced violence in school. Mocking, insulting, teasing, or taunting (verbal violence) was the most common form of violence recognized by students in this study (Gašić-Pavišić, 2004).

A study conducted by Popadić and Plut (2007) highlights that 65.3% of children experienced some form of peer violence within a three-month period. This research found that the most common forms of peer violence were insulting (45.6%) and gossiping (32.6%).

Ožegović conducted a study aimed at identifying the most common forms of aggressive behavior among elementary school children and determining the causes of aggression and reactions to aggressive behavior. The results of this study showed that more than two-thirds of children had been exposed to some form of aggressive behavior, while 39.92% of children had not experienced it. The most prominent forms of aggression identified were: swearing (50%), mocking (44%), physical attacks (43%), threats (25%), and extortion of money (9%). In most cases (53.16%), students openly admitted to exhibiting some form of aggressive behavior themselves (Ožegović, 2008).

Cyberbullying – A New Form of Violence Among Adolescents

From traditional forms of violence, today's so-called cyberbullying has become increasingly prevalent, where children are exposed to various forms of violence via the internet. Cyberbullying can be defined as "any behavior performed through electronic or digital media by individuals or groups that repeatedly communicate hostile or aggressive messages intended to inflict harm or discomfort on others" (Tokunaga, 2010, p. 278). A distinctive feature of this type of violence is the absence of temporal and spatial limitations for its occurrence. This form of violence is treated as a unique type due to its lack of temporal and spatial constraints, the large number of observers, and the frequent anonymity of the perpetrators (Bozbayindir, 2019). This research focuses on peer bullying, which includes verbal and physical aggression such as name-calling, mocking, hitting, and pushing, and cyberbullying, which involves harmful behaviors conducted through digital platforms like social media and messaging services.

Characteristics of cyberbullying among school children include malicious messaging, sharing offensive or false information, creating fake profiles, and online exclusion from groups. Cyberbullying often results in emotional stress, poor academic performance, and withdrawal from social activities. Numerous studies have shown that the increased use of digital technologies and social networks contributes to the growing trend of cyberbullying among children. Serbia is one of the countries that has decided to sanction cyberbullying by applying existing criminal laws (Janković and Stošić, 2022, p. 105).

The occurrence of bullying and cyberbullying among children and adolescents, along with concerns about their negative implications, has led to an increasing number of publications focusing on this topic (Cretu and Morandau, 2024, p. 372). As we continue to discuss cyberbullying, "future research should be more specific about possible mediating factors between different types of victimization and

demographic categories (such as gender), socialization processes (e.g., family type), children's social skills development, and other psychological factors (e.g., self-esteem)" (Savahl, Adams, and Hoosen, 2024, p. 23). It is also important to note that cyberbullying is linked to the consequences of internet addiction, and the "internet addiction disorder should indeed be considered a general disorder under which there are other disorders directly related to the internet" (Bjelajac, Filipović and Stošić, 2022, p. 59). Additionally, artificial intelligence, which is continually advancing, offers new avenues for autonomous systems to exploit data for harmful outcomes with every new application of this technology (Bjelajac, Filipović, and Stošić, 2023, p. 530).

Research Methods

The subject of this research is the identification of forms of peer bullying in school. The aim of this research is to identify the prevalence of various forms of peer bullying.

The tasks in this research are:

1. How common is peer bullying and cyberbullying among elementary school children in some school in Serbia?
2. What are the most common forms of peer bullying and cyberbullying?
3. To examine whether children are more exposed to name-calling.
4. To examine whether children are more exposed to rumor spreading in order to attract attention.
5. To examine whether children more frequently engage in name-calling.
6. To examine whether children more frequently engage in rumor spreading to attract attention.
7. To examine whether children have been minimally exposed to peer bullying throughout their entire schooling.

The research included 98 children, consisting of 51 boys and 47 girls. From the fifth grade, 20 children participated, accounting for 20.4%, with 13 boys and 7 girls. From the sixth grade, 30 children participated, accounting for 30.6%, with 13 boys and 17 girls. From the seventh grade, 18 children participated, accounting for 18.4%, with 12 boys and 6 girls. From the eighth grade, 30 children participated, accounting for 30.6%, with 13 boys and 17 girls. The table shows that we have the same number of male participants in the fifth, sixth, and eighth grades, while the highest number of female participants is in the sixth and eighth grades.

Table 1. *Structure of Participants by Gender and Grade*

			Grade				Total
			Fifth	Sixth	Seventh	Eighth	
Gender	Male	Total	13	13	12	13	51
		% total	13.3%	13.3%	12.2%	13.3%	52.0%
	Female	Total	7	17	6	17	47
		% total	7.1%	17.3%	6.1%	17.3%	48.0%
Total		Total	20	30	18	30	98
% total			20.4%	30.6%	18.4%	30.6%	100.0%

In our sample of 98 participants (100% valid sample), the value of the Cronbach's Alpha coefficient (Cronbach's Alpha = 0.775) demonstrates very good reliability and internal consistency of the scale for this sample, thus meeting the reliability criterion.

Results

The analysis of the research results reveals that peer bullying is prevalent among elementary school children, with verbal abuse being the most common form. The study also indicates a significant presence of cyberbullying, highlighting the need for effective interventions. The findings underscore the importance of addressing both traditional and modern forms of bullying to create a safer school environment.

Table 2. *Frequency of Bullying Behavior Experienced by Children*

	Never		Happened once or twice		Happened multiple times		Almost every day	
	F	%	F	%	F	%	F	%
I have experienced being called names, mocked, or insulted by other children.	41	**41.8**	36	**36.7**	13	**13.3**	8	**8.2**
I have experienced being hit, pushed, and kicked.	61	**62.2**	33	**33.7**	3	**3.1**	1	**1**
They have tried to turn other children against me by gossiping and spreading lies about me.	59	**60.2**	24	**24.5**	12	**12.2**	3	**3.1**
I have experienced having my money and other belongings taken away, and my things being destroyed.	90	**91.8**	6	**6.1**	1	**1**	1	**1**
I have experienced being threatened and intimidated.	81	**82.7**	15	**15.3**	2	**2**	0	**0**
I have been forced to do things I did not want to do and to behave badly.	87	**88.8**	9	**9.2**	1	**1**	1	**1**
I have experienced being touched in an uncomfortable way and have been sexually harassed.	84	**85.7**	7	**7.1**	3	**3.1**	4	**4.1**
Someone spread the story that you were on drugs.	92	**93.9**	4	**4.1**	0	**0**	2	**2**
Someone is spreading rumors about you to attract attention to themselves.	71	**72.4**	20	**20.4**	4	**4.1**	3	**3.1**
Someone said in front of your friends that you flatter the teacher	64	**65.3**	22	**22.4**	8	**8.2**	4	**4.1**
Someone has called you selfish and stingy in front of everyone.	74	**75.5**	17	**17.3**	5	**5.1**	2	**2**
Friends are avoiding you because of your low social status.	93	**94.9**	2	**2**	2	**2**	1	**1**
I have received SMS messages with unpleasant content.	88	**89.8**	7	**7.1**	1	**1**	2	**2**
Friends have threatened me through the social network Facebook.	89	**90.8**	7	**7.1**	1	**1**	1	**1**

For the first statement, "I have experienced being called names, mocked, or insulted by other children," 41 respondents (41.8%) answered that they have never experienced being called names, mocked, or insulted. A total of 36 respondents (36.7%) answered that they have experienced this once or twice. Thirteen respondents (13.3%) reported that this has happened multiple times, and 8 respondents (8.2%) stated that they experience this almost every day.

For the statement, "I have experienced being hit, pushed, and kicked," 61 respondents (62.2%) answered that they have never experienced this, 33 respondents (33.7%) stated that it happened once or twice, three respondents (3.1%) reported that it happened multiple times, and one child (1%) stated that they experience this almost every day.

For the statement, "They have tried to turn other children against me by gossiping and spreading lies about me," 59 respondents (60.2%) answered "never," 24 respondents (24.5%) stated that this happened once or twice, 12 respondents (12.2%) reported that it happened multiple times, and three respondents (3.1%) stated that this happens almost every day.

From the presented table, we can see that 90 respondents (91.8%) stated that they have never experienced having their money and other belongings taken away or having their belongings destroyed. Six children (6.1%) reported that this happened once or twice, while only one respondent reported that it happened multiple times. Among the respondents, there is one children who stated that they experience money and belongings being taken away almost every day.

For the next statement, "I have experienced being threatened and intimidated," 81 respondents (82.7%) answered that they have never experienced this, while 15 respondents (15.3%) stated that it happened once or twice. Two respondents (2%) reported that it happened multiple times, and none of the respondents experienced this type of violence every day.

Regarding the statement, "I have been forced to do things I did not want to do and to behave badly," 87 respondents (88.8%) answered that they have never been forced. Nine respondents (9.2%) reported

that this happened once or twice. One respondent reported that it happened multiple times, and one respondent experienced it almost every day.

For the final statement, "I have experienced being touched in an uncomfortable way and have been sexually harassed," 84 respondents (85.7%) answered that they have never experienced this type of violence, seven respondents (7.1%) reported experiencing it once or twice, three respondents (3.1%) stated that it happened multiple times, and four respondents (4.1%) reported experiencing this type of violence almost every day.

For the statement, "Someone has spread rumors that you are using drugs," 92 respondents (93.9%) answered "never." Four respondents (4.1%) reported that this happened once or twice. Interestingly, no one reported that it happened multiple times, while two respondents (2%) stated that it happens almost every day.

For the statement, "Someone is spreading rumors about you to attract attention to themselves," 77 respondents (72.4%) answered "never," 20 respondents (20.4%) reported that this happened once or twice, four respondents (4.1%) stated that it happened multiple times, and three respondents (3.1%) reported that it happens almost every day.

For the statement, " Someone said in front of your friends that you flatter the teacher," 64 respondents (65.3%) answered negatively. Twenty-two respondents (22.4%) reported that this happened once or twice. Eight respondents (8.2%) stated that it happened multiple times, while four respondents (4.1%) reported that it happens almost every day.

For the statement, "Someone has called you selfish and stingy in front of everyone," 74 respondents (75.5%) answered "never." Seventeen respondents (17.3%) reported that this happened once or twice. Five respondents (5.1%) stated that it happened multiple times, and only two respondents (2%) reported that it happens almost every day.

For the statement, "Friends are avoiding you because of your low social status," 93 respondents (94.9%) indicated that their friends do not avoid them. Two respondents (2%) stated that this happened once or twice, and another two stated that it happened multiple times. Only one respondent reported that it happens almost every day.

Regarding the statement, "I have received SMS messages with unpleasant content," 88 respondents (89.8%) said they have never received such messages, 7 respondents (7.1%) reported that it happened once or twice, only one respondent stated that it happened multiple times, and two respondents reported that it happens almost every day.

For the statement, "Friends have threatened me through the social network Facebook," 89 respondents (90.8%) answered that they have not received threats. Seven respondents (7.1%) reported that they experienced threats once or twice, one respondent stated that it happened multiple times, and another one reported that it happens almost every day.

For the statement, "I have called other children names, mocked, or insulted them," 48 respondents (49%) answered "never," 39 respondents (39.8%) said it happened once or twice, seven respondents (7.1%) reported that it happened multiple times, and four respondents (4.1%) stated that they called other children names or mocked them almost every day.

Regarding the statement, "I have hit, pushed, and kicked a children," 65 respondents (66.3%) answered "never," 21 respondents (21.4%) said it happened once or twice, seven respondents (7.1%) reported that it happened multiple times, and five respondents (5.1%) stated that it happened almost every day.

For the statement, "I have persuaded children not to be friends with a particular children," 89 respondents (90.8%) answered "never," six respondents (6.1%) said it happened once or twice, no one reported that it happened multiple times, and three respondents (3.1%) stated that it happened almost every day.

For the statement, "I have taken money and other belongings from a children and destroyed their things," 95 respondents (96.9%) answered that they have never done this. One children reported that it happened once or twice. No one reported that it happened multiple times, while only two children stated that they did this almost every day.

Table 3. *Frequency of Bullying Behavior Perpetrated by Children*

	Never		Happened once or twice		Happened multiple times		Almost every day	
	F	%	F	%	F	%	F	%
I have called other children names, mocked, or insulted them.	48	**49**	39	**39.8**	7	**7.1**	4	**4.1**
I have hit, pushed, and kicked a children.	65	**66.3**	21	**21.4**	7	**7.1**	5	**5.1**
I have persuaded children not to be friends with a particular children.	89	**90.8**	6	**6.1**	0	**0**	3	**3.1**
I have taken money and other belongings from a children and destroyed their things.	95	**96.9**	1	**1**	0	**0**	2	**2**
I have threatened and intimidated a children.	81	**82.7**	14	**14.3**	2	**2**	1	**1**
I forced the children to do what he didn't want to do and to appear ugly.	95	**96.9**	2	**2**	0	**0**	1	**1**
I touched the children in an unpleasant way and I sexually harassed him/her.	85	**86.7**	6	**6.1**	3	**3.1**	4	**4.1**
You spread the story that one of your friends is using drugs.	97	**99**	1	**1**	0	**0**	0	**0**
You spread rumors about someone else or a friend to draw attention to yourself.	92	**93.9**	6	**6.1**	0	**0**	0	**0**
You talked about how one of the children flatters the teacher.	48	**49**	34	**34.7**	11	**11.2**	5	**5.1**
You called someone selfish and miserly in front of everyone.	67	**68.4**	25	**25.5**	4	**4.1**	2	2
I avoided my friends because of their insufficient social status.	93	**94.9**	4	**4.1**	0	**0**	1	**1**
You sent SMS messages with unpleasant content.	95	**96.9**	0	**0**	1	**1**	2	**2**
You threatened someone via the Facebook social network.	93	**94.9**	4	**4.1**	0	**0**	1	**1**

Regarding the statement, "I have threatened and intimidated a children," 81 respondents (82.7%) stated that they never threatened anyone, 14 respondents (14.3%) said they threatened someone once or twice, two respondents reported that they threatened others multiple times, and only one respondent stated that they did this almost every day.

For the statement, "I have forced a children to do things they did not want to do and to behave badly," 95 respondents (96.9%) answered that they never forced other children. Two respondents stated that they forced others once or twice. No one reported forcing others multiple times, while only one children stated that they did this almost every day.

For the statement, "I have touched a children in an uncomfortable way and have sexually harassed them," 85 respondents (86.7%) answered "never." Six respondents (6.1%) reported that it happened once or twice, three respondents (3.1%) stated that it happened multiple times, and four respondents (4.1%) stated that it happened almost every day.

Regarding the statement, "I have spread rumors that one of my friends is using drugs," 97 respondents (99%) answered "never," one respondent reported that it happened once or twice. No respondents reported that it happened multiple times or almost every day.

For the statement, "I have spread rumors about a friend to attract attention to myself," 92 respondents (93.9%) answered "never," six respondents (6.1%) reported that it happened once or twice, and no respondents stated that it happened multiple times or almost every day.

For the statement, "You talked about how one of the children flatters the teacher" 48 respondents (49%) answered "never," 34 respondents (34.7%) said it happened once or twice, 11 respondents (11.2%) reported that it happened multiple times, and 5 respondents (5.1%) stated that it happens almost every day.

Regarding the statement, "I have called someone selfish and stingy in front of everyone," 67 respondents (68.4%) answered "never," 25 respondents (25.5%) said it happened once or twice, 4 respondents stated that it happened multiple times, and 2 respondents (2%) reported that it happens almost every day.

For the statement, "I have avoided friends because of their low social status," 93 respondents

(94.9%) answered "never," 4 respondents (4.1%) said it happened once or twice. No one reported that it happened multiple times, and only 1 respondent stated that it happens almost every day.

Regarding the statement, "I have sent SMS messages with unpleasant content," 95 respondents (96.9%) answered "never," none reported that it happened once or twice, 1 respondent stated that it happened multiple times, and 2 respondents (2%) reported that it happens almost every day.

For the statement, "I have threatened someone through the social network Facebook," 93 respondents (94.9%) answered that they have never threatened anyone through Facebook. Four respondents (4.1%) said it happened once or twice. No one reported that it happened multiple times, and only one respondent stated that it happens almost every day.

Table 4. *Exposure to Violence Throughout Entire Schooling*

	Frequency	%	Valid %	Cumulative %
Never	50	51.0	51.0	51.0
Happened once or twice	38	38.8	38.8	89.8
Happened multiple times	8	8.2	8.2	98.0
Almost every day	2	2.0	2.0	100.0
Total	98	100.0	100.0	

The table presents the frequency and percentage of children' exposure to peer bullying throughout their schooling. Results present that:

- Never: 50 children (51.0%) reported that they have never been exposed to peer bullying.
- Happened once or twice: 38 children (38.8%) experienced bullying once or twice.
- Happened multiple times: 8 children (8.2%) reported multiple instances of bullying.
- Almost every day: 2 children (2.0%) faced bullying almost every day.

Overall, more than half of the children have never experienced peer bullying, while a significant portion has encountered it at least once or twice, indicating that bullying is a recurring issue for a minority of the children.

Conclusion

From the obtained results, we can conclude that children are most frequently exposed to name-calling, mocking, or insulting. To a lesser extent, children are exposed to being touched in uncomfortable ways, sexually harassed, and being accused of flatters the teacher in front of their peers. Additionally, we can conclude that children most frequently exhibit violence through hitting, pushing, and kicking other children, and spreading rumors about others that flatters the teacher. Regarding the overall exposure to violence throughout their schooling, we can conclude that more than half of the children have never experienced violence.

On the other hand, the emerging form of violence, cyberbullying among children, requires a comprehensive approach that includes education, prevention, and intervention. It is important for schools and parents to educate children about safe internet use and the dangers of cyberbullying. Moreover, it is necessary to develop programs that promote empathy and digital literacy. Intervention includes quick and effective responses to reported cases of cyberbullying, providing support to victims, and ensuring appropriate consequences for perpetrators.

The research reveals that over half of the children have never encountered bullying, indicating a generally safe school environment; however, 38.8% have experienced bullying once or twice, and 10.2% have faced it multiple times or almost daily, underscoring that a significant minority still struggles with persistent bullying. The prevalence of both peer and cyberbullying suggests a pressing need for targeted interventions and comprehensive anti-bullying strategies. Schools should focus on fostering a culture of empathy and digital literacy to prevent cyberbullying and ensure quick responses to incidents. The implications are clear: while many children feel safe, efforts must continue to protect those vulnerable to bullying and to educate all children on the impact of such behaviors. This dual approach can help create a more inclusive and supportive educational environment, emphasizing the necessity of ongoing vigilance

and prevention initiatives.

In summary, while peer bullying in schools is not highly prevalent, it is essential to continue with violence prevention efforts in schools, as well as to educate about the new form of violence—cyberbullying—from the very beginning of schooling.

Conflict of interests

The authors declare no conflict of interest.

Author Contributions

Conceptualization, L.S., I.S. and A.J.; methodology, L.S., I.S.; writing—original draft preparation, L.S., I.S. and A.J.; writing—review and editing, L.S., I.S. and A.J.; Analysis, discussion and conclusion, L.S., I.S. and A.J.; All authors have read and agreed to the published version of the manuscript.

References

Baldry, A. C. (2003). Bullying in schools and exposure to domestic violence. *Child abuse & neglect,* 27(7), 713-732. https://doi.org/10.1016/S0145-2134(03)00114-5

Bjelajac, Ž., Filipović, A. M., & Stošić, L. V. (2022). Internet Addiction Disorder (IAD) as a Consequence of the Expansion of Information Technologies. *International Journal of Cognitive Research in Science, Engineering and Education (IJCRSEE)*, 10(3), pp. 155–165. https://doi.org/10.23947/2334-8496-2022-10-3-155-165

Bjelajac, Željko, Filipović, A. M., & Stošić, L. (2023). Can AI be Evil: The Criminal Capacities of ANI. *International Journal of Cognitive Research in Science, Engineering and Education (IJCRSEE)*, *11*(3), 519–531. https://doi.org/10.23947/2334-8496-2023-11-3-519-531

Bozbayindir, G. B. (2019). Cyberbullying and criminal law. *İstanbul Hukuk Mecmuası*, *77*(1), 425-450. https://doi.org/10.26650/mecmua.2019.77.1.0009

Cretu, D. M., & Morandau, F. (2024). Bullying and cyberbullying: a bibliometric analysis of three decades of research in education. *Educational Review*, *76*(2), 371-404. https://doi.org/10.1080/00131911.2022.2034749

Gašić-Pavšić, S. (2004). Mere i programi za prevenciju u školi [Measures and programs for school prevention], *Zbornik instituta za pedagoška istraživanja*, Beograd: Institut za pedagoška istraživanja, 36, 168-188.

Janković, A. V., & Stošić, L. V. (2022). Cyberbullying legislation: the role of cyberbullying law. *Pravo - Teorija i Praksa*, *39*(4), 97–108. https://doi.org/10.5937/ptp2204097J

Ministarstvo prosvete Republike Srbije (2009). Priručnik za primenu posebnog protokola za zaštitu dece i učenika od nasilja, zlostavljanja i zanemarivanja u obrazovno-vaspitnim ustanovama [Manual for the implementation of a special protocol for the protection of children and students from violence, abuse and neglect in educational institutions]. Beograd: UNICEF.

Ožegović, D. (2008). Uloga škole u prevenciji agresivnog ponašanja učenika [The role of the school in the prevention of aggressive student behavior], *Naša škola, 1-2*, 57-67.

Pravilnik o protokolu postupanja u ustanovi u odgovoru na nasilje, zlostavljanje i zanemarivanje [Rules on the protocol of procedures in institutions in response to violence, abuse and neglect]. *Službeni glasnik RS, br. 11/2024*.

Popadić, D., & Plut, D. (2007). Nasilje u osnovnoj školi u Srbiji – oblici i učestalost. *Psihologija, 40*(2), 309-328. https://doi.org/10.2298/PSI0702309P

Savahl, S., Adams, S., & Hoosen, P. (2024). Children's Experiences of Bullying Victimization and the Influence on Their Subjective Well-Being: a Population-Based Study. *Child Indicators Research*, *17*(1), 1-29. https://doi.org/10.1007/s12187-023-10084-4

Stajić, Lj., Miljković, S., & Stanarević, S. (2006). Bezbednosna kultura mladih: kako živeti bezbedno [Youth safety culture: how to live safely]. Beograd: Draganić.

Tokunaga, R. S. (2010). Following you home from school: A critical review and synthesis of research on cyberbullying victimization. *Computers in human behavior*, *26*(3), 277-287. https://doi.org/10.1016/j.chb.2009.11.014

Original scientific paper

Received: May 10, 2024.
Revised: July 09, 2024.
Accepted: July 30, 2024.

UDC:
37.091.12:005.963(497.11)
00:437.091.322.7(497.11)
10.23947/2334-8496-2024-12-2-407-417

Check for updates

Predictors of ICT Integration in Teaching: The Role of Teachers' ICT Self-Efficacy and ICT Infrastructure

Marijana Momčilović[1*], *Stefan Ninković*[1]

[1] Faculty of Philosophy, University of Novi Sad, Serbia
e-mail: marijana.momcilovic@ff.uns.ac.rs, stefan.ninkovic@ff.uns.ac.rs

Abstract: Information and Communication Technologies (ICT) have the potential to enhance teaching and learning and influence the development of students' digital competencies. However, harnessing the potential of ICT in a way that contributes to positive student outcomes poses a challenge for many teachers. The question arises as to whether providing adequate ICT infrastructure in schools facilitates access and, therefore, the use of ICT in teaching. Additionally, it is significant to examine the role of teachers' knowledge and beliefs in this context. Therefore, this study aimed to explore the relationship between teachers' perception of ICT infrastructure in schools, ICT self-efficacy, and ICT integration. The study involved 590 teachers from primary and secondary schools in Serbia. By conducting multiple regression analysis, significant effects of teachers' ICT self-efficacy and perception of available ICT equipment in schools on the use of ICT in teaching activities were obtained. ICT self-efficacy explains the criterion variable to a greater extent. The paper concludes with recommendations for future research and practice.

Keywords: *Information and Communication Technologies (ICT), teachers' ICT self-efficacy, ICT infrastructure, ICT integration, teachers*

Introduction

The digitalization of school systems presents numerous challenges worldwide (Drossel, Eickelmann and Vennemann, 2020). Educational technologies are attributed with the potential to enhance the quality of teaching and, consequently, student learning (Chauhan, 2017; OECD, 2015). Technology can impact specific aspects of teaching quality, such as student cognitive engagement during learning, providing personalized feedback, and adapting teaching to individual students (Kunter, Klusmann, Baumert, Richter, Voss and Hachfeld, 2013). Therefore, it is important to promote teaching practices focused on students rather than conventional content-focused practices (Tondeur, Pareja Roblin, van Braak, Voogt and Prestridge, 2017).

Furthermore, fostering students' digital literacy is considered crucial for future education and professional advancement (Geisinger, 2016). In this context, numerous national and international initiatives have been launched. The European Commission emphasizes that every citizen must have digital competencies to participate in 21st-century society (Carretero, Vuorikari and Punie, 2017). Regarding factors that support or hinder teachers' use of technology in teaching, one possibility is distinguishing between material factors (e.g., school resources) and non-material factors related to teacher variables (Eickelmann, 2011).

Technological innovation involves another significantly challenging aspect compared to other educational innovations related to the required financial investments (Lomos, Luyten and Tieck, 2023). Despite the observed high availability of digital devices per student and the quality of ICT resources, in some countries, the use of ICT in teaching practice remains low, as found in the ICILS 2018 study (Fraillon, Ainley, Schulz, Friedman and Duckworth, 2019). The quality of technology integration concerns teachers' motivational factors (Backfisch, Lachner, Stürmer and Scheiter, 2021; Taimalu and Luik, 2019;

*Corresponding author: marijana.momcilovic@ff.uns.ac.rs

Vongkulluksn, Xie and Bowman, 2018). Previous research indicates a positive correlation between technology integration and teachers' self-efficacy in using technology in the classroom (Taimalu and Luik, 2019). At the same time, beliefs about the usefulness of technology for teaching purposes have been linked to the quantity and quality of technology use (Backfisch et al., 2021). The Republic of Serbia also participates in the international ICILS 2023 study, which will provide data on predictors of ICT use in the national education system (Institute for the Evaluation of the Quality of Education and Upbringing, 2023).

ICT Infrastructure

ICT infrastructure is a necessary condition for teachers to use ICT and refers to computers, digital tools, and a well-functioning internet connection (Lomos et al., 2023). Therefore, ICT infrastructure in schools is largely determined by the ICT equipment itself and the available technical-pedagogical support, which is an essential characteristic for the successful implementation of new technologies in teaching and learning processes (Gerick, Eickelmann and Bos 2017; Vanderlinde and van Braak, 2010).

However, countries with educational systems characterized by a high level of available ICT resources for teaching and learning do not necessarily have a high level of ICT use by teachers in the classroom. On the other hand, some countries, such as Denmark and Finland, have both a high level of available ICT resources and a high level of ICT use by teachers. Therefore, even in educational systems where ICT infrastructure and digital learning materials have been made available (Gil-Flores, Rodríguez-Santero and Torres-Gordillo, 2017), teachers still differ in the extent to which they use these resources in their teaching practice (Lomos et al., 2023).

Many studies have investigated factors related to the use of ICT in the classroom (Lomos et al., 2023; Spiteri and Chang Rundgren, 2020). The primary obstacle to teachers' use of ICT for learning and e-learning relates to ICT infrastructure, especially in educational contexts in development (Auma and Achieng, 2020; Lomos et al., 2023). From the teachers' perspective, "equipment remains the biggest barrier to ICT use" (European Commission, 2013, p. 71). Teachers need access to necessary technology (Eickelmann, 2011), and beyond that, they must have the time and opportunities to utilize this infrastructure in their practice. If appropriate ICT infrastructure is provided, teachers are more likely to use educational technology (Kundu, Bej and Dey, 2020).

Several studies (Lomos et al., 2023; Kundu, Bej and Dey, 2021; Shiue, 2007) clearly demonstrate that ICT infrastructure can be a factor influencing teachers' ability to apply technology pedagogically. This finding is further supported by various studies identifying ICT infrastructure in schools as a key factor in its use for learning purposes (Drossel, Eickelmann and Gerick, 2017; Petko, 2012). In explaining the use of ICT in education, providing ICT equipment constitutes a starting point in educational policies. The first (emerging) phase involves introducing infrastructure. In the second (application) phase, teachers apply technology in their ongoing teaching-learning processes. In the third (infusion) phase, teachers will start using technology in various innovative ways in teaching (Gil-Flores et al., 2017).

ICT Teacher Self-Efficacy

For the teaching profession, "teacher's efficacy belief is a judgment of his or her capabilities to bring about desired outcomes of student engagement and learning, even among those students who may be difficult or unmotivated" (Tschannen-Moran and Hoy, 2001, p. 783). In other words, teacher self-efficacy is defined as "teachers' beliefs that they are capable of carrying out good teaching in the classroom" (Christophersen, Elstad, Turmo and Solhaug, 2016, p. 241). Bandura (Bandura, 1997) emphasizes that self-efficacy beliefs are a strong motivational factor. Self-efficacy beliefs can become self-fulfilling prophecies in a specific domain and primarily influence individuals' motivation levels, persistence, and cognitive processes. Expectations of efficacy regarding task accomplishment affect individuals' performances, increasing their task performance levels. In addition to professional knowledge and skills, the perceived efficacy of teachers in performing tasks in different work domains plays a significant role (Skaalvik and Skaalvik, 2007).

Pedagogical use of technology may require specific types of teacher self-efficacy. Bandura (Bandura, 1997) highlights that self-efficacy is not a global trait but is domain-specific and context-specific. Several researchers (Wang, Ertmer and Newby, 2004; Anderson and Maninger, 2007) define the construct of self-efficacy in the domain of technology integration as teachers' belief in their ability to effectively use technology in teaching. Moreover, the literature indicates that ICT teacher self-efficacy is a

multidimensional construct. Scherer and Siddiq (2015) point out that, although highly correlated, computer self-efficacy in basic and advanced ICT skills and self-efficacy in using computers for instructional purposes represent separate constructs. One way to interpret this positive association is teachers' overall perception of their ICT skills (general ICT self-efficacy), which is necessary but insufficient to determine the determinants of ICT use for instructional purposes (Hatlevik and Hatlevik, 2018).

Hammond, Reynolds and Ingram (2011) found that lower levels of self-efficacy are reasons for less frequent ICT use. Teachers with low self-efficacy may fear technological innovations and may show resistance to computer use (Holden and Rada, 2011). On the other hand, teachers with higher levels of ICT self-efficacy have higher confidence levels in using ICT (Fanni, Rega and Cantoni, 2013) and are more likely to use ICT devices more frequently and experience less anxiety related to using these tools (Sam, Othman and Nordin, 2005). They are more open to new ideas and willing to experiment with new methods. Research even suggests that teachers who perceive higher levels of self-efficacy regarding ICT are more likely to use constructivist teaching methods more frequently (Teo, Chai, Hung and Lee, 2008).

A high level of computer self-efficacy contributes to positive attitudes toward computer-supported education (Yeşilyurt, Ulaş and Akan, 2016). Among other variables, scientists see teachers' ICT competence as a relevant condition for promoting the complex process of integrating ICT for instructional purposes (Vanderlinde and van Braak, 2010). Self-efficacy in using technology is significantly associated with perceived usefulness and ease of use (Scherer, Siddiq and Tondeur, 2019). Moreover, a positive relationship has been established between self-efficacy in using digital tools and ICT use for instructional purposes (Hatlevik, 2017).

Research objective

The availability of ICT resources in schools represents a direct determinant of users' acceptance regarding technology utilization. According to the Technology Acceptance Model (Venkatesh, Morris, Davis and Davis, 2003), resource availability facilitates technology use. Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur and Sendurur (2012) describe two types of barriers related to the pedagogical use of technology in teaching. Second-order barriers concerning teachers' professional beliefs require fundamental changes. First-order barriers relate to missing or inadequately provided resources such as equipment, training, and support. These are usually barriers that can be easily overcome through financial investments. Therefore, there is a need to understand the effects of different variables regarding the use of ICT in teaching practice. With all this in mind, the following research questions are posed:

1. Is ICT equipment a significant predictor of ICT use by teachers in the Serbian school context?
2. Is ICT teacher self-efficacy significantly associated with the use of ICT in teaching practice?
3. What is the most significant predictor of ICT use in teaching, after controlling for sociodemographic variables?

Materials and Methods

The research included 590 Serbian teachers from the territory of AP Vojvodina, specifically those working in urban schools. The sample consisted of 80.7% women, aged between 23 and 65 years (M = 46.46, SD = 9.31). About a quarter of them have up to 10 years of teaching experience (25.9%) and between 11 and 20 years (27.8%), while about half of the sample consists of teachers with over 20 years of teaching experience (46.3%). Slightly more teachers (56.6%) come from primary schools, while the remaining 43.4% teach in high schools or vocational schools. School principals' consent was obtained for conducting the research, and the questionnaire was distributed to teachers. Participation in the research was voluntary and anonymous.

The instruments used in foreign studies were carefully translated and adapted to the context of the education system in the Republic of Serbia. The ICT Teacher Self-Efficacy Scale is authored by Vanderlinde and van Braak (2010). An example item is: "I have enough organizational skills to use ICT in teaching." The reliability of the scale measured by Cronbach's alpha coefficient is .939, which indicates that it is a reliable measure of teachers' ICT self-efficacy.The following scale related to the use of ICT in teaching is the translated scale (Cheng, Lu, Xie, and Vongkulluksn, 2020) consisting of seven statements, with an example item being: "I use ICT to present teaching content."The Cronbach's alpha for the ICT use in

teaching is high and is .924, suggesting that the scale is a reliable measure of the use of digital technologies in the teaching process.The availability of ICT equipment in schools was assessed using questions from the Senić Ružić questionnaire (2019). These questions relate to the types of ICT used in the school (e.g., computer labs, internet). The frequency of using specific ICT equipment was measured using a five-point scale. The alpha coefficient value for the Availability of ICT equipment scale is .703, indicating an acceptable level of scale reliability.

Results

Hierarchical multiple regression was conducted to explore the relationship between factors considered significant in the context of ICT integration in teaching, including sociodemographic characteristics, teachers' perceptions of ICT infrastructure, and ICT self-efficacy. This analysis aims to determine the combined significance of these variables in explaining the outcome, as well as to individually assess their contributions. The regression models were constructed using the R program. Semi-partial correlation squared was used to measure the unique variance in the outcome explained by each predictor. We tested various regression models separately to understand the effects and variance explained by different factors related to ICT integration in teaching. Initially, we tested a demographics model, including only demographic characteristics, which were kept as control variables across all subsequent models. Next, an ICT infrastructure model was introduced, followed by the inclusion of teachers' self-efficacy in ICT in the third block of the hierarchical regression analysis.

Descriptive Statistics

Table 1 displays descriptive statistical indicators, including means, standard deviations, and indicators of distribution flatness and skewness, as well as correlations among the variables under investigation. All three variables exhibit moderate positive correlations (ranging from .288 to .455). Teachers achieve mean scores close to the theoretical average on measures of ICT use in teaching and assessment of equipment availability in the schools where they work, while the mean score on the assessment of ICT teacher self-efficacy is slightly above the theoretical average. The distribution flatness and skewness indicators values suggest that the data for the three variables examined do not deviate from normal distribution.

Table 1. *Descriptive statistics and correlations among variables*

	1.	2.	3.
1. ICT integration in teaching	1		
2. Availability of ICT infrastructure in schools	.392**	1	
3. ICT Self-efficacy	.455**	.288**	1
M	3.290	1.993	3.904
SD	.889	.734	.824
Skewness	-.206	-.065	-.892
Kurtozis	-.280	-.086	1.236

Note: M = mean; SD = standard deviation
***p < .01; *p < .05.*

Regression Model

To examine the predictive contribution of equipment availability and self-efficacy in the context of ICT in explaining technology use in teaching, hierarchical regression analysis was conducted in three blocks (Table 2). In the first block, control sociodemographic variables were introduced, including gender, age, years of experience, and type of school where teachers teach. The first block of variables explains only 3.5% of the outcome variance (R2 = .035; adjusted R2 = .027), with significant predictive contributions from gender (β = -.097, p=.019) and age (β = -.135, p=.039). Male teachers perceive more frequent ICT use in schools compared to female teachers, while ICT use in teaching decreases with teacher age.

In the second block of hierarchical regression analysis, the variable measuring equipment availability in schools was introduced. The second block of variables explains 19.3% of the outcome variance

(R2 = .193; adjusted R2 = .185), with significant predictive contributions to ICT use in teaching from the type of school (β = .118, p =.002) and equipment availability (β = .403, p < .001). Teachers teaching in high schools report more frequent ICT use in teaching than those employed in primary schools. Equipment availability is a significant predictor of ICT use in teaching, even after controlling for sociodemographic variables. Teachers who perceive equipment availability in their workplace as higher are more likely to report frequent ICT use in teaching.

In the third block of hierarchical regression analysis, teachers' self-efficacy in the context of ICT was introduced into the model. The third block of variables explains 29.4% of the outcome variance (R2 = .294; adjusted R2 = .285), with significant predictors of ICT use in teaching, including school type (β = .090, p= .014), equipment availability (β = .302, p < .001), and teachers' self-efficacy in the context of ICT (β = .345, p < .001). Teachers' self-efficacy in the context of ICT is a significant predictor of ICT use in teaching even after controlling for sociodemographic variables and above equipment availability assessment in schools. With an increase in teachers' self-efficacy in the context of ICT, ICT use in teaching also increases.

Table 2. *Results of hierarchical regression analysis*

	R	ΔR^2	B	S.E.	Partial r	B	P
Block 1: sociodemographic variables	.187**	.035**					
Gender (rg = male)			-.219	.093	-.097	-.097	.019
Age			-.013	.006	-.085	-.135	.039
Teaching experience $_{11\text{-}20\ years}$ (rg = less than 10 years)			.045	.112	.016	.023	.691
Teaching experience $_{20\ years\ and\ more}$ (rg = less than 10 years)			.012	.142	.003	.007	.935
School type (rg = primary school)			.099	.075	.054	.055	.189
Block 2: availability of ICT infrastructure	.439**	.158**					
Gender (rg = male)			-.149	.085	-.072	-.066	.081
Age			-.011	.006	-.081	-.116	.051
Teaching experience $_{11\text{-}20\ years}$ (rg = less than 10 years)			.013	.103	.005	.006	.903
Teaching experience $_{20\ years\ and\ more}$ (rg = less than 10 years)			-.010	.130	-.003	-.006	.939
School type (rg = primary school)			.212	.070	.125	.118	.002
Availability of ICT infrastructure			.488	.046	.405	.403	.000
Block 3: ICT self-efficacy	.542**	.101**					
Gender (rg = male)			-.070	.080	-.036	-.031	.385
Age			-.007	.005	-.055	-.074	.183
Teaching experience $_{11\text{-}20\ years}$ (rg = less than 10 years)			.027	.096	.012	.014	.781
Teaching experience $_{20\ years\ and\ more}$ (rg = less than 10 years)			.059	.122	.020	.033	.628
School type (rg = primary school)			.161	.065	.101	.090	.014
Availability of ICT infrastructure			.366	.045	.320	.302	.000
ICT self-efficacy			.373	.041	.353	.345	.000

Note: rg = reference group;
**p < .01; *p < .05.

Discussions

Our findings enrich the understanding of key factors regarding the implementation of ICT in schools. The research focuses on the ongoing debate about first-order barriers (insufficient resources) and second-order barriers (teachers' beliefs) that hinder the use of ICT. The international contribution of this research lies in the detailed analysis of factors that support the pedagogical use of ICT. Comprehensive theoretical framework regarding factors that influence ICT integration is currently lacking, this empirical study sheds light on the specific contributions of factors at the school level, ICT infrastructure, and teacher-related factors, including ICT self-efficacy. Although not conducted on a representative sample of teachers at the level of the Republic of Serbia, the findings of this study provide a valuable contribution and allow for comparison with the results obtained in the ICILS 2023 testing.

Firstly, we highlight the results of the descriptive analysis. A moderately positive correlation was documented between teachers' ICT self-efficacy and ICT use in teaching (r = .455), while the correlation value for the predictor of ICT equipment availability in schools was slightly lower at (r = .398). All three

variables show moderate positive correlations (ranging from .288 to .455). Teachers achieve the highest average score in assessing self-efficacy in the context of ICT. This score is higher than the mean score on the ICT use scale, which is consistent with Bandura's finding that self-beliefs of efficacy can be higher than actual abilities (Bandura, 1997).

We tested different regression models to identify the individual effects of the examined variables. Specifically, we first tested a model that includes only teachers' demographic characteristics. These demographic variables were retained in all subsequent tested models. In the first regression model, teachers' sociodemographic variables were introduced as predictors of ICT use in teaching, including gender, age, years of experience, and type of school. These variables explain only 3.5% of the outcome variance, while significant predictive contributions to ICT use in teaching are observed from gender and age. Male teachers apply ICT in schools more frequently than female teachers, while teacher age is negatively associated with ICT use in teaching. This finding may be explained by the generally more positive attitudes of men towards technology compared to women and the tendency for female teachers to experience greater anxiety about technology use than male teachers (Cai, Fan and Du, 2017). However, Ferreira (2017) argues that these differences may stem from deeply ingrained gender stereotypes and preconceived ideas about how women and men use (or are expected to use) technology. A more careful interpretation of the results reveals that the surveyed teachers, on the whole, perceive ICT use positively (Pozas and Letzel, 2023). The finding regarding the effect of teacher age on ICT use is consistent with the results of other studies that have shown higher use among relatively young teachers (Guillén-Gámez, Lugones and Mayorga-Fernández, 2019; Scherer, Siddiq and Teo, 2015). Younger teachers tend to be more enthusiastic about using ICT (Mahdi and Al-Dera, 2013), while older teachers feel less confident using computers. Also, many older teachers have had no initial computer education and, as a result, need additional training (Becta, 2004). Recent research has identified a statistically significant effect of a teacher's age related to the school's vision of the importance of ICT, suggesting a possible interaction between age and teachers' attitudes toward the usefulness of ICT (Lomos et al., 2023).

In the second regression model, the availability of ICT equipment in schools was introduced as a variable. This model explains 19.3% of the variance in ICT use, and significant effects on ICT use in teaching are observed for equipment availability and school type. High school teachers demonstrate a more frequent ICT use in teaching than those employed in primary schools. Equipment availability is a significant predictor of ICT use in teaching, even after controlling for sociodemographic variables. This finding is consistent with several previous studies (Vanderlinde and van Braak, 2010; Kundu et al., 2020) that have found infrastructure to be an important factor in ICT use. Lomos and associates (Lomos et al., 2023) found a small but significant effect of available resources on teachers' ICT use in teaching. Teachers' frequent use of ICT in the classroom is less likely when there are problems with resource availability in schools (Gil-Flores et al., 2017). However, the main predictors of ICT use can vary from country to country due to differences in economic development, educational tradition, and cultural background. For example, some developed countries like the Netherlands pay little attention to the impact of school ICT infrastructure (Drent and Meelissen, 2007), while in some developing countries, the lack of infrastructure is a key issue for teachers' ICT use (Chen, Zhou, Meng and Wu, 2019). Some research highlights a greater emphasis on acquiring ICT skills in high schools compared to primary schools due to the nature of the subjects taught in those schools (Pelgrum, 2001). Additionally, more frequent use of ICT resources is reported in high schools compared to primary schools (Williams, Coles, Wilson, Richardson and Tuson, 2000), as well as a higher level of ICT skills among high school teachers (Almerich, Suárez, Belloch, Gastaldo, Orellana, Bo and Diaz, 2005; Almerich, Orellana, Suárez-Rodríguez and Díaz-García, 2016). Given that high school teachers typically have access to a broader range of resources, access to technology for primary school teachers may outweigh all other factors in ICT use in teaching. However, this should not necessarily be interpreted as a deficiency of inhibiting factors to educational technology implementation, such as teachers' lack of competence (Williams et al., 2000).

In the third model of hierarchical regression analysis, teachers' self-efficacy for ICT use was introduced. This third model explains 29.4% of the variance in ICT use in teaching. Teachers' self-efficacy in the context of ICT is a significant predictor of ICT use in teaching even after controlling for sociodemographic variables and above equipment availability assessment in schools. With an increase in teachers' self-efficacy in the domain of ICT, the frequency of ICT use in teaching also increases. This result is consistent with other research showing that teachers' ICT self-efficacy significantly contributes to and

is positively associated with ICT use in teaching practice. Teachers reporting higher levels of ICT self-efficacy also report greater use of ICT in practice (Baturay, Gökçearslan and Ke, 2017; Tondeur, Petko, Christensen, Drossel, Starkey, Knezek and Schmidt-Crawford, 2020). This result confirms the expectation that the perceived ICT self-efficacy of teachers influences their intention to use ICT for teaching (Hatlevik, 2017; Teo et al., 2008), as well as their perceived use of it (Paraskeva, Bouta and Papagianni, 2008). Perceived self-efficacy has been linked in previous studies to the pedagogical use of technology in teaching (Lee and Lee, 2014), the use of digital learning materials (Kreijns, Vermeulen, Kirschner, Buuren and Acker, 2013), and the creation of materials for online assessment (Ninković, Olić Ninković, Lazarević and Adamov, 2021). This study has allowed us to confirm that teacher characteristics are relevant, as well as ICT infrastructure availability in explaining ICT use (Gil-Flores et al., 2017). Thus, second-order barriers, such as teachers' attitudes, self-perceived competencies, and skills, significantly influence the implementation of technology in teaching (Hämäläinen, Nissinen, Mannonen, Lämsä, Leino and Taajamo, 2021). Consistent with previous research, we conclude that high financial investments in ICT for schools and communities make sense only when there are other factors related to staff and context (Lomos et al., 2023). Furthermore, it should be noted that the higher the school's ICT development, the more prominent the personal factors in enhancing teaching and learning are (Wu, Yu and Hu, 2019). The finding that teachers' ICT self-efficacy and perception of ICT infrastructure contribute to ICT use is consistent with the study conducted by Kundu and associates (2020). Unlike the mentioned study, this research emphasizes the more outstanding predictive contribution of teachers' ICT self-efficacy to the dependent variable.

The practical implications of this study suggest that it is important to create professional development programs for teachers in the field of ICT. According to Bandura (1997), the most potent source of teachers' self-efficacy is mastery experience – achieving goals through personal action. Authors (Morris, Usher and Chen, 2017) state that teacher education is most effective when teachers are allowed to test acquired knowledge and skills in an authentic context. To achieve this goal, teacher training can be team-based (Vanderlinde, Aesaert and Van Braak, 2014), promoting professional collaboration in schools, developing teachers' self-efficacy, and fostering acceptance of constructivist teaching concepts. At the organizational level, it is necessary to allocate time for teacher collaboration, reflection on experiences regarding the use of ICT in teaching and learning, and joint planning of the application of digital learning resources. These measures can impact schools, teachers, and students. A school culture that favors integrating ICT into education, increased teacher competence, and confidence in ICT use results in increased ICT use in classrooms and contributes to improved student motivation, learning, and digital literacy (Gil-Flores et al., 2017). The priority in school should be a shared vision of ICT use and benefits in teaching practice, promoting teachers' self-efficacy and ICT use. Although investing financially in equipping schools with the latest technology is significant, previous research indicates that beliefs about the purpose of technology can compensate for the lack of appropriate equipment in schools (Cheng et al., 2020).

This study has some limitations. It would be significant to include variables within the school environment in the analyses, such as school support or the principal's attitude towards ICT implementation, as well as to consider the perception of other stakeholders in the school. This indicates that broader institutional factors should be included in future studies to provide a more comprehensive view, for example organization management readiness which was attributed of having the highest importance in the implementation of technology in teaching (Štilić, Puška, Puška and Božanić, 2023). When it comes to teachers, it would be relevant in future research to examine teachers' previous experience with ICT both in teaching and in professional development activities, as well as their attitudes and beliefs about the usefulness of ICT use. Additionally, it would be interesting to examine teachers' ICT competency using qualitative methods such as classroom observation. Also, one of the limitations of this study is measuring teachers' ICT self-efficacy as a unidimensional construct, as some authors treat this construct as multidimensional (Hatlevik and Hatlevik, 2018; Scherer and Siddiq, 2015). Finally, rapid technological development necessitates the use of new instruments to assess different aspects of ICT use.

Conclusions

Educational technologies have the potential to significantly enhance student engagement and interest in learning, offering personalized learning environments and timely feedback (Kunter et al., 2013). Therefore, promoting technology-enhanced teaching that moves away from traditional methods is crucial.

Despite students' receptiveness to new technologies, there remains a challenge in how teachers can effectively harness benefits of new technologies. Currently, technology integration in teaching is limited, with frontal teaching methods still predominant, resulting in inadequate teacher-student interaction. In contrast, educational technology allows students to independently progress through the curriculum, track their own advancement, and receive feedback through interactive and multimedia content. Thus, students are better adapted to technologies, while teachers need to have the willingness to use new technologies. This adaptability is crucial for the effective integration of ICT in teaching (Stošić, 2015).

Barriers to ICT implementation in teaching often stem from motivational factors among teachers and access issues related to ICT infrastructure and sociodemographic characteristics. While some countries equip their school systems with ICT infrastructure, actual implementation of digital materials remains sparse, particularly in developing countries where insufficient ICT equipment in schools poses a significant obstacle. ICT self-efficacy, defined as teachers' belief in their ability to teach effectively with ICT, emerges as a critical determinant. Teachers with higher levels of self-efficacy are more inclined to adopt innovative methods and use ICT more frequently. This self-efficacy correlates with perceived ease of use, usefulness, and persistence in the complex process of technology integration.

Hierarchical regression analysis revealed significant predictors of ICT use in teaching. ICT equipment emerged as a predictor even after controlling for sociodemographic variables, indicating its role in facilitating ICT utilization. However, ICT self-efficacy explained a greater proportion of variance in ICT use, underscoring its pivotal role. As teachers' ICT self-efficacy increases, so does their use of ICT in teaching.

In conclusion, while ICT equipment plays an important role in predicting ICT use in teaching, ICT self-efficacy exerts a more substantial influence. This finding highlights the need for further exploration into factors shaping teachers' beliefs regarding ICT integration. It is imperative to provide ongoing training within schools, fostering collaborative environments where teachers can observe and engage in reflective dialogue with colleagues to enhance their self-efficacy. Beyond financial investments in innovative technologies, creating supportive school environments is essential for effective ICT application. Future research should consider additional variables such as teacher attitudes and organizational factors to broaden our understanding of ICT integration in education.

Conflict of interests

The authors declare no conflict of interest.

Author Contributions

M.M. and S.N. made a substantial contribution to the conception and design, as well as to the analysis and interpretation of results. M.M. and S.N. were jointly responsible for drafting and revising the article. All authors have read and agreed to the published version of the manuscript.

References

Almerich, G., Orellana, N., Suárez-Rodríguez, J., & Díaz-García, I. (2016). Teachers' information and communication technology competences: A structural approach. *Computers & Education, 100*, 110-125. https://doi.org/10.1016/j.compedu.2016.05.002

Almerich, G., Suárez, J., Belloch, C., Gastaldo, I., Orellana, N., Bo, R., & Diaz, I. (2005). Digital divide in ICT competences in primary and secondary education: a complex relation with other key dimensions. *Recent Research Developments in Learning Technologies, 1,* 81-85.

Anderson, S. E., & Maninger, R. M. (2007). Preservice teachers' abilities, beliefs, and intentions regarding technology integration. *Journal of educational computing research, 37(2),* 151-172. https://doi.org/10.2190/H1M8-562W-18J1-634P

Auma, O. M., & Achieng, J. (2020). Perception of teachers on effectiveness of online learning in the wake of COVID-19 pandemic. *Journal of Humanites and Social Sciences, 25(6),* 19-28. DOI: 10.9790/0837-2506111928

Backfisch, I., Lachner, A., Stürmer, K., & Scheiter, K. (2021). Variability of teachers' technology integration in the classroom: A matter of utility!. *Computers & Education, 166*, 104159. https://doi.org/10.1016/j.compedu.2021.104159

Bandura, A. (1997). *Self-efficacy: The exercise of control*. WH Freeman. New York.

Baturay, M., Gökçearslan, Ş, & Ke, F. (2017). The relationship among pre-service teachers' computer competence, attitudes towards computer-assisted education and intention of technology acceptance. *International Journal of Technology Enhanced Learning, 9(1),* 1–13.

Becta, A. (2004). *A review of the research literature on barriers to the uptake of ICT by teachers*. London, UK, BECTA.

Cai, Z., Fan, X., & Du, J. (2017). Gender and attitudes toward technology use: A meta-analysis. *Computers & Education, 105,* 1-13. https://doi.org/10.1016/j.compedu.2016.11.003

Caprara, G. V., Barbaranelli, C., Steca, P., & Malone, P. S. (2006). Teachers' self-efficacy beliefs as determinants of job satisfaction and students' academic achievement: A study at the school level. *Journal of school psychology, 44(6),* 473-490. https://doi.org/10.1016/j.jsp.2006.09.001

Carretero, S., Vuorikari, R., & Punie, Y. (2017). *DigComp 2.1. The digital competence framework for citizens with eight profciency levels and examples of use.* Luxembourg: Publications Office of the European Union. https://doi.org/10.2760/38842

Chauhan, S. (2017). A meta-analysis of the impact of technology on learning effectiveness of elementary students. *Computers & Education, 105,* 14-30. https://doi.org/10.1016/j.compedu.2016.11.005

Cheng, S. L., Lu, L., Xie, K., & Vongkulluksn, V. W. (2020). Understanding teacher technology integration from expectancy-value perspectives. *Teaching and Teacher Education, 91,* 103062. https://doi.org/10.1016/j.tate.2020.103062

Chen, M., Zhou, C., Meng, C., & Wu, D. (2019). How to promote Chinese primary and secondary school teachers to use ICT to develop high-quality teaching activities. *Educational Technology Research and Development, 67*, 1593-1611. https://doi.org/10.1007/s11423-019-09677-0

Christophersen, K. A., Elstad, E., Turmo, A., & Solhaug, T. (2016). Teacher education programmes and their contribution to student teacher efficacy in classroom management and pupil engagement. *Scandinavian journal of educational research, 60(2)*, 240-254. https://doi.org/10.1080/00313831.2015.1024162

Drent, M., & Meelissen, M. (2007). Which factors obstruct or stimulate teacher educators to use ICT innovatively? *Computers & Education,51(1)*, 187–199. https://doi.org/10.1016/j.compedu.2007.05.001

Drossel, K., Eickelmann, B., & Vennemann, M. (2020). Schools overcoming the digital divide: In depth analyses towards organizational resilience in the computer and information literacy domain. *Large-Scale Assessments in Education, 8,* 1-19. https://doi.org/10.1186/s40536-020-00087-w

Drossel, K., Eickelmann, B., & Gerick, J. (2017). Predictors of teachers' use of ICT in school—The relevance of school characteristics, teachers' attitudes and teacher collaboration. *Education and Information Technologies, 22*, 551–573. https://doi.org/10.1007/s10639-016-9476-y

Eickelmann, B. (2011). Supportive and hindering factors to a sustainable implementation of ICT in schools. *Journal for educational research online, 3(1),* 75-103. https://doi.org/10.25656/01:4683

Ertmer, P. A., Ottenbreit-Leftwich, A. T., Sadik, O., Sendurur, E., & Sendurur, P. (2012). Teacher beliefs and technology integration practices: A critical relationship. *Computers & Education, 59(2),* 423-435. https://doi.org/10.1016/j.compedu.2012.02.001

Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. *Journal of research on Technology in Education, 42(3),* 255-284. https://doi.org/10.1080/15391523.2010.10782551

European Commission. (2013). *Survey of schools: ICT in education*. URL: https://ec.europa.eu/digital-agenda/node/51275

Fanni, F., Rega, I., & Cantoni, L. (2013). Using self-efficacy to measure primary school teachers' perception of ICT: Results from two studies. *International journal of education and development using ICT, 9(1),* 100-111.

Ferreira, E. (2017). *The co-production of gender and ICT: Gender stereotypes in schools*. First Monday. https://doi.org/10.5210/fm.v22i10.7062

Fraillon, J., Ainley, J., Schulz, W., Friedman, T., & Duckworth, D. (2019). *IEA international computer and information literacy Study 2018 assessment framework.* Springer Nature. https://doi.org/10.1007/978-3-030-19389-8

Geisinger, K. F. (2016). 21st century skills: What are they and how do we assess them?. *Applied measurement in education, 29(4)*, 245-249. https://doi.org/10.1080/08957347.2016.1209207

Gerick, J., Eickelmann, B., & Bos, W. (2017). School-level predictors for the use of ICT in schools and students' CIL in international comparison. *Large-scale Assessments in Education, 5,* 1-13. https://doi.org/10.1186/s40536-017-0037-7

Gil-Flores, J., Rodríguez-Santero, J., & Torres-Gordillo, J. J. (2017). Factors that explain the use of ICT in secondary-education classrooms: The role of teacher characteristics and school infrastructure. *Computers in Human Behavior, 68,* 441-449. https://doi.org/10.1016/j.chb.2016.11.057

Guillén-Gámez, F. D., Lugones, A., & Mayorga-Fernández, M. J. (2019). ICT use by pre-service foreign languages teachers according to gender, age and motivation. *Cogent Education, 6(1),* 1574693. https://doi.org/10.1080/2331186X.2019.1574693

Hammond, M., Reynolds, L., & Ingram, J. (2011). How and why do student teachers use ICT?. *Journal of Computer assisted learning, 27(3)*, 191-203. https://doi.org/10.1111/j.1365-2729.2010.00389.x

Hämäläinen, R., Nissinen, K., Mannonen, J., Lämsä, J., Leino, K., & Taajamo, M. (2021). Understanding teaching professionals' digital competence: What do PIAAC and TALIS reveal about technology-related skills, attitudes, and knowledge? *Computers in Human Behavior, 117*, 106672. https://doi.org/10.1016/j.chb.2020.106672

Hatlevik, I. K., & Hatlevik, O. E. (2018). Examining the relationship between teachers' ICT self-efficacy for educational purposes, collegial collaboration, lack of facilitation and the use of ICT in teaching practice. *Frontiers in psychology, 9*, 364376. https://doi.org/10.3389/fpsyg.2018.00935

Hatlevik, O. E. (2017). Examining the relationship between teachers' self-efficacy, their digital competence, strategies to evaluate information, and use of ICT at school. *Scandinavian Journal of Educational Research, 61(5)*, 555-567. https://doi.org/10.1080/00313831.2016.1172501

Holden, H., & Rada, R. (2011). Understanding the influence of perceived usability and technology self-efficacy on teachers' technology acceptance. *Journal of research on technology in education, 43(4),* 343-367. https://doi.org/10.1080/15391523.2011.10782576

Institute for the Evaluation of the Quality of Education and Upbringing, (2023). *Počelo istraživanje ICILS 2023 [Research ICILS 2023 has begun].* URL: https://ceo.edu.rs/pocelo-istrazivanje-icils-2023/

Kreijns, K., Vermeulen, M., Kirschner, P. A., Buuren, H. V., & Acker, F. V. (2013). Adopting the Integrative Model of Behaviour Prediction to explain teachers' willingness to use ICT: a perspective for research on teachers' ICT usage in pedagogical practices. *Technology, Pedagogy and Education, 22(1),* 55-71. https://doi.org/10.1080/1475939X.2012.754371

Kundu, A., Bej, T., & Dey, K. N. (2021). Investigating effects of self-efficacy and infrastructure on teachers' ICT use, an extension of UTAUT. International Journal of Web-Based Learning and Teaching Technologies (IJWLTT), 16(6), 1-21. https://doi.org/10.4018/IJWLTT.20211101.oa10

Kundu, A., Bej, T., & Dey, K. N. (2020). An empirical study on the correlation between teacher efficacy and ICT infrastructure. *The International Journal of Information and Learning Technology, 37(4),* 213-238. https://doi.org/10.1108/IJILT-04-2020-0050

Kunter, M., Klusmann, U., Baumert, J., Richter, D., Voss, T., & Hachfeld, A. (2013). Professional competence of teachers: Effects on instructional quality and student development. *Journal of educational psychology, 105(3),* 805. https://doi.org/10.1037/a0032583

Lee, Y., & Lee, J. (2014). Enhancing pre-service teachers' self-efficacy beliefs for technology integration through lesson planning practice. *Computers & Education, 73*, 121-128. https://doi.org/10.1016/j.compedu.2014.01.001

Lomos, C., Luyten, J. W., & Tieck, S. (2023). Implementing ICT in classroom practice: what else matters besides the ICT infrastructure?. *Large-Scale Assessments in Education, 11(1),* 1. https://doi.org/10.1186/s40536-022-00144-6

Mahdi, H. S., & Al-Dera, A. S. A. (2013). The Impact of Teachers' Age, Gender and Experience on the Use of Information and Communication Technology in EFL Teaching. *English Language Teaching, 6(6),* 57-67. https://doi.org/10.5539/elt.v6n6p57

Morris, D. B., Usher, E. L., & Chen, J. A. (2017). Reconceptualizing the sources of teaching self-efficacy: A critical review of emerging literature. *Educational psychology review, 29*, 795-833. https://doi.org/10.1007/s10648-016-9378-y

Ninković, S., Olić Ninković, S., Lazarević, T., & Adamov, J. (2021). Serbian teachers' perceptions of online assessment during COVID-19 school closure: The role of teachers' self-efficacy. *Educational Studies,* 1-13. https://doi.org/10.1080/03055698.2021.1960151

OECD. (2015). *Students, computers and learning: Making the connection*. PISA, OECD Publishing.

Paraskeva, F., Bouta, H., & Papagianni, A. (2008). Individual characteristics and computer self-efficacy in secondary education teachers to integrate technology in educational practice. *Computers & Education, 50(3),* 1084-1091. https://doi.org/10.1016/j.compedu.2006.10.006

Pelgrum, W. J. (2001). Obstacles to the integration of ICT in education: results from a worldwide educational assessment. *Computers & Education, 37(2),* 163-178. https://doi.org/10.1016/S0360-1315(01)00045-8

Petko, D. (2012). Teachers' pedagogical beliefs and their use of digital media in classrooms: Sharpening the focus of the 'will, skill, tool'model and integrating teachers' constructivist orientations. *Computers & Education, 58(4),* 1351-1359. https://doi.org/10.1016/j.compedu.2011.12.013

Pozas, M., & Letzel, V. (2023). "Do you think you have what it takes?"–exploring predictors of pre-service teachers' prospective ICT use. *Technology, Knowledge and Learning, 28(2),* 823-841. https://doi.org/10.1007/s10758-021-09551-0

Sam, H. K., Othman, A. E. A., & Nordin, Z. S. (2005). Computer self-efficacy, computer anxiety, and attitudes toward the Internet: A study among undergraduates in Unimas. *Journal of Educational Technology & Society, 8(4),* 205-219. http://www.jstor.org/stable/jeductechsoci.8.4.205

Scherer, R., Siddiq, F., & Tondeur, J. (2019). The technology acceptance model (TAM): A meta-analytic structural equation modeling approach to explaining teachers' adoption of digital technology in education. *Computers & Education, 128,* 13-35. https://doi.org/10.1016/j.compedu.2018.09.009

Scherer, R., & Siddiq, F. (2015). Revisiting teachers' computer self-efficacy: A differentiated view on gender differences. *Computers in Human Behavior, 53*, 48-57. https://doi.org/10.1016/j.chb.2015.06.038

Scherer, R., Siddiq, F., & Teo, T. (2015). Becoming more specific: Measuring and modeling teachers' perceived usefulness of ICT in the context of teaching and learning. *Computers & Education, 88*, 202-214. https://doi.org/10.1016/j.compedu.2015.05.005

Shiue, Y. M. (2007). Investigating the sources of teachers' instructional technology use through the decomposed theory of planned behavior. *Journal of Educational Computing Research, 36(4),* 425-453. https://doi.org/10.2190/A407-22RR-50X6-2830

Senić Ružić, M. (2019). *Razvijanje digitalne pismenosti u osnovnoj školi (doktorska disertacija).* Univerzitet u Beogradu Filozofski fakultet.

Skaalvik, E. M., & Skaalvik, S. (2007). Dimensions of teacher self-efficacy and relations with strain factors, perceived collective teacher efficacy, and teacher burnout. *Journal of educational psychology, 99(3)*, 611. https://doi.org/10.1037/0022-0663.99.3.611

Spiteri, M., & Chang Rundgren, S. N. (2020). Literature review on the factors affecting primary teachers' use of digital technology. *Technology, Knowledge and Learning, 25(1),* 115-128. https://doi.org/10.1007/s10758-018-9376-x

Stošić, L. (2015). The importance of educational technology in teaching. *International Journal of Cognitive Research in Science, Engineering and Education*, *3*(1), 111-114. https://doi.org/10.23947/2334-8496-2015-3-1-111-114

Strietholt, R., Fraillon, J., Liaw, Y. L., Meinck, S., Wild, J., Christensen, J., & Cortés, D. (2021). *Changes in Digital Learning During a Pandemic: Findings from the ICILS Teacher Panel*.

Suárez-Rodríguez, J., Almerich, G., Orellana, N., & Díaz-García, I. (2018). A basic model of integration of ICT by teachers: competence and use. *Educational technology research and development, 66*, 1165-1187. https://doi.org/10.1007/s11423-018-9591-0

Štilić, A., Puška, E., Puška, A., & Božanić, D. (2023). An Expert-Opinion-Based Evaluation Framework for Sustainable Technology-Enhanced Learning Using Z-Numbers and Fuzzy Logarithm Methodology of Additive Weights. *Sustainability*, *15*(16), 12253. https://doi.org/10.3390/su151612253

Taimalu, M., & Luik, P. (2019). The impact of beliefs and knowledge on the integration of technology among teacher educators: A path analysis. *Teaching and teacher Education, 79*, 101-110. https://doi.org/10.1016/j.tate.2018.12.012

Teo, T., Chai, C. S., Hung, D., & Lee, C. B. (2008). Beliefs about teaching and uses of technology among pre-service teachers. *Asia‐Pacific Journal of Teacher Education, 36(2),* 163-174. https://doi.org/10.1080/13598660801971641

Tondeur, J., Petko, D., Christensen, R., Drossel, K., Starkey, L., Knezek; G., & Schmidt-Crawford, D. (2020). Quality criteria for conceptual technology integration models in education: Bridging research and practice. *Educational Technology Research and Development, 69,* 2187–2208. https://doi.org/10.1007/s11423-020-09911-0

Tondeur, J., Pareja Roblin, N., van Braak, J., Voogt, J., & Prestridge, S. (2017). Preparing beginning teachers for technology integration in education: Ready for take-off?. *Technology, Pedagogy and Education, 26(2),* 157-177. https://doi.org/10.1080/1475939X.2016.1193556

Tschannen-Moran, M., & Hoy, A. W. (2001). Teacher efficacy: Capturing an elusive construct. *Teaching and teacher education, 17(7)*, 783-805. https://doi.org/10.1016/S0742-051X(01)00036-1

Vanderlinde, R., Aesaert, K., & Van Braak, J. (2014). Institutionalised ICT use in primary education: A multilevel analysis. *Computers & Education, 72*, 1–10. https://doi.org/10.1016/j.compedu.2013.10.007

Vanderlinde, R., & Van Braak, J. (2010). The e-capacity of primary schools: Development of a conceptual model and scale construction from a school improvement perspective. *Computers & Education, 55(2)*, 541-553. https://doi.org/10.1016/j.compedu.2010.02.016

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS quarterly*, 425-478. https://doi.org/10.2307/30036540

Vongkulluksn, V. W., Xie, K., & Bowman, M. A. (2018). The role of value on teachers' internalization of external barriers and externalization of personal beliefs for classroom technology integration. *Computers & Education, 118*, 70-81. https://doi.org/10.1016/j.compedu.2017.11.009

Wang, L., Ertmer, P. A., & Newby, T. J. (2004). Increasing preservice teachers' self-efficacy beliefs for technology integration. *Journal of research on technology in education, 36(3)*, 231-250. https://doi.org/10.1080/15391523.2004.10782414

Williams, D., Coles, L., Wilson, K., Richardson, A., & Tuson, J. (2000). Teachers and ICT: Current use and future needs. *British journal of educational technology, 31(4),* 307-320. https://doi.org/10.1111/1467-8535.00164

Wu, B., Yu, X., & Hu, Y. (2019). How does principal e-leadership affect ICT transformation across different school stages in K-12 education: Perspectives from teachers in Shanghai. *British Journal of Educational Technology, 50(3),* 1210-1225. https://doi.org/10.1111/bjet.12766

Yeşilyurt, E., Ulaş, A. H., & Akan, D. (2016). Teacher self-efficacy, academic self-efficacy, and computer self-efficacy as predictors of attitude toward applying computer-supported education. *Computers in Human Behavior, 64*, 591-601. https://doi.org/10.1016/j.chb.2016.07.038

Užarević, Z., & Dubovicki S. (2024). The Role and Importance of Quality of Life among Preschool Children as a Prerequisite for a Positively Oriented Upbringing, *International Journal of Cognitive Research in Science, Engineering and Education (IJCRSEE), 12*(2), 419-425.

Original scientific paper

UDC: 613.95/.97-053.4(497.5)

Received: March 24, 2024.
Revised: July 29, 2024.
Accepted: August 07, 2024.

10.23947/2334-8496-2024-12-2-419-425

Check for updates

The Role and Importance of Quality of Life among Preschool Children as a Prerequisite for a Positively Oriented Upbringing

Zvonimir Užarević[1], *Snježana Dubovicki*[1*]

[1] Faculty of Education, University of Osijek, Osijek, Croatia,
e-mal: zuzarevic@foozos.hr, sdubovicki@gmail.com

Abstract: The aim of this study was to evaluate the health-related quality of life (QoL) in a sample of healthy preschool children in the Republic of Croatia and comment on whether and how the research results open the preconditions for positive individual scenarios of the future related to positively oriented upbringing. The Pediatric quality of life inventory generic core scales (PedsQLTM) was completed by 230 healthy preschool children (5-6 years old) and their parents as a proxy-report. The data was descriptively analysed first. Reliability was assessed by Cronbach's alpha. The statistically significant difference between the PedsQLTM scales (physical, emotional, social, kindergarten and psychosocial functioning) for preschool children and their parent's proxy-report were analysed. The PedsQLTM scale score means for children's self-report ranged 71.32-76.49, with the total score was 74.53. Score means for their parent's proxy-report scale ranged 73.59-85.46, with the total score of 80.93. All the self-report and proxy-report scales showed satisfactory reliability with Cronbach's alpha varying between 0.64 and 0.89. Statistically significant difference between scales in self-report and proxy-report was for physical (t=-7.12, p<0.01), social (t=-6.42, p<0.01) and school functioning (t=-2.62, p<0.01) as well as psychosocial (t=-4.82, p<0.01) and total health (t=-6.85, p<0.01). The Croatian PedsQLTM is valid and reliable generic pediatric health-related QoL measurement that can be recommended for children's self-reports and their parent's proxy-reports. The results of the research open a precondition for positive individual scenarios of the future related to positively oriented upbringing.

Keywords: *quality of life, preschool children's, Pediatric quality of life inventory (PedsQLTM), Croatia*

Introduction

The quality of life (QoL) of adults has always been interesting to researchers, especially because it partly depended on the state of health (as a multidimensional concept) and the clinical picture. QoL is a complex concept which includes the objective factors and the subjective evaluation of physical, material, social, and emotional wellbeing, including personal development and purposeful activity, observed through personal system the values of the individual. As such research is "easier" to conduct among adults, it is not surprising that there is still a lack of scientific research dealing with the QoL of children, in general, and particularly with the QoL of preschool children (Hao et al., 2010; Klassen et al., 2003). The QoL of a child depends on the physical and mental factors and relations in the family and relationships with a wide environment (family, peers or kindergarten collective), and the quality of his life is undermined if there are health, emotion or social difficulties. Related to health, QoL includes the physical and mental domains, but also the domains of social well-being and functioning that play a significant role in assessing the impact on the child's current health, but also on his possible treatment in everyday life if necessary (Knez et al., 2013; Acquadro et al., 2003; Eiser and Mose, 2001).

The situation is far more unfavourable if we look at similar research related to the QoL of children in the Republic of Croatia, and even more unfavourable if we focus on the population of preschool children only. The results of a study in which preschool children underwent an eight-week intervention (were ex-

*Corresponding author: sdubovicki@gmail.com

posed to frequent physical activity) indicate that there are no significant indicators of improving the overall QoL compared to the control group (Truelove, 2016), which is contrary to the results of research in adults involved in a rehabilitation treatment, and especially in the treatment of persons with chronic conditions and health difficulties (Gu et al., 2016; Bize, Johnson and Plotnikoff, 2007; Penedo and Dahn, 2005). The results of research conducted among preschool children indicate that the lower the health-related QoL of a child, the greater the impacts on family life (Knez et al., 2013;Jastrowski Mano et al. 2011; Mazaheri et al., 2012; McGrath-Morrow et al. 2012; Medrano et al. 2013). In the mentioned, earlier papers, a larger number of studies were noticed in which children patients or children with disabilities (of various types) were involved. In relation to the above, the paper will provide a novelty in the research of the mentioned aspects among the population of healthy children aged five to six years.

Precisely for ethical reasons, but also for the complexity of conducting research, such research is still insufficient. Speaking of research ethics, using this instrument on a sample of preschool children the results obtained largely depend on communication, cooperation and agreement between children's and parents' reports among parents, guardians or adults indirectly participating in research helping the child. It is certainly necessary to conduct more research in which to determine the optimal level of agreement between parent and child. It is this issue that has triggered a number of discussions about the level of agreement between children's own views and those of their parents on the functioning of the child (Laaksonen et al., 2008; Cremeens, Eiser and Blades, 2006). Following this, it is interesting to mention research in which it was found that children of mothers who rated their QoL as poor were also considered worse, which may suggest the influence and projection of their own feelings (mothers') on the overall judgement of the child's functioning (Eiser, Eiser and Stride, 2005; Goldbeck and Melches, 2005; Cremeens, Eiser and Blades, 2006). Also, the level of agreement between the child and the parent may depend on the sex and age of the child, the parent's relationship with the child, health status, and ultimately in relation to the type of disease (if the child has it) (Le Coq et al., 2000; Eiser and Mose, 2001; Jovokic, Locker and Guyatt, 2004). As a possible solution to this challenge, some authors suggest that a child's self-assessment of well-being should be the first choice of information for the researcher (Gkoltsiou et al., 2008). It is extremely important that young people have a positive opinion about their personal, but also their professional development, which indirectly affects the QoL, a positive orientation on education, which in the long term leads to a positive orientation towards the future, and a successful educational process that enables young people to have a better professional and personal affirmation and reduces problematic behaviours (Chen and Vazsonyi, 2011; Dubovicki and Budić, 2019; Dubovicki, 2020, Dubovicki and Dilica, 2022; Dubovicki and Kostanjčar, 2023). If the overall quality of preschool children is positive, it can be assumed that this positive relationship will create prerequisites for the creation of positive quality later in primary and secondary education. The above leads us to the connection between a positive QoL and a positively oriented upbringing, which is important for a positive orientation in the life of every individual.

The aim of this study was to evaluate the health-related QoL in a sample of healthy preschool children (aged 5-6 years) in the Republic of Croatia and comment on whether and how the research results open the preconditions for positive individual scenarios of the future related to positively oriented upbringing. The research seeks answers to the following research questions:

1. Do preschool children's rate their QoL as low or high?
2. In which dimensions of QoL do children's self-report and parent's proxy-report match?
3. In which dimensions of QoL are the biggest differences in children's self-report and parents' proxy-report?
4. Do the research results and how do they open the preconditions for positive individual scenarios of the future related to positively oriented upbringing?

Materials and Methods

Participants

Participants were 230 healthy preschool children's (5-6 years old) recruited from ten kindergartens and their parents or guardians. Children were excluded if they were receiving any treatment for a chronic or acute medical condition, or if they had a history of special needs or learning difficulties. Written consent

from parents or guardians and verbal assent from children were obtained. The aforementioned ten kindergartens were deliberately selected for the reason that (according to the data obtained before conducting the research) at the time of conducting the research, there were the most healthy children of the specified age in them.

Assessment of health-related quality of life

The Paediatric quality of life inventory generic core scale (PedsQL™) includes parallel children self-report and parent proxy-report versions for ages 5-7 years, differing only in wording and length of response scale. The young children self-report version employs a 3-point Likert scale going from "never" to "almost always" with smiley faces to aid in the rating task. Items on parent proxy-report version are virtually identical to the children version, with minor language changes. The parallel parent version uses a 5-point Likert response scale going from "never" to "almost always". The PedsQL™ scale had 23 items grouped into four subscales: physical functioning (8 items), emotional functioning (5 items), social functioning (5 items) and kindergarten functioning (5 items), and the psychosocial scale includes emotional, social and kindergarten subscale. The questionnaire asked about the frequency of problems that occurred during the past month. Items are reverse-scored and linearly transformed to a 0-100 scale (i.e., 0 = 100, 1 = 75, 2 = 50, 3 = 25, 4 = 0), higher scores indicated better health-related QoL. Subscale scores were computed as the sum of the items divided by the number of items answered. The PedsQL™ scale was developed in the U.S. and the reliability and validity is well-established (Varni, Seid and Rode, 1999; Varni, Seid and Kurtin, 2001; Varni et al., 2002; Varni et al., 2003). Children were given the Croatian version of the PedsQL™ scale, administered as directed by the PedsQL™ manual for children's self-report (Varni, Seid and Rode, 1999; Varni, Seid and Kurtin, 2001; Schwartz and Rapkin, 2004). Children were interviewed individually in a quiet room separate from their groups. Parents completed the Croatian version of the PedsQL™ scale in relation to their child for parent's proxy-report. This questionnaire was sent home with each children for parents to complete.

Statistical analysis

The collected research data were stored in a database in Microsoft Office Excel program and processed by a personal computer using the statistical program Statistica 13.1. The quality of data was descriptively analysed (mean value and standard deviation) and internal consistency reliability was assessed by Chronbach's alpha. The statistically significant difference between means of the PedsQL™ scale total score and subscale scores (physical, emotional, social, kindergarten and psychosocial functioning) in children's self-report and parent's proxy-report were analysed with Student's t-test. The level of significance was set to $p<0.05$.

Results

The results of the research (table 1) show high values in all contexts on the basis of which we can conclude that preschool children assess their QoL as high (M=74.53) which gives us a positive answer to the first research question. Comparing the values obtained by children and parents (second and third research questions), we can see that the greatest coincidence in responses is with the emotional dimension (functioning), and the greatest differences are observed with the social and physical dimensions (functioning). Authors of educational research have written about the importance and encouragement of the development of children's social competence, which later have an impact on peer relationships and even on school success (Katz and McClellan, 1999). In addition to the above, it is important that those who will teach future generations of preschoolers (future educators) be aware of the importance of investing in the development of social competences of future educators and teachers (Dubovicki and Brust Nemet, 2015).

Also, the differences can be observed in Cronbach's α for children (α=0.69) and parents (α=0.89), which supports previous research that highlights this phenomenon as a major challenge for scientists (Laaksonen et al., 2008; Cremeens, Eiser and Blades, 2006).

Table 1. *Scale descriptive statistics and internal consistency reliability of the PedsQL™ generic core scales for children's self-report and parent's proxy-report*

	Children's self-report		Parent's proxy-report	
Scale	M (SD)	Cronbach's α	M (SD)	Cronbach's α
Physical functioning	76.49 (15.41)	0.73	85.46 (11.28)	0.76
Emotional functioning	71.32 (19.22)	0.72	73.59 (13.16)	0.71
Social functioning	75.01 (15.03)	0.67	84.24(15.81)	0.84
Kindergarten functioning	74.13 (14.41)	0.64	77.72 (14.91)	0.74
Psychosocial functioning*	73.48 (10.19)	0.65	78.51 (12.14)	0.87
Total score	74.53 (9.33)	0.69	80.93 (10.67)	0.89

M - mean, SD - standard deviation, * The psychosocial domain includes emotional, social and kindergarten subscale

Table 2 shows a statistically significant difference between subscales in children's self-report and parents' proxy report in which the fact from the previous table are also confirmed, especially in the part of emotional functioning of preschool children (there is no statistically significant difference in significance level of 0.05) which gives us an answer to the second research question. The comparison is important for the reason that it is necessary to determine whether the children are evaluated as functioning equally in the various researched aspects as their parents, whether there is a (dis)harmony in that relationship and whether the parents ultimately know their children, which can also be inferred from this comparison. A possible discrepancy in the results would be a potential challenge for a possible future (too) big influence of the parents on the child's extracurricular and out-of-school activities (Peko, Dubovicki and Munjiza, 2014; Munjiza, Peko and Dubovicki, 2016).

Table 2. *Statistically significant difference between subscales in children's self-report and parent's proxy-report of the PedsQL™ generic core scales*

Scale	t-value	p
Physical functioning	-7.12	**<0.01**
Emotional functioning	-1.49	0.14
Social functioning	-6.42	**<0.01**
Kindergarten functioning	-2.62	**<0.01**
Psychosocial functioning*	-4.82	**<0.01**
Total score	-6.85	**<0.01**

Bold - statistically significant difference on p<0.05

* The psychosocial domain includes emotional, social and kindergarten subscale

From the review of the obtained results it can be concluded that the overall picture of the QoL of preschool children (aged 5-6) in the Republic of Croatia is at a satisfactory level. All values are above average, and yet in line with research on this issue in the world (Truelove, 2016; Gkoltsiou et al., 2008; Jirojanakul, Skevington and Hudson, 2003). The obtained results indicate that preschool children at the age of five to six self-assess themselves positively, i.e., they estimate that their QoL is at a satisfactory level, which is one of the first prerequisites for long-term planning of positively oriented education in the form of creating positive visions of personal and professional life of the future which gives us the answer to the fourth research question (Dubovicki, 2020; Dubovicki and Dilica, 2022; Dubovicki and Kostanjčar, 2023).

Discussion

The importance of this issue is evidences by a significant number of studies in the global context, and one such was written by Jirojanakul, Skevington and Hudson (2003) who conducted a similar study among children (N=498) aged 5-8 that showed significant differences in life satisfaction between urban children and children of construction workers. Children's satisfaction was most often conditioned by the father's income, education, type of school, mode of transportation to school and additional activi-

ties. Additional sports activities and additional jobs (other than housework) improved the QoL of urban children, while the QoL of children of construction workers was directly related to the father's education and income. There is also evidence that among children of construction workers, boys have a lower QoL than girls. Different causal explanations for the QoL of urban children and children of construction works suggest that it is context specific, and what affects one group of children's QoL in a particular context may not affect another group in a different situation.

The results of our research are extremely significant due to the later possible connection between self-assessment of the QoL of a preschool child and future school functioning, relationships with peers, school success and more (Mlinarević, 2004). Also, satisfaction with the QoL of preschool children creates preconditions for scenario of a positive future, which is extremely important for school, but also the overall life functioning of young people in growing up and preparing for future careers (Dubovicki, 2020). Maintaining a positive orientation in personal and professional growth and development is very important, because earlier research shows that young people, often at the end of their education, have increasingly negative visions of their personal and professional future, which leads to dark scenarios, loss of will to find employment and depression (Dubovicki, 2020; Beara, and Dubovicki, 2023; Dubovicki and Kostanjčar, 2023).

The QoL of preschool children should be considered as an investment in the future of our society, because children inevitably play the most important role in the development of society in the future. QoL has been conceptualized and studied in children for several decades, but with disparate approaches that have rarely been discussed jointly with application to children in general (Wallander and Koot, 2016).

Conclusions

The results of previous research have shown that parents, and especially mothers, have an influence on their children's answers, so in further research on this issue, another method is proposed using this tool, based on which the results could be obtained as objectively as possible. The above is important to point out because some of the earlier research shows that parents can interpret questions to their children in a way that "the children understand". However, it can also mean "drawing water to one's mill", i. w. by asking suggestive questions to which the children will give answers in accordance with the parents' answers.

Therefore, the QoL is not and cannot be determined only by statistical indicators that are most often used in this type of research. Quality also depends on factors that cannot be measured in detail, but are created based on the planning of personal positive scenarios of each individual. In other words, everyone creates positive or negative personal and professional scenarios for themselves. The prospects for success in the future are better if a person starts with a positive scenario.

Also, we consider it important to point out the fact that the QoL and the future positive orientation of preschool children in education were not linked in previous studies investigating this issue. We certainly believe that researching this issue with the help of futures studies will have a very important impact on the prevention of negative social and individual scenarios, possible adverse outcomes, especially when it comes to the QoL of preschool children. It is desirable that children have a positive self-image form an early age, which is evident from their self-assessment of the QoL, so that in the future, when making personal and professional choices, they have as positive future scenarios as possible (Dubovicki and Budić, 2019; Dubovicki, 2020; Dubovicki and Dilica, 2022).

Since we are today in a time where it is necessary to carefully plan and anticipate a desirable future (Singh and Yadav, 2017), the focus on positive future orientation and a successful educational process enables young people to improve their professional and personal affirmation and reduce problematic behaviours (Chen and Vazsonyi, 2011), which is an additional benefit to society as a whole.

Furthermore, the results of this paper can serve as a starting point for research and comparison of the results of healthy preschool children with children with health, emotional and/or social difficulties.

Conflict of interests

The authors declare no conflict of interest.

Acknowledgements

The authors would like to thank to all the participants who participated in this research.

Author Contributions

Conceptualization, Z.U.; methodology, Z.U. and S.D.; investigation, Z.U. and S.D.; formal analysis, Z.U.; data curation, Z.U.; resources, Z.U. and S.D.; supervision, Z.U.; project administration, Z.U.; writing-original draft preparation, Z.U. and S.D.; writing-review and editing, Z.U. and S.D. All authors have read and agreed to the published version of the manuscript.

References

Acquadro, C., Berzon, R., Dubois, D., Leidy, N. K., Marquis, P., Revicki, D., ... & PRO Harmonization Group. (2003). Incorporating the patient's perspective into drug development and communication: an ad hoc task force report of the Patient-Reported Outcomes (PRO) Harmonization Group meeting at the Food and Drug Administration, February 16, 2001. *Value in Health*, *6*(5), 522-531. https://doi.org/10.1046/j.1524-4733.2003.65309.x

Beara, M., & Dubovicki, S. (2023). The Polak game and the futures of education–are university students optimists or pessimists about the future of education?. *Journal of futures studies*, *27*(4). 17-39.

Bize, R., Johnson, J. A., & Plotnikoff, R. C. (2007). Physical activity level and health-related quality of life in the general adult population: a systematic review. *Preventive medicine*, *45*(6), 401-415. https://doi.org/10.1016/j.ypmed.2007.07.017

Chen, P., & Vazsonyi, A. T. (2011). Future orientation, impulsivity, and problem behaviors: a longitudinal moderation model. *Developmental psychology*, *47*(6), 1633-1645. https://doi.org/10.1037/a0025327

Cremeens, J., Eiser, C., Blades, M. (2006). Factors influencing agreement between child self-report and parent proxy-reports on the Pediatric Quality of Life Inventory™ 4.0 (PedsQL™) generic core scales. *Health and Quality of Life Outcomes, 4*, 58. https://doi.org/10.1186/1477-7525-4-58

Dubovicki, S. (2020). Do We Focus On the Positive Future in Higher Education? In A. Peko; M. Ivanuš Grmek; J. Delcheva Dizarevikj (Eds.), *Didactic challenges III: didactic retrospective and perspective - Where/how do we go from here?, conference proceedings* (pp. 78-91). Osijek: Josip Juraj Strossmayer University of Osijek, Faculty of Education

Dubovicki, S., & Brust Nemet, M. (2015). Self-Assessment of the Social Competence of Teacher Education Students. *The New Educational Review, 42*, 227-238. https://doi.org/10.15804/tner.2015.42.4.19

Dubovicki, S., Budić, M. (2019). Present and future challenges of upbringing in education. *JAHR, 20*/10(2), 411-423. https://doi.org/10.21860/j.10.2.8

Dubovicki, S., Dilica, K. (2022). Biographies of the Future as a Creative Method of Visioning in Education. *Journal of Futures Studies, 27*(1), 109-118. https://doi.org/doi:10.6531/JFS.202209_27(1).0008

Dubovicki, S., Kostanjčar, A. (2023). How can future studies help us in professional and personal development? In S. Inayatullah; S. Dubovicki; A. Bilić, Anica (Eds.), *Didactic Challenges IV: Futures Studies in Education* (pp. 46-57). Osijek: Faculty of Education, University of Osijek and Croatian Academy of Sciences and Arts, Center for Scientific Work in Vinkovci.

Eiser, C., Eiser, J. R., Stride, C. B. (2005). Quality of life in children newly diagnosed with cancer and their mothers. *Health Qual Life Outcomes, 3*, 29. https://doi.org/10.1186/1477-7525-3-29

Eiser, C., Morse, M. (2001). Can parents rate their child's health-related quality of life? Results of a systematic review. *Qual Life Res, 10*, 347-357. https://doi.org/10.1023/A:1012253723272

Gkoltsiou, K., Dimitrakaki, C., Tzavara, C., Papaevangelou, V., Varni, J. W., & Tountas, Y. (2008). Measuring health-related quality of life in Greek children: psychometric properties of the Greek version of the Pediatric Quality of Life Inventory™ 4.0 Generic Core Scales. *Quality of Life Research, 17*, 299–305. https://doi.org/10.1007/s11136-007-9294-1.

Goldbeck, L., Melches, J. (2005). Quality of life in families with congenital heart disease. *Qual Life Res,14*, 1915-1924. https://doi.org/10.1007/s11136-005-4327-0

Gu, X., Chang, M., & Solmon, M. A. (2016). Physical activity, physical fitness, and helathrelated quality of life in school-aged children. *Journal of Teaching in Physical Education, 35*(2), 117-126. https://doi.org/10.1123/jtpe.2015-0110

Hao, Y., Tian, Q., Lu, Y., Chai, Y., Rao, S. (2010). Psychometric properties of the Chinese version of the Pediatric Quality of Life InventoryTM 4.0 generic core scales. *Quality of Life Research, 19*, 1229–1233. https://doi.org/10.1007/s11136-010-9672-y

Jastrowski Mano, K. E., Khan, K. A., Ladwig, R. J., & Weisman, S. J. (2011). The impact of pediatric chronic pain on parents' healthrelated quality of life and family functioning: reliability and validity of the PedsQL 4.0 Family Impact Module. *Journal of Pediatric Psychology, 36*, 517–527. https://doi.org/10.1093/jpepsy/jsp099

Jovokic, A., Locker, D., & Guyatt, G. (2004). How well do parents know their children? Implications for proxy reporting of child healthrelated quality of life. *Qual Life Res, 13*, 1297-1307. https://doi.org/10.1023/B:QURE.0000037480.65972.eb

Katz, L. G., & McClellan, D. E. (1999). *Poticanje razvoja dječje socijalne kompetencije*. Zagreb: Educa.

Klassen, A. F., Landgraf, J. M., Lee, S. K., Barer, M., Raina, P., Chan, H. WP., Matthew, D., & Brabyn, D. (2003). Health related quality of life in 3 and 4-year-old children and their parents: preliminary findings about a new questionnaire. *Health and Quality of Life Outcomes, 1,* 81. https://doi.org/10.1186/1477-7525-1-81

Knez, R., Stevanovic, D., Vulić-Prtorić, A., Vlašić-Cicvarić, I., & Peršić, M. (2013). The Croatian Version of the Pediatric Quality of Life Inventory (PedsQL (TM)) Family Impact Module: Cross-Cultural Adaptation and Psychometric Evaluation. *Journal of Child and Family Studies, 24*, 363-371. https://doi.org/10.1007/s10826-013-9844-9

Laaksonen, C., Aromaa, M., Heinonen, O.J., Koivusilta, L., Koski, P., Suominen, S., Vahlberg, T., & Salanterä, S. (2008). Health related quality of life in 10-year-old schoolchildren. *Quality of Life Research, 17*, 1049–1054. https://doi.org/10.1007/s11136-008-9388-4

Le Coq, E. M., Boeke, A. J., Bezemer, P. D., Colland, V. T., Van Eijk, J. T. (2000). Which source should we use to measure quality of life in children with asthma: the children themselves or their parents? *Qual Life Res, 9*, 625-636. https://doi.org/10.1023/A:1008977200176

Mazaheri, M. M., Rae-Seebach, R. D., Preston, H. E., Schmidt, M., Kountz-Edwards, S., Field, N., ... & Packman, W. (2012). The impact of P rader–W illi syndrome on the family's quality of life and caregiving, and the unaffected siblings' psychosocial adjustment. *Journal of Intellectual Disability Research*, *57*(9), 861-873. https://doi.org/10.1111/j.1365-2788.2012.01634.x

McGrath-Morrow, S. A., Ryan, T., Riekert, K., Lefton-Greif, M. A., Eakin, M., & Collaco, J. M. (2013). The impact of bronchopulmonary dysplasia on caregiver health related quality of life during the first 2 years of life. *Pediatric pulmonology*, *48*(6), 579-586. https://doi.org/10.1002/ppul.22687

Medrano, G. R., Berlin, K. S., & Hobart Davies, W. (2013). Utility of the PedsQL™ family impact module: assessing the psychometric properties in a community sample. *Quality of Life Research*, *22*, 2899-2907. https://doi.org/10.1007/s11136-013-0422-9

Mlinarević, V., (2004). Vrtićko okruženje usmjereno na dijete [A child-centered kindergarten environment]. *Život i škola, 11*(1), 112-119.

Munjiza, E., Peko, A. & Dubovicki, S. (2016). *Paradoks (pre)opterećenosti učenika osnovne* škole [The paradox of (over)loading primary school students]. Osijek: Faculty of Education, University of Osijek

Opić, S. (2016). Interpersonal relations in school. *International Journal of Cognitive Research in Science, Engineering and Education (IJCRSEE), 4*(2), 9-21. https://doi.org/10.5937/IJCRSEE1602009O

Peko, A., Dubovicki, S., & Munjiza, E. (2014). Does homework as a learning strategy stimulate additional student overload?. *Didactica Slovenica-pedagoška obzorja: znanstvena revija za didaktiko*, *29*(3-4), 49-65. https://urn.nsk.hr/urn:nbn:hr:141:367885

Penedo, F. J., & Dahn, J, R. (2005). Exercise and well-being: A review of mental and physical health benefits associated with physical activity. *Current Opinion in Psychiatry, 18*(2), 189-193. https://doi.org/10.1097/00001504-200503000-00013

Schwartz, C.E., & Rapkin, B.D. (2004). Reconsidering the psychometric properties of quality of life assessment in the light of response shift and appraisal. *Health and Quality of Life Outcomes, 2*, 16. https://doi.org/10.1186/1477-7525-2-16

Singh, R. & Yadav, Y. (2017). Perspective of Futurology and its Implication in Education. *Global Journal of Enterprise Information System, 9*(4), 57-61. https://gjeis.com/index.php/GJEIS/article/view/297

Truelove, S. (2016). Change in Preschoolers' Health-Related Quality of Life Following the Implementation of a Childcare Physical Activity Intervention. *Electronic Thesis and Dissertation Repository*. 3855. Available 15. 6. 2021. at: https://ir.lib.uwo.ca/etd/3855.

Varni, J. W., Burwinkle, T. M., Seid, M., & Skarr, D. (2003). The PedsQL™* 4.0 as a pediatric population health measure: feasibility, reliability, and validity. *Ambulatory pediatrics*, *3*(6), 329-341. https://doi.org/10.1367/1539-4409(2003)003<0329:tpaapp>2.0.co;2

Varni, J. W., Seid, M., & Kurtin, P. S. (2001). PedsQL™ 4.0: Reliability and validity of the Pediatric Quality of Life Inventory™ Version 4.0 Generic Core Scales in healthy and patient populations. *Medical care*, *39*(8), 800-812. https://doi.org/10.1097/00005650-200108000-00006

Varni, J. W., Seid, M., & Rode, C. A. (1999). The PedsQL™: measurement model for the pediatric quality of life inventory. *Medical care*, *37*(2), 126-139. https://doi.org/10.1097/00005650-199902000-00003

Varni, J.W., Seid, M., Knight, T.S., Uzark, K., & Szer, I.S. (2002). The PedsQL™ 4.0 Generic Core Scales: Sensitivity, responsiveness, and impact on clinical decision-making. *Journal of Behavioral Medicine, 25*, 175-193. https://doi.org/10.1023/a:1014836921812

Vidić, T. (2021). Students' school satisfaction: The role of classroom climate, self-efficacy, and engagement. *International Journal of Cognitive Research in Science, Engineering and Education (IJCRSEE)*, 9(3), 347-357. https://doi.org/10.23947/2334-8496-2021-9-3-347-357

Wallander, J. L. & Koot, H. M. (2016). Quality of life in children: A critical examination of concepts, approaches, issues, and future directions. *Clinical Psychology Review, 45*, 131-143. https://doi.org/10.1016/j.cpr.2015.11.007

Original scientific paper

UDC: 316.64-057.875:355.01

Received: June 24, 2024.
Revised: July 30, 2024.
Accepted: August 07, 2024.

10.23947/2334-8496-2024-12-2-427-436

Check for updates

Psychological Resources of Resilience in a Crisis Situation: Transformations of the Value-semantic Sphere of Students Living in a Zone of Local Military Conflict

Selezneva Yulya[1*] , *Abakumova Irina*[1] , *Sotnikov Sergey*[1]

[1] Faculty of Psychology, Pedagogy and Defectology, Don state technical university, Rostov-on-Don, Russia
e-mail: yulya.selezneva@gmail.com, abakira@mail.com, svsotnikov@mail.ru

Abstract: This article substantiates the impact of the crisis situation on the actualization and development of personal resources and coping with a difficult life situation. Using the example of students living in a local military conflict zone, it is shown that value-semantic resources (psychological resources of stability) in a crisis situation can transform and manifest themselves at the level of reducing the level of meaningfulness of life, value basis and existential fulfillment of life, reducing the degree of emotional response to current events. A crisis situation for a person, on the one hand, can become a source of disintegration in the perception of events of the past, present and future; loss of meaningfulness of life and devaluation of past experience; on the other hand, it can result in subjective well–being if a person works with a psychoemotional state (that includes working with fear and anxiety; perception of a difficult life situation as a challenge and finding new ones personal meanings); works with goals (building an image of the future in the short term), and if a person is rethinking and updating new personal meanings. According to the results of our research, goal-setting and building an image of the future are interrelated with the ability of the subject to be more open to emotional experiences, to show willingness to work with negative emotions (the "Self-Transcendence" scale); to actualize his personal potential (the "Personality" scale). The following empirical methods were used: Test of life-meaning orientations. SJO (J. Crumbo, L. Maholik in adaptation by D. A. Leontyev); Test of research into the real structure of a person's value orientations (S.S. Bubnova); Methodology for diagnosing the subjective well-being of an individual (Shamionov R.M., Beskova T.V.); «The scale of existence» (Existenzskala) by A. Langle and K. Orgler (adapted by I. N. Mainina and A. Yu. Vasanov).

Keywords: *meanings, purpose, life perspective, values, subjective well-being*

Introduction

In the current situation of social instability and uncertainty, one of the tasks of psychology is to explore the mechanisms and resources of coping with complexity. In psychological research, the challenges of uncertainty and complexity are often described as destructive challenges of the "shock of the future" (Asmolov A., 2018), which make it difficult for a person to adapt and cause the development of a number of negative conditions. However, we note that a situation of uncertainty, difficult life situations (in addition to negative influence) can also positively affect a person through activation and restructuring of regulatory mechanisms, increasing psychological stability (taking into account the need to often change habitual behavior programs), and ensure the development of new personal resources. As the uncertainty and unpredictability of the modern world grow, the focus of socio-psychological research is increasingly studying the problems of human personal resources, the peculiarities of human adaptation to a new reality. Given the high intensity of information flows, the difficulties of forecasting and planning, the high stress of the modern world, a large number of foreign and domestic researchers determine the possibilities of self-regulation as determinants of stability (Morosanova V.I., 2021), personal potential (Leontiev D.A., 2016). Today, new areas of psychology have emerged that set new approaches to understanding a

*Corresponding author: yulya.selezneva@gmail.com

person: the psychology of uncertainty (Kornilova T.V., 2014; Petrovsky V.A., 2021), psychology of social instability and digital socialization of personality (Soldatova G.U., Rasskazova E.I., Nestik T.A., 2017; Nestik T.A., 2023), psychology of choice (Leontiev D.A., Pham A.H., 2013); personology of maladaptive behavior (Petrovsky V.A., 2021), systemic anthropological psychology and psychology of self–organization of psychological systems (Klochko V.E., Klochko Yu.V., 2015), the study of personality in a traumatic situation in a military conflict (Maksimenko E.G., 2021) In a number of individual situations, a crisis situation appears. Overcoming difficult life situations is interconnected with the effectiveness of semantic regulation, the ability to turn traumatic experience into a basis for further growth and development. Thus, D. Leontiev identifies a special class of personal resources (universal resources) that compensate for the lack of psychological resources in an extreme life situation. (Leontiev D.A., 2016) Universal resources ensure the restructuring of connections with the outside world and the use of conditionally "negative" situations, emotions, experiences into resources for growth and adaptation. For example, in a situation of despair, a person is able to rethink his experience and use more effective behavioral strategies; a situation of injury and illness can become a source of personal growth, etc. Within the framework of existential psychology, V. Frankl and A. Langle noted that the acquisition of meaning sometimes becomes a resource that provides a way out of their crisis state. The pursuit of meaning and the realization of values, according to the author, are the basic aspirations of a person. (Frankl V., 1990; Längle A., 2015) The situation of local military conflicts largely affects the transformation of habitual patterns of conduct, values and semantic attitudes, the development of a number of severe emotional states (increased situational and personal anxiety, a sense of insecurity and helplessness, experiencing feelings of loneliness, exacerbation of existential fears). Despite the steady and constantly increasing scientific interest in the problem of human functioning in psychogenic circumstances, the problem of individual psychological characteristics of a person's experience of a situation of military conflict is insufficiently developed. The most studied problem is the identification of the role of the semantic sphere of personality in determining the nature of experiencing a traumatic event and choosing a trajectory for overcoming a personal crisis. In the works of M. S. Magomed-Eminova (Magomed-Eminov M.Sh ., 2009) it is shown that a traumatic situation transforms the semantic sphere of a person, making it "bipolar" (semantic structures concentrated around the idea of "life" and the idea of "death"). Psychologists point to the fact that a person who is in an unfavorable psychological state due to traumatic experience is characterized by a shift in emphasis from the functioning of meanings in the present to the future and the past. In a difficult life situation with a protracted character, a person often faces an obstacle in the form of difficulties in "semantic processing of current experience", which leads to deformation of life orientations (Magomed-Eminov M.Sh ., 2009). Psychological studies of the structure of life-meaning orientations of a person experiencing post-traumatic stress syndrome have shown the presence of contradictions between the components of meaningfulness of life, such as: lack of deep understanding of past events and their disintegration with the actual context of the present moment; a tendency to "semantic loading" of the future with projections of unrealized expectations; loss of meaning of past experience and difficulties in adequately understanding what is happening (Magomed-Eminov M.Sh ., 2009). In such a situation, according to psychologists, there is a significant narrowing of time orientations, one feels "thrown out" from the flow of life, which contradicts the desire to gain stability, has an adverse effect on personality. Overcoming the feeling of emptiness and lack of meaning in life as a result of an incident situation requires purposeful transformative activity from the individual. In the context of traumatic situations, a person experiences a partial loss of identity, which is associated with the perception of his activity in the present as meaningless. Here it is important for the subject to gain real personal support, which helps to make a choice towards building a life on new, completely uncertain grounds. In psychology, attention is focused on the fact that it is important not only to comprehend a traumatic event as an experience, the formation of new meanings, but also to immerse it in a broader semantic context of personal value relations. Assimilating at the level of individual consciousness, values and meanings function as determinants underlying the choice of a life path, determining human behavior (Borisov R.B., 2019). Modern researchers focus on the fact that people who have been in armed conflict for a long time are forced to experience a number of negative emotional reactions and, as a rule, demonstrate transformations of the motivational, need-based and semantic sphere. Empirical data show that for representatives of this contingent, it is important to preserve meanings that were previously given great personal importance. In case of loss or devaluation of previously important meanings, a person in a difficult situation tries to create new ones in order not to lose a life perspective. The established system of

meaningful life orientations provides a relatively stable orientation of needs and interests, a sequence of human behavior strategies, including in extreme situations. In a sense, we can say that the restructuring of life orientations, the acquisition of new meanings can act as a personal resource that will help to withstand difficult life situations. Theoretical analysis allows us to conclude that emotional discomfort resulting from being in a military conflict zone provokes dissatisfaction with oneself as a subject of an actual life situation, lack of a clear understanding of future plans and ideas about prospects, which generates changes in the system of meanings and values. A subject who has been in a military conflict zone for a long time gradually begins to experience certain difficulties in exercising semantic self-control of social behavior, doubts about the achievability of desired goals, shows distrust of values and meanings that were prioritized in the past, as well as rigidity of emotions, demonstrating rigid behavioral attitudes.

Materials and Methods

The purpose of our research is to study the value structure and features of the life orientations of students living in a military conflict zone. The empirical object of the study is 80 students, 40 of them living in the zone of local military conflict (hereinafter group “A”) and 40 students living in the border area (hereinafter group “B”). Research methods: The test of life orientations. SOHO (J.Crambo, L. Makholik in the adaptation of D.A. Leontiev); Test of the study of the real structure of personality value orientations (S.S.Bubnova); The methodology for diagnosing the subjective well-being of a person (Shamionov R.M., Beskova T.V.); The scale of existence” (Existenzskala) by A. Langle and K. Orgler (adapted by I. N. Mainina and A. Y. Vasanov). Nonparametric methods were used in the course of mathematical processing. The comparison of the average data was carried out according to the Mann-Whitney U-criterion, as well as a Spearman correlation analysis. During data processing, a standard software package was used: SPSS 23.0

Results

At the first stage of the study, we analyzed the features of the life orientations of students living in regions with different levels of geopolitical risks. According to the results, the level of expression of indicators of meaningfulness of life (Locus of control-life; Locus of control – I; Result of life; Process; Goals) in both groups of respondents has an average degree of severity. Respondents of both groups are able to control themselves and their lives, however, students from the military conflict zone do not always show confidence in life choice situations, and have great difficulties in managing their lives. The orientation towards the future, purposefulness, is expressed higher among students living in the border area. As part of the study, it was important for us to correlate life-meaning orientations with the value profile of respondents. Thus, according to the results of the study, the most significant values for group “A” (respondents living in the territory of a local military conflict) are “Pleasant pastime and rest” (4.4), “Help and mercy to other people” (4.3), “High material well-being” and “Recognition and respect of people and influence on others” (3.9), “Love” (3.7), “Health” (3.0). For the respondents of the two groups, important values are hedonistic and altruistic, recognition and respect for other people. At the same time, the five significant values of the students of group “B” also include cognitive and hedonistic orientations, and the students of group “A” – “Love” and “Health”. For students from the military conflict zone, as well as for students from the border area, the least significant values are “Social activity to achieve positive changes in society”, “High social status and people management”, and the value of “Communication”. It is worth mentioning that one of the basic human needs (the value of “Communication”) it becomes less significant for the respondents of our sample. In order to verify the statistical reliability of differences in the severity of value orientations in the studied groups of respondents, a statistical analysis was carried out using the Mann Whitney U-test. The analysis showed that for students of the border area, compared with students living in the zone of local military conflict, the following value orientations are the most important – “Search and enjoyment of beauty” and “Learning new things in the world, nature, man”, while for students of group “A” the value is more significant “High material well-being.” Perhaps, in a situation of loss of stability, it is more important to meet basic needs and ensure vital activity.

Table 1. *Comparative analysis of differences in the ranks of values in two groups of respondents using the U-M. Whitney*

Scales	Group «A»	Group «B»	U-emp	(p-level)
	3,9	3,0	303	0,01
High material well-being	2,8	3,9	293,5	0,01
The search and enjoyment of the beautiful				
Learning new things in the world, nature, and man	3,0	3,6	346	0,04
Social activity to achieve positive changes in society				
	1,8	2,3	364	0,06

The least important values in the hierarchy of values for both groups are socially oriented values - social activity, high social status and communication. At the next stage of the empirical study, the subjective well-being of the students of the selected groups was studied. Subjective well-being (as opposed to psychological well-being) indicates only internal subjective criteria that allow you to feel happy (a subjective assessment of the measure of happiness). The concept of subjective well-being was introduced by E. Diener, who proceeded from the position that well-being is determined by a subjective assessment, and not by objective conditions. The analysis of the results showed that the severity of well-being indicators in the two groups is within the average values, however, the severity of all indicators among students of the border area has higher values than among students living in the zone of local military conflict. In terms of severity, the "socio-normative well-being" scale received the highest values in the two groups, which indicates that respondents associate their well-being, primarily with compliance with social norms of life, and are guided by moral norms of behavior; next is the "Existential Well-being" scale. In a situation of social instability, perhaps social norms, well-practiced habitual behavior programs often help to feel and maintain stability. Thus, the average degree of expression of indicators of subjective well-being among the respondents of the two groups indicates that the respondents are mostly satisfied with their lives, guided by the values transmitted by society, their lives are filled with meaning, but they are least satisfied with themselves and the living conditions in which they find themselves.

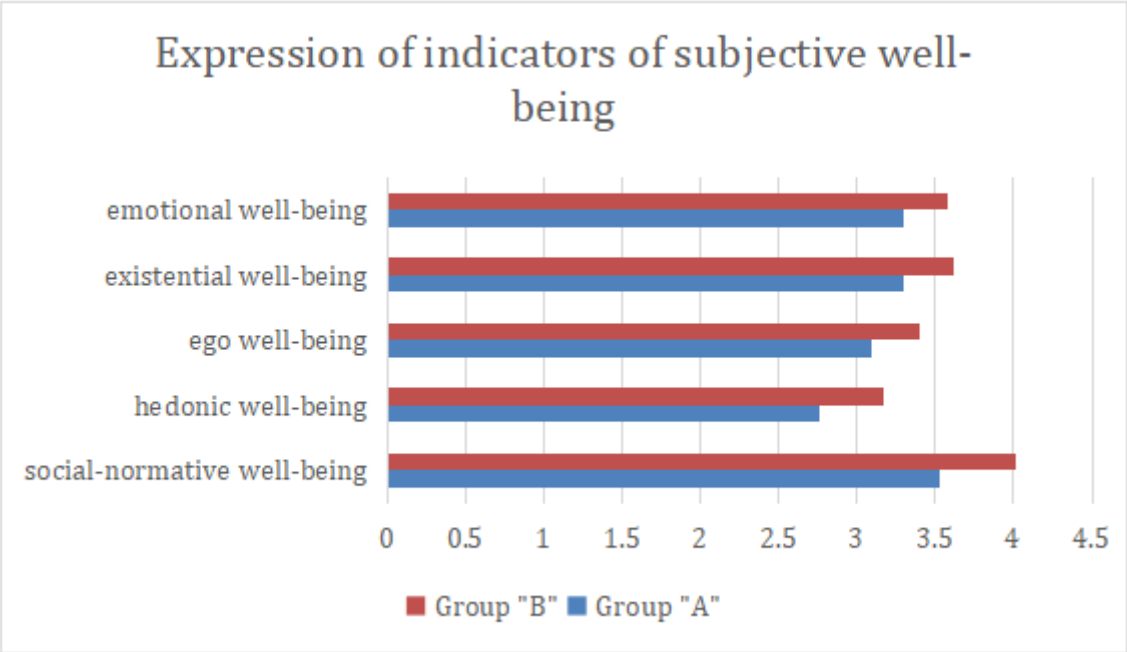

Figure 1. Symbols: Group "A" - students living in a local military conflict zone; Group "B" - students living in the border area

An important research task in the framework of studying the transformation of the value-semantic sphere for us was the study of basic anthropological abilities (the "Scale of Existence" by A. Langle and K. Orgler). So, according to the authors, four abilities can be distinguished that determine the ability to realistically perceive events and phenomena of the world, separating them from subjective assessment

(Self-distancing-SD); to treat them emotionally and valuably (Self-Transcendence-ST); to make a choice (Freedom-F); and to realize it (Responsibility-V). In our opinion, the inclusion of this technique in the diagnostic program will allow us to analyze how the value-semantic profile determines a person's ability to make choices and act.

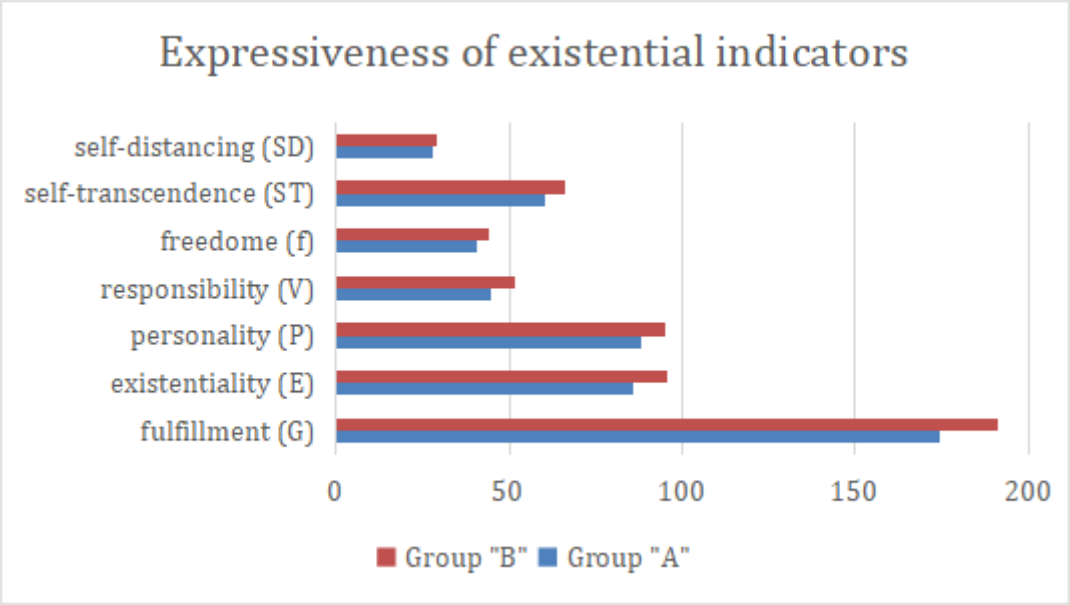

Figure 2. Symbols: Group "A" - students living in a local military conflict zone; Group "B" - students living in the border area

A comparative analysis of the results showed that all scales of existence in a group of students from the border area have a greater degree of severity, compared with the results of group "A" (students living in a local military conflict zone). The analysis showed that the SD index (Self-distancing) among students of group "A" is on the border of low and average values, which rather indicates a low distance from oneself, which may be due to experiencing internal conflict and post-traumatic state. Severe emotional stress and emotional entanglement can lead to difficulties in adequately perceiving the situation, to focus on satisfying current intentions and desires. A person in a crisis situation, as a rule, is focused on obsessive thoughts, situational states, may be somewhat disoriented in a stress situation – all this prevents a sober assessment of surrounding phenomena and narrows the possibilities of perception. The ST scale (self-transcendence) manifests itself in the ability to feel close to something/ someone, to sympathize, to relate emotionally to the events and phenomena of life. Self-transcendence allows a person to establish an inner attitude to what he sees, to distinguish events and phenomena more subtly on the basis of a value attitude to reality. This ability is interconnected with the ability to feel and differentiate one's own emotional states, desires, which directly affects self-acceptance and the ability to make and realize choices. The severity of this indicator among respondents living in a military conflict zone is below average, which is manifested in the emotional scarcity of emotional response. It can be assumed that in a situation of stress, a reassessment of values may occur and the range of emotions (as conductors of meanings) becomes significantly narrowed. The emotional response is limited to basic emotions to current life situations, providing an adaptive function. In this case, in rehabilitation and psychological support programs for such people, it is important to develop the emotional sphere (self-regulation skills, differentiation of emotions, etc.) as an important component for decision-making and orientation in difficult life situations. The F (freedom) scale in the two groups is also in the range of average values, but the results of the students of group "A" are close to low. Freedom manifests itself in the ability to find real opportunities for action, create a hierarchy of them in accordance with their value and thus approach decision-making more reasonably and personally. In our opinion, a decrease in the indicators of this scale among students of this group of students may be correlated with severe anxiety (as a characteristic of a stress reaction); with depressive and apathetic manifestations as a result of low control over the events of his life, with a fatalistic life attitude. In this regard, an important therapeutic task is to distinguish between situations that can be

controlled and those that we cannot control and the development of active behaviors. Indicators on the Responsibility scale (V) in the two groups also have an average degree of severity. Responsibility is understood as the ability to bring to completion those decisions that were made on the basis of personal values. The severity of the indicator "Personality" (P) in a group of students from a military conflict zone is on the border of medium and low values, which may indicate that basic personal abilities are blocked or not actively used. Students of group "B" have indicators on this scale within the average values. The respondents of the two groups have a predominance of self-transcendence over self-distancing (SD < ST), which may indicate the presence of emotional responsiveness, empathy, and expressed inner experience. The respondents of the two groups have a combination of F > V, which indicates impulsive behavior, difficulties in accepting responsibility, and the importance of personal freedom, which can sometimes take on narcissistic tendencies. At the final stage of the study, a correlation analysis was performed using Spearman's criterion. The analysis showed that students' focus on the future is positively associated with the scales of subjective well–being - "emotional well–being" (0, 601*) and "Ego well-being" (0, 683**) and the scales of existence - "self-transcendence" (0, 519*) and "personality" (0, 513*) value orientation towards communication (0, 489*).

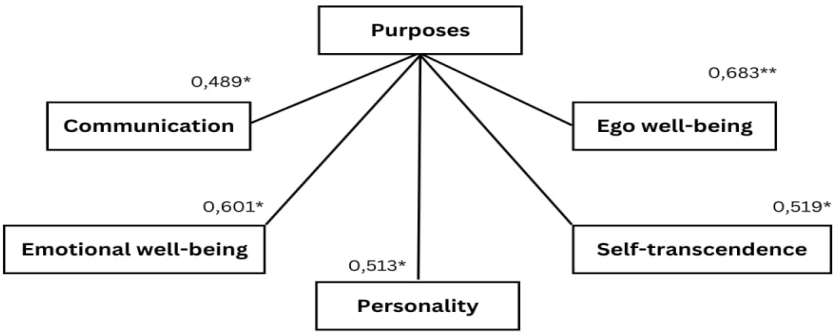

Figure 3. Correlation connections of the "Purpose" scale with indicators of subjective well-being and existence scales (group "A")

Students of group "A" primarily associate their life perspective and planning of their future with self-satisfaction and internal consistency. The relationship of orientation towards the future also has positive links with self-transcendence, which manifests itself in understanding the meaning of one's actions, the ability to respond emotionally to life events and treat them with value. Modern research empirically confirms the thesis about the relationship between future orientation and subjective well-being. The meanings of the future create a support in the present and affect the feeling of being a full-fledged subject of life. In our opinion, working with goals and focusing on the future is an important area of psychological support for students who find themselves in a difficult life situation. Understanding and correlating your capabilities with the result in the outside world will help you gain confidence in your abilities and overcome anxiety about the uncertain present. In this case, working with goals will help to actualize personal potential and direct the activity of the subject in the direction of achieving goals and gaining personal meaning of actions. The idea of the significance and importance of actualizing personal goals was also confirmed in a sample of students from border areas. The analysis of correlations in group "B" showed the following: a focus on the future has direct strong links with all scales of subjective well-being and scales of existence.

Strong correlations were found with the scale of "Emotional well-being" (0, 706**), " Existential well-being" (0, 735**), " Self-transcendence" (0, 853**), " Freedom" (0, 808**), " Personality" (0, 751**), "Existentiality" (0, 748**), " Fulfillment" (0, 776**). Interesting results were obtained on the "Process" scale, which (in group "A") has only two correlations with the scales of subjective well–being - "Emotional well-being" (0, 617**) and "Ego well-being" (0, 564**). The results obtained may indicate that the emotional saturation of the present gives a person the opportunity to feel happier and more confident in himself. In a difficult life situation, sometimes this task becomes unsolvable. However, rethinking the current experience, focusing on the meaningful and emotionally colored for the subject can create a foothold in the present and give a feeling of happiness. However, there were no correlations with the scales of existence in this group. We see the exact opposite picture in the respondents of group "B". The "Process"

scale has moderate and strong connections with all scales of subjective well-being, scales of existence and the value of "Communication". The respondents of this group associate the emotional saturation of their being with the satisfaction of basic needs, a sense of joy and fullness in their lives, and a sense of general existential fulfillment. The present among the respondents of this group is associated with the value of "Communication", which indicates the importance of communication for the meaningfulness of life and understanding oneself through Another. The study of the relationships between the "Locus of control –I" scale and other studied indicators showed that, unlike the ability to manage one's life, the ability to control oneself and one's development has more correlations. In group A, direct moderate and strong connections were found between the idea of oneself as a strong personality capable of controlling oneself and indicators of subjective well–being - "Emotional well-being" (0.475*), "Existential well-being" (0, 665**), " Ego-well-being" (0, 490*), "Hedonistic well–being" (0, 509*), the scales of existence are "Self-transcendence" (0, 623**) and "Personality" (0, 542*). A positive self-image also has a direct moderate connection with the value of "Communication" (0.475*). Thus, the more a person feels the ability to manage his life, the more prosperous he feels and the more productively he is able to respond to the challenges of life. It should be noted that the "Goals" scale and the "Locus of control – I" scale are positively related to the "Personality" scale. One of the tasks of psychological support for people in difficult life situations is to strengthen self-esteem, to create internal psychological supports that provide the basis for adaptation and overcoming difficult life situations. In this case, the crisis situation activates the psychological mechanisms of coping with complexity and provides an opportunity to realize oneself and one's potential, provided that a person is oriented and self-development and is capable of designing life goals (the "Personality" scale). Thus, according to the results of our research, the ability to set goals is interrelated with the ability of the subject to be sensitive towards himself and the world, ready to actualize his personal potential. This thesis is fundamentally important from the point of view of the possibilities of self-realization and self-realization in a crisis situation and presents ample opportunities in terms of considering the impact of a crisis situation on rethinking oneself and one's life story.

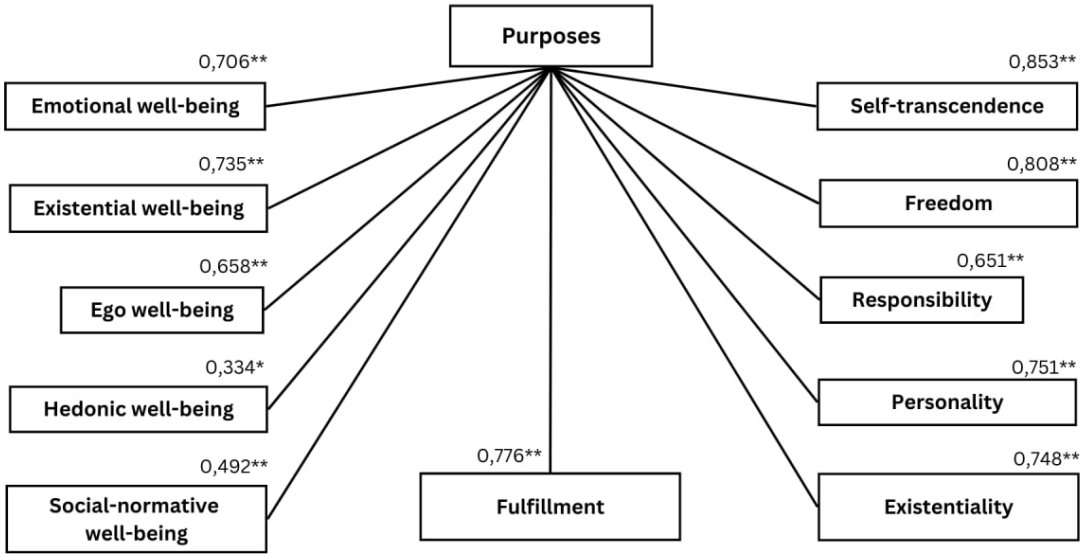

Figure 4. Correlation connections of the "Purpose" scale with indicators of subjective well-being and existence scales (group "B")

In group B, the correlation matrix of the relationships between the "Locus of control –I" scale and other studied indicators is similar to the results of the correlations of the "Locus of control-Life" scale. Thus, the scale "Locus of control –I" is positively interrelated with the scales "Emotional well-being" (0.745**), "existential well-being" (0, 741**), " Ego-well-being" (0, 700**), " Hedonistic well-being" (0, 350*), The scales of existence are "Self–transcendence" (0, 931**), and "Personality" (0, 847**); " Freedom" (0, 862**); " Responsibility" (0, 725**); " Fulfillment" (0, 858**). The analysis of correlations between the "Meaningfulness of life" scale and other studied indicators in group "A" showed that the meaningfulness of life determines subjective well-being in this group of respondents (emotional, 0.689**; existential, 0.507**),

the ability to self-transcendence (0.506*), the ability to realize their potential and be open to the world (the "Personality" scale, 0.457*). In group "B" (students of the frontier theory), the scale "Meaningfulness of life" has positive moderate and strong connections with the scales of subjective well-being and scales of existence: "Self-transcendence" (0.862**), "Personality" (0.767**); "Freedom" (0.796**); "Responsibility" (0.622**); "Fulfillment" (0.773**); "Existentiality" (0.734**). According to the results, the higher the level of meaningfulness of life, the happier and more internally consistent a person feels. Thus, in relation to this group, it can be said that the level of meaningfulness of life contributes to the development of three basic anthropological abilities - the ability to feel (self-transcendence (ST)), the ability to choose (freedom (F)) and the ability to accept responsibility (V). However, no connection was found with the "Self-distancing" scale. Analyzing the results obtained in the aspect of developing psychological support programs for students living in a local military conflict zone, it should be noted that the ability to be emotionally open to oneself and the world, actualize one's potential and realize one's capabilities (the "Personality" scale) is interrelated with the ability to set goals, control oneself and one's development, and the general meaningfulness of life (the scale "OJ", "Goals", "Locus of control-I"). In this regard, important areas of work with such students (in addition to stabilizing the emotional state and increasing stress tolerance) may be sessions aimed at understanding and realizing their life goals, correlating them with available opportunities, accepting a crisis situation as a challenge situation through the development of emotional regulation skills. An important task in this case is the recognition of interfering metaprograms and the selection of the most productive behavioral strategies. The range of goals can be completely different (from solving current problems to life design). However, it is the setting and awareness of one's own goal, correlation with a value profile, that can become a vector that affects a person's ability to make decisions, act and adapt to a difficult life situation and realize their unique life plan.

Discussions

Currently, issues related to the study of the psychological characteristics of a person's experience of difficult life situations, incident situations, and situations of military local conflict are being actively investigated. So, in the study of O. V. Boyko, N. V. Novikov, studying the individual psychological characteristics of a person's experience of a situation of military conflict, it was revealed that characteristics such as temperament properties, character traits, components of the motivational and need sphere, systems of life orientations and life meanings, as well as indicators of self-actualization of a person can influence the characteristics of a person's experience of a situation of military conflict. Thus, the constructive experience of a military conflict situation, which is characterized by a meaningful attitude to a crisis situation, a prosperous psycho-emotional state, is influenced by the following individual psychological characteristics of a personality: a high level of extraversion and a low level of neuroticism; a stable system of life orientations (goals in life, interest in life and emotional saturation, life effectiveness, locus of control – I (I am the master of life), the locus of control is life or the manageability of life, a general indicator of the meaningfulness of life); altruistic, hedonistic, vital meanings of self-realization. These results are consistent with the results of our study. The value-semantic profile, which includes altruistic, hedonistic values, as well as high meaningfulness of life (with the severity of the target component), can provide high opportunities for the subject to overcome the crisis and adapt to difficult life situations.

A separate layer of research is aimed at studying stress factors that affect the intensity of experiences of people living in a local military conflict zone. Thus, in the study of E. Ryadinskaya, the most pronounced were stress factors from the "threat to health" block; problems of an economic and socio-political nature; difficulties with employment, loss of meaning in life, disbelief in life prospects, lack of opportunity to plan the future; social stress factors: lack of social protection; the inability or restriction of education in general education, secondary and higher educational institutions; the inability to fully receive high-quality medical services; the lack of normal living conditions, etc.. Comparing these results with the results obtained in our study, it should be noted that focus on the future, setting and maintaining goals is an important factor of psychological well–being. In a situation of loss of control over life events, social and political instability, the meanings of the future can become a support for a person in the present. Also, psychological stress factors (lack of understanding on the part of relatives and relatives; lack of life prospects; conflicts; loss of the location of the head; loss of love; separation from family; loneliness; the influence of the media due to lack or redundancy of information; the general situation of uncertainty) turned out to be no less significant

in E. Ryadinskaya's study. (Ryadinskaya E.N., 2018) According to the author, psychological changes due to experiencing a crisis situation and perception of wartime can manifest themselves in the post-conflict period in deformation and changes in the value-semantic structure of the personality.

Conclusions

In a situation of geopolitical instability and high stress, the ideas of existential psychology expressed by V. Frankl and actively developed by his followers within the framework of logotherapy are becoming more relevant. (Frankl V., 1990; Längle A., 2015) The concept of the "will to meaning" in a situation of noogenic neuroses, existential frustration, intense experiences of a person in a difficult life situation allows you to discover those personal resources (a fundamental need for meaning), the realization of which will eventually allow a person to go beyond himself and cope with a difficult life situation. The search for meaning is the creative path that a person can go through, and the acquisition of meaning is the answer that he finds one day, responding to the challenges of time. In this sense, as V. noted. Frankl, the task of education, of course, is not to transfer knowledge, experience, traditions, but rather to strengthen the abilities that allow a person to find unique meanings of existence. The idea of the possibility of determining a personal position, which formed the basis of V. Frankl's theory, allows us to take a fresh look at the situation of severe suffering and experiences of people who find themselves in a difficult life situation. (Frankl V., 1990) We cannot always reduce suffering or escape from it, but we can always determine our attitude to our own experiences, take a personal position in relation to them. Sometimes only our thoughts can be controlled, and this becomes the powerful resource that allows us to rise above the situation, above ourselves, see new goals and start moving.

As a result of the conducted empirical research, the following conclusions were drawn: it was found that the value structure of students living in a local military conflict zone, unlike students in border areas, includes the values of hedonism (pleasant pastime), altruism (help and mercy to other people) and security values (high material well-being). For students of group "B", social values (recognition and respect of people and influence on others) are the most pronounced. It is also established that the change in the life orientations of students from the zone of military conflict manifests itself in a decrease in the level of meaningfulness of life, value bases and existential fulfillment of life, in impoverishment and narrowing of the emotional profile; it is established that living in the zone of military conflict to a greater extent reduces the processality of life, the fullness of life in the present, which can negatively affect the ability to cope with difficult life circumstances. An important result in terms of developing psychological support programs for students living in a local military conflict zone is the identification of conditions under which their personal potential and adaptive capabilities can significantly increase, and at the same time, the level of subjective well-being. Thus, the identification of the features of deformation of the meaning-of-life orientations of a person who has been in a military conflict zone for a long time makes it possible to develop and implement effective targeted psychological assistance programs.

Acknowledgements

The research was supported by the Russian Science Foundation (Project No. 23-18-00848) (2023) «The research of the value-semantic sphere and the development of technologies for the psychological rehabilitation of the population of the region of a local military conflict in the context new geopolitical risks».

Conflict of interests

The authors declare no conflict of interest.

Author Contributions

Conceptualization, Selezneva Y., Abarumova I.; methodology, Selezneva Y., Abarumova I; formal analysis, Sotnikov S. and Selezneva Y.; writing—original draft preparation, Selezneva Y., . Abarumova I; All authors have read and agreed to the published version of the manuscript.

References

Asmolov, A. (2018). Mobilis in mobile. Personality in an era of change. M, 546 p. https://psy.su/mod_files/additions_1/fle_file_additions_1_8075.pdf

Borisov, R. B. (2019). The relationship between values and life-meaning orientations of the individual // Psychological problems of the meaning of life and acme. Electronic collection of materials from the XXIV International Symposium. Dedicated to the 95th anniversary of the birth of V.E. Chudnovsky. pp. 37-41. https://elibrary.ru/download/elibrary_38018215_93954446.pdf

Boyko, O. V., & Novikova, N. V. (2019). Individual psychological features of a person's experience of a situation of military conflict // Bulletin of the Vyatka State University. No. 4. pp. 94-105. https://cyberleninka.ru/article/n/individualno-psihologicheskie-osobennosti-perezhivaniya-lichnostyu-situatsii-voennogo-konflikta

Frankl, V. (1990). Man in Search of Meaning M.: Progress, 368c. https://imwerden.de/pdf/frankl_chelovek_v_poiskakh_smysla_1990.pdf

Kornilova, T. V. (2014). Perspectives of the dynamic paradigm in the psychology of choice. Psychological research. Vol. 7, 36. p. 2. https://psystudy.ru/index.php/num/article/view/611

Klochko, V. E., Klochko, Yu. V. (2015). Man: an open system in a closed environment. Siberian Psychological Journal. (57). pp. 6-16. https://cyberleninka.ru/article/n/chelovek-otkrytaya-sistema-v-zakrytoy-srede/viewer

Leontiev, D. A., & Pham, A. H. (2013). Subjective construction of choice in situations of different levels of significance (Part 1). Bulletin of Moscow University. Series 14. Psychology, 1, p. 84-96. https://msupsyj.ru/pdf/vestnik_2013_1/vestnik_2013-1_84-96.Pdf

Leontiev, D. A. (2016) Self-regulation, resources and personal potential//Siberian Psychological Journal. No. 62. pp. 18-37. https://doi.org/10.17223/17267080/62/3

Leontiev, D. A., & Pham A. H. (2013). Subjective construction of choice in situations of different levels of significance (Part 1). Bulletin of Moscow University. Series 14. Psychology, 1, p. 84-96. https://msupsyj.ru/pdf/vestnik_2013_1/vestnik_2013-1_84-96.Pdf

Langle A. (2015). Meaning, feeling and happiness // Scientific notes of SPbGIPSR. Issue 1. Volume 23. Pp.7-15. https://psyjournals.ru/journals/scientific_notes/archive/2015_n1/scientific_notes_2015_n1_lengle.pdf

Magomed-Eminov, M. Sh. (2009). Phenomenon of posttraumatic growth. Bulletin of TSU, issue 3 (71), pp. 111-117. https://cyberleninka.ru/article/n/fenomen-posttravmaticheskogo-rosta/viewer

Maksimenko, E. G. (2021). Psychological support for families and youth in conditions of military conflict // Sociocultural and psychological problems of a modern family: current issues of support and support. Collection of materials of the VII International Scientific and Practical Conference. Cheboksary, 2021. pp. 27-36. https://phsreda.com/e-articles/10315/Action10315-99932.pdf

Morosanova, V. I. (2021). Conscious self-regulation as a meta-resource for achieving goals and solving life problems // Bulletin of Moscow University. Episode 14. Psychology. No. 1. pp. 3–37. https://doi.org/10.11621/vsp.2021.01.01

Nestik T. A. (2023). The influence of military conflicts on the psychological state of society: promising areas of research // Social psychology and society. T. 14. No. 4. P. 5-22. https://doi.org/10.17759/sps.2023140401

Petrovsky V. A. (2021). Man above the situation (2021) Publisher: Northern Pilgrim, 2021. 559 p. https://dpo-journal.ru/pablik/Petrovsky-2.pdf

Ryadinskaya E. N. (2018). Analysis of stress factors affecting the physical and mental health of civilians in the conflict zone in the South-East of Ukraine [Electronic resource] // Psychology and Law. Vol. 8. No. 4. pp. 252–266. https://doi.org/10.17759/psylaw.2018080421

Soldatova, G. U., Rasskazova, E. I., & Nestik T. A. (2017). Digital generation of Russia: competence and safety. (2017) M.: Smysl, 375 p. https://bmu.vrn.muzkult.ru/media/2022/10/27/1286894904/2017cifrovoe_pokolenie_rossii_compressed.pdf

Review Article

Received: May 30, 2024.
Revised: August 05, 2024.
Accepted: August 24, 2024.

UDC:
378.014.621
378.091.8
10.23947/2334-8496-2024-12-2-437-450

Participation of Students in all Areas of Governance in Higher Education Institutions in the Light of the Literature – A Systematic Review

Enim Rejubi Peter[1*], *Alzmeter Laura*[2], *Rónay Zoltán*[3]

[1] Eötvös Loránd University, Faculty of Education and Psychology, Doctoral School of Education, Budapest, Hungary
e-mail: rejenim@student.elte.hu
[2] Eötvös Loránd University, Faculty of Education and Psychology, Doctoral School of Education, Budapest, Hungary
e-mail: lauralzmeter@student.elte.hu
[3] Eötvös Loránd University, Faculty of Education and Psychology, Budapest, Hungary
e-mail: ronay.zoltan@ppk.elte.hu

Abstract: This paper presents a comprehensive methodology for conducting a systematic literature review on student participation in higher education institutions (HEIs), focusing on decision-making, student engagement, and extracurricular activities. Following PRISMA guidelines, the review uses evaluation criteria techniques to ensure the quality and transparency of information critical to the design of the paper. A search strategy utilising key terms across EBSCO and Web of Science databases identified 41 relevant articles. Each article underwent thorough analysis, addressing research inquiries about student participation in educational institutions. The review combines findings from diverse perspectives while highlighting students' importance in decision-making and the relevance of student voices in this process. In addition, it highlights the importance of student engagement and the impact of extracurricular activities on academic success. Through such discussions, the paper emphasises the need for integrated frameworks focused on understanding student participation across higher education institutions, suggesting recommendations for optimising student involvement or participation in decision-making processes, fostering student engagement in teaching and learning, and enhancing participation in extracurricular activities. Overall, the paper highlights the multi-dynamic nature of student participation in the modern structure of higher education institutions and advocates for a holistic approach that empowers and motivates students to participate in all areas of the education system, which will go a long way in shaping their educational experiences.

Keywords: *Higher education institutions, Student participation, Decision-making, Student engagement, Extracurricular activities*

Introduction

This paper discusses students' roles and participation within the higher education institution (HEI) system from the angles of decision-making and student voice. In addition, it will analyse the influence of student engagement and participation in extracurricular activities on the design structure of modern higher education. This is purposefully done through a Systematic Literature Review (SLR) of articles and studies in the field of student participation in HEI that aligns with the intentions of this paper, which is to portray the various ways of student participation in HEI. By so doing, we distinguished that this literature put student participation within three major categories.

The first is decision-making and student voice, which includes studies about university governance and decision-making processes, either as individuals or through student organisations, advocating for greater inclusiveness. Followed by this are studies on student engagement focused on shaping the teaching and learning processes. In addition, these studies are particularly interested in student participation in extracurricular activities concerning academic performance. The review is done this way to decrease the likelihood of inaccurate conclusions being reached through chance but through proper examination of various works in this field of study and to present the ideas concerning student participation.

The objective of this paper is to review diverse academic research and identify the key areas

*Corresponding author: rejenim@student.elte.hu

where student participation is prominent within higher education institutions, particularly in academic and administrative domains. By integrating and analyzing various studies, the aim is to highlight how students participate in decision-making processes within higher education systems.

Additionally, the paper explores other significant dimensions of student participation, including their engagement in extracurricular activities, which are crucial areas of interest and impact for students in higher education.

In this article, we recognise that student participation is sometimes thought of as encompassing a broad spectrum of ideas such as learning styles, teaching methods aimed at fostering active participation, considerations of attendance patterns, and the involvement of students in educational governance.

However, it is critical to mention that this paper focuses specifically on student participation in administrative procedures, governance and decision-making processes, and out-of-the-lecture room participation within the higher education institutional structure, often called “student voice”.

The growing focus on students as customers in higher education policy and implementation, along with the use of student’s voice as evaluative criteria within the processes and corners of higher education institutions, underscores the growing interest and clamour for students’ participation in all areas of HEI. (Luescher-Mamashela, 2010)

In 2008, the former United Kingdom (UK) Higher Education Academy (HEA) chief executive, delivered a report to the universities minister, Bill Rammell, titled ‘The Future of Higher Education Teaching and the Student Experience.’ The purpose of this report was to serve as a guideline for decisions made on policies concerning student and teacher-based experiences for the upcoming decade or so. (Ramsden, 2008)

Within the report, Ramsden identifies worldwide race as a significant challenge and proposes that the aim should be focused on positioning a partnership between providers and students in the higher education system epicentre of the UK. (White, 2018)

Within the university government policy, university students are increasingly portrayed as consumers encouraged to engage with their degree studies pragmatically to maximise personal benefits and gains. Consequently, students are expected to adopt a strategic and instrumental approach, essentially becoming active participants in their university community as part of the gains while in the system. Accordingly, the increasing marketisation of the higher education sector has increased the significance of the need for students’ input and influence on quality assurance endeavours, amongst others. Hence, there is a need for active student citizenry within the institution. (Mendes and Hammett, 2023)

Theoretical framework of power dynamic for student participation

The idea and concept of student participation have also become a widespread focus in the policies and practices within and around the higher education system. Nonetheless, critics have argued that despite its popularity, the concept of student participation needs a coherent theoretical foundation. Higher education institutions employ the notion of student participation in numerous, often vague and ambiguous ways as they develop different policies to encourage students’ participation throughout their academic journey. (Buckley, 2014)

The notion of student participation often suggests the traditional concept of elected student government and councils. However, such student governments are now viewed not merely as information-gathering entities but as vehicles for fostering participation in decision-making and granting access to the governance structure in universities. (Kuruuzum et al., 2005)

We are delving into the normative endeavour of promoting student voice in educational settings and students’ democratic participation rights within HEI processes. At its core are the values guiding student voice practices and the dimension of power and power dynamics by scrutinising the theoretical basis of student voice, including its relationship with power and its historical roots in radical pedagogy. The potential contribution of postmodernist analyses is part of a deeper understanding of student voice practices. Emphasising the need for ongoing theoretical exploration rather than premature synthesis, there is a need to initiate a critical discourse on the complex interplay between power dynamics, student voice, and participation to ignite broader theoretical debates in the field. (Taylor and Robinson, 2009)

However, the theoretical framework revolves around the “students as co-constructors” paradigm, recognising students as pivotal contributors to maintaining and improving the quality of educational pro-

grams. Ideally, most student government organisations should adopt the viewpoint that collaboration entails empowering students to actively participate in shaping knowledge, learning, and the entirety of higher education. (Moyo and Boti, 2020)

Materials and Methods

Objectives of the Paper

The objective of this paper is shaped around the ideology of examining various scholarly works to ascertain the areas of interest and influence where student participation has gained attention in HEI, especially across the academic and administrative spectrum. Hence, the objectives are categorised into the following:

- Establish a solid base in this paper through a combination and review of different studies to show the areas and influence of student participation in decision-making within the HEI system.
- In addition, the paper seeks to show other critical aspects that shape student participation initiatives, such as student engagement in teaching and learning and extracurricular activities. These are vital aspects of influence and interest for students in HEI.
- *Questions as basis for the review*
- The review is structured on the following research questions:
- What are the common considerations among scholars about the influence of student participation in the decision-making of the Higher Education Institutions (HEI)?
- What areas are students interested in participating within the HEI identified by scholars?

Methodology of the Paper

We conducted a systematic review to fulfil our objectives, drawing from the PRISMA directives (Preferred Reporting Items for Systematic Reviews and Meta-Analyses). Additionally, we ensured that we used evaluation criteria that would provide us with the best quality, transparency, and replicability.

The Systematic Literature Review (SLR) is crucial for navigating a specific field's vast expanse of knowledge. Its objectives enable researchers to chart and access the existing intellectual landscape while pinpointing gaps and posing inquiries for future investigations. (Tranfield et al., 2003)

Originating in medical sciences and subsequently adopted extensively in the social sciences, the Systematic Literature Review sets itself apart from conventional narrative reviews through its commitment to a transparent, systematic, and reproducible approach, thereby enhancing the rigour of the process. (Tranfield et al., 2003)

Search Strategy

From formulating these research questions, the next step involves delineating the search criteria. The initial term selected was "Student Participation", which was queried within quotation marks to ensure comprehensive coverage. Considering the research aims, this term was contextualised within the educational domain. To achieve this, a combination of five terms was explored: "higher education institution", "decision-making", "University", "extra-curricular activities" and "Student engagement".

To conduct this review, we employed searches across the databases EBSCO and the repository of the Web of Science. Our search criteria focused on identifying articles published in international scientific journals from 2005 to 2024.

The selection of these databases was deliberate as they align with some of the most expansive research repositories commonly employed in literature reviews. Opting for two databases was strategic to mitigate the possibility of overlooking relevant documents due to their distinct publication coverage. Moreover, the decision to utilise both EBSCO and Web of Science stems from their utilisation of distinct search mechanisms, rendering it impractical to apply identical parameters across both database platforms.

Following this, the researchers individually examined the complete texts of 41 publications, focusing mainly on four elements: (a) the aims and research inquiries, (b) the methodologies employed, (c) the

findings, and (d) the geographical location of the publication. This scrutiny facilitated the elimination of works that did not align with the inclusion criteria.

Study Selection Procedure

The search procedures took place in March 2024. Regarding the EBSCO and Web of Science databases, the outcomes were as follows: employing the search term "Student Participation" along with "higher education institution", "decision-making", "University", "extra-curricular activities", and "Student engagement" in subfields of the databases provided the possibility to find the best article for the paper. 621 documents were identified (513 in Web of Science and 108 in EBSCO). Subsequently, filters were applied, including English language, research areas (education, educational research, higher education research), and document type (article) without temporal restrictions, excluding 492 documents. One reason was due to duplication across both databases.

Another round of screening was implemented, this time focusing on assessing abstracts and discovering duplication across both databases. This resulted in the exclusion of 63 articles deemed irrelevant to the research objective and needing a more specific reference to student participation in higher education institutions, which revolves around extracurricular activities, decision-making, and governance.

Following these screening procedures, all retained articles were thoroughly reviewed, during which an additional 25 articles were deemed unsuitable for the review purposes.

Following this procedure, 41 articles were selected for subsequent examination. Further graphical summaries explain the criteria and search methodology employed and designed by the authors using Microsoft Soft Visio (MS Visio) and the Mendeley software to properly track and represent the references in the paper.

The analysis of the 41 articles (*see Table A1 & Figure A1*) led to each article undergoing examination, such as content analysis, which was conducted to address the research inquiries posed and to pinpoint potential avenues for further investigation.

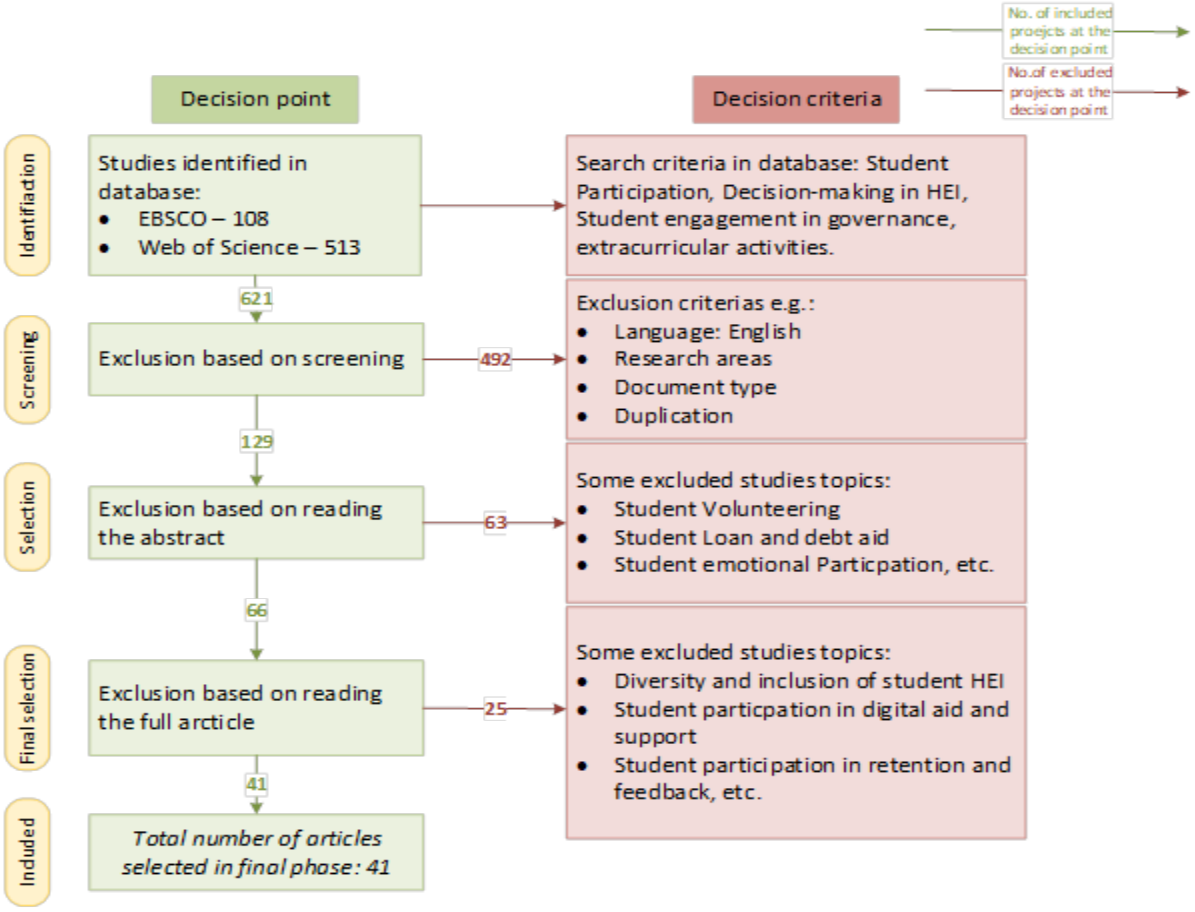

Figure I. *Flowchart of the Study Selection procedure*
Source: Elaborated by the authors using MS Visio

Results

Decision-making and Student Voice

Seale's research highlights a gap in understanding student voice transformative potential in higher education. Little discourse exists on translating these concepts into practical student voice initiatives. Seale proposes a participatory method, promising to empower students and enhance the university administration's responsiveness to feedback. However, the short duration of these projects suggests the need for long-term evaluations to assess their full impact. (Seale, 2010)

The complexities of student participation and the inclusion of student voice within a UK university faculty, using the Communities of Practice (CoP) framework. While CoP helps understand engagement and organisational boundaries, it also highlights disparities between staff and student engagement. The study emphasises the importance of recognising student representation as a legitimate participation in HEI, suggesting potential shifts in CoP dynamics. Although no specific solutions are provided, the research underscores the need for scholarly efforts to develop more equitable and inclusive approaches. Ultimately, the evolving nature of communities of practice offers optimism for future collaboration between student representatives and staff, fostering healthier partnerships in institutional governance (Flint and O'Hara, 2013). Students as Partners (SaP) within HEI is progressing, with partnership approaches striving to acknowledge students as credible sources of knowledge and foster more egalitarian relationships between students and staff. This trend is becoming more prevalent in higher education. (de Bie, 2022; Mercer-Mapstone et al., 2017)

The question is whether student voice truly empowers, particularly in higher education governance. Despite institutional efforts, students often feel their input needs to have a significant impact. These channels, perceived as control mechanisms by the administration, only sometimes lead to student empowerment. It is therefore suggested that examining how student involvement is structured within higher education to understand its effects. (Freeman, 2016)

Fletcher's (2017) study highlights the need for genuine student input beyond learning and teaching. He identifies five pathways for comprehensive student engagement:

I. Elevating the visibility of student contributions within higher education.
II. Empowering students to be agents of change.
III. Creating safe environments for student expression.
IV. Educating students on broader issues.
V. Fostering active participation in policy feedback and revisions. (Fletcher, 2017)

Higher education institutions promote active citizenship through initiatives like Campus Compact, which involves over 1,000 universities in the United States of America (USA). Founded in the mid-1980s, Campus Compact underscores higher education's role in fostering engaged citizenship. Such initiatives are socially responsible and address broader societal needs. (Miles et al., 2008; Miller et al., 2012)

Efforts to enhance student participation may encounter challenges, including discrepancies in the perceived importance of student involvement between staff and students. Conflicting expectations and resource constraints can hinder effective collaboration between departments and staff-student initiatives. (Islam et al., 2021)

Despite concerns about potential distancing between students and staff due to increased participation, examples like the 2012 Kovacs Crisis at UWC in South Africa demonstrate the effectiveness of student involvement. The Student Representative Council successfully negotiated a decrease in student accommodation costs, highlighting the importance of active student engagement in decision-making processes, even within public-private partnership frameworks.(Mugume and Luescher, 2015)

Through this example, it becomes increasingly apparent that student participation within the channel of student governance creates part of the nucleus of the university administration system, and their interest and power dynamic has become increasingly present. This leads to the establishment of a typology of student governance by outlining four distinct aspects of student governance regimes (the community of scholars, representative-democratic university, prestigious national university, and market-oriented university) that can be identified based on various perspectives of the university. (Luescher-Mamashela, 2010)

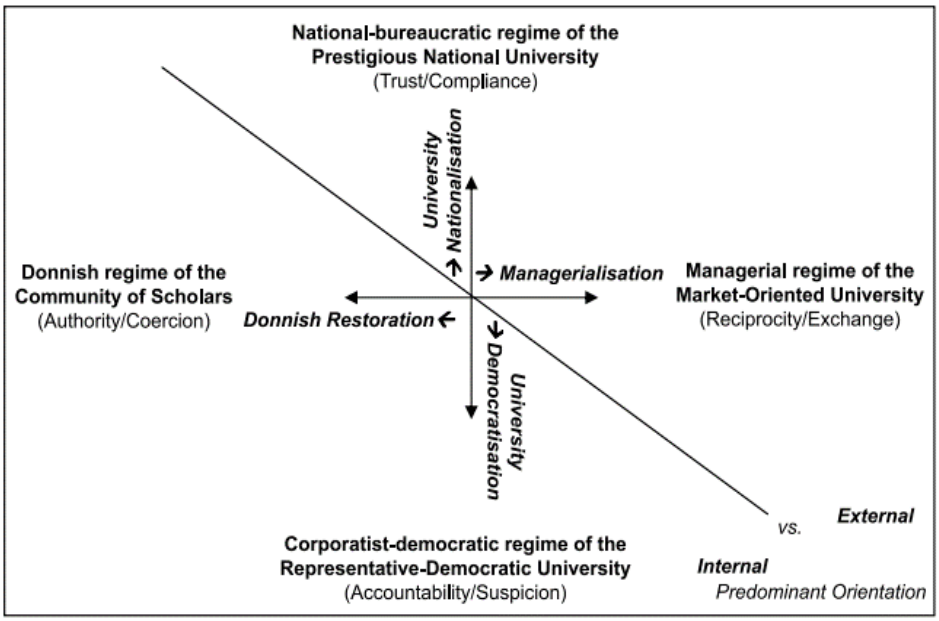

Figure II. *a typology of student governance*

Source: (Carey, 2018)

The focus of the typology outlined examines the political dynamics between students and universities by categorising the diverse relationships between them into different regimes of student governance, which remains a massive channel for student participation in decision-making and student voice. It views shifts in this connection as transformations between these regimes. This typology is a systematic tool for analysing the various operational structures of student governance, specifically emphasising student participation in university governance. (Luescher-Mamashela, 2010) Therefore, it is essential to consider the activities the university mandates, anticipates or sanctions alongside frameworks that focus on students' actions. This concept is presented through a Nested Hierarchy of Student participation and interactions, depicted in the figure below. This model correlates student roles with institutional roles, showing how institutions influence and inspire student behaviour and participation approaches. (Carey, 2018)

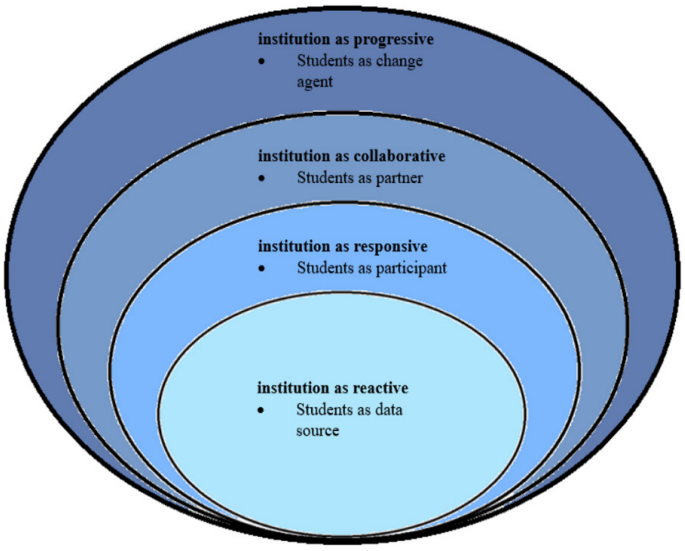

Figure III. *Nested Hierarchy of Student Participation*

Source: (Carey, 2018)

Moving away from a general worldview of student participation and taking a more geographical look into the European Higher Education Area (EHEA), the concept of student participation in governance faces tensions stemming from conflicting views on the reasons and roles of higher education (HE). While the

Bologna Process emphasises the multiple purposes of HE, the European Union's modernisation agenda precedes higher education's role in serving the knowledge-based economy of the continent. Although the Bologna papers do not prescribe governance reforms, the European Commission's contributions reflect the ideology of new public management in HE. Governments and HE institutions adopt these recommendations, albeit with variations influenced by national and institutional processes. (Klemenčič, 2012b)

Despite their varied and heterogeneous nature, the prevailing direction in governance models across European universities is toward greater institutional autonomy, resulting in increased financial independence, heightened accountability, and amplified managerial oversight. This transition comes with an increase in the dominance of executive and authority entities within higher education establishments, frequently resulting in reduced authority and sway among established governing authorities. The legitimate bolstering of administrative leadership roles and greater engagement of external stakeholders characterise this process. (Planas et al., 2013)

On the other hand, the organisational evolution of FZS (Freier Zusammenschluss von Studentinnenschaften), the student union national organisation in Germany, shows us the transformation and journey of student participation. Its development traced from its inception to 2010 and concluded that over recent decades, the student organisation FZS in Germany has undergone significant transformations, evolving from a smaller, ideologically driven network to a more professionally structured umbrella organisation. Various political developments, such as the Bologna procedures and shifts in higher education legislation among the German states, influenced these changes. Increased formal student participation and external pressures, like tuition fee debates, initially led to the growth and professionalisation of this organisation. Subsequent factors, which include the bringing in payment of tuition fees in some states and diminishing federal influence in higher education policy, have challenged FZS's influence and led to declining membership and reform capabilities. (Jungblut and Weber, 2012)

Despite students being recognised as a significant constituency in Europe and typically participating in higher education governance, it is remarkable how limited scholarly research on student-representative organisations exists. This scarcity of research may stem from a broader lack of study into domestic and European higher education politics rather than an assumption that student associations hold marginal roles in these spheres. (Klemenčič, 2012a; Matthews and Dollinger, 2023)

Student Engagement

Student engagement originates from the constructivist notion that an individual's active participation moulds learning in meaningful educational endeavours. It is perceived as a collaborative endeavour shaped by institutions and educators who establish the environment, opportunities, and expectations for student involvement. However, individual learners are still considered the central figures in discussions concerning engagement. (Matthews, 2016)

In market-driven higher education systems, there is a growing focus on student engagement and partnership, driven by practices of high-impact educational performances.(Trogden et al., 2023) Marketisation pervades higher education and high-impact educational practices, creating disparities between consumers and producers and leading to inefficiencies. To address these imbalances, policymakers promoting a market-oriented approach to higher education typically seek to empower students by offering more information or amplifying their voices. This approach stems from viewing students from the angle of consumers within the circle of an uneven market dynamic. Consequently, participation-based policies are introduced to encourage students, bolster their independence, and address inequality between the HEI producers and students as consumers, particularly evident in Western higher education systems. (White, 2018)

Student engagement has received increased attention in recent years, often with the belief that it can oppose neoliberal agendas and practices of teaching and learning in education. (Holen et al., 2021) Sometimes, student engagement is termed the 'tyranny of participation' because of its modern approach to integrating students deeper into higher education establishments. (Gourlay, 2015) However, researchers and policymakers now view student engagement as a positive aspect of higher education. (Ashwin and Mcvitty, 2015)

A survey among undergraduate students and academic faculty from three Chinese universities explored collaborative practices through student engagement. The study focused on 17 students participating in Student as Partners (SaP) activities and initiatives. The study revealed widespread agreement

among the participants on the importance of such collaborative processes. This study's students and faculty members demonstrated that active participation in SaP practices is necessary in HEI. The study echoed trends observed in Western contexts, albeit with minor variations in areas like course representation and governance activities. (Liang and Matthews, 2021)

Ultimately, the aim of further initiatives for student engagement should involve collaborating with learners and tackling the challenge of shared responsibility to establish the potential for achieving a mutual sense of accountability concerning both students and their ongoing education. (Cook-Sather, 2010)

Participation in Extracurricular activities

Student engagement has become a widespread focus in the policies and practices within and around the higher education system. Nonetheless, critics have said student participation needs a coherent theoretical foundation despite its popularity. In reality, higher education institutions employ the notion of student participation in numerous, often vague and ambiguous ways, as they bring forth different policies to encourage students' participation throughout their academic journey. (Blair and Valdez, 2014; Buckley, 2014)The HEI landscape has student participation in deciding the university's extracurricular activity (ECA). Such a governance structure is predominantly driven by quality assurance and enhancement efforts. For example, this mirrors a broader trend in Europe, emphasising increased student partaking in quality-based initiatives, including ECA assessment. For instance, UK policy directives echo this sentiment. The Quality Assurance Agency in the UK urges HEI to actively involve students, either as a group or as individuals, in partnership, which leads to ensuring and improving the experiences within the institution, which can be said to include, most certainly, extra-curricular activities. (Gvaramadze, 2011)

When it comes to student extracurricular activities, student governments, known by various names such as guilds, societies, unions, or councils, play a central role in representing student interests within higher education institutions and taking responsibility for organising such activities. (Kennedy and Pek, 2023)

Their primary function is to represent the students across various areas of the HEI set-up. Part of this includes extracurricular activities where a team of representatives works to advocate for the student body. To do this effectively, proper representation and discussion regarding all matters of concern to students must be addressed in such interactions with university authorities. (Enright et al., 2017)

Amidst the complexities of higher education (HE) settings, ongoing discussions revolve around extracurricular activities (ECAs) and students' involvement in such activities within this environment. (Dickinson et al., 2021). This evolving method, which involves student participation in teaching and learning processes, for example, can influence students, the public, educational curricula, and the higher education system. (Nowell et al., 2024)

Relevance of ECA to Academic Success

Regarding extracurricular activities involvement among higher education (HE) students, 294 participants from a Higher Education Institution (HEI) in the northern parts of England participated in a survey. This survey evaluated students' perceptions of their effectiveness in academic performance and social interactions. Additionally, 54 of these students completed a follow-up survey. The main discovery was a favourable link between participation in certain extracurricular activities and students' self-confidence about academic success within the university setting. (Griffiths et al., 2021a)

Recognition of the importance of ECA as a critical part of the HEI set-up has been established as being connected to students' success in the classroom and in their academics. However, if left only to the administration to make crucial decisions to achieve the institution's goals and execute these decisions without the involvement of students, it will lack credibility. The design and implementation of the extracurricular activities should also include the students and not just to partake in. Administrators and students who are part of the decision-making process are tasked with choosing the most appropriate option from a range of options that will be most pleasing to the students, especially in areas pertaining to their academics. (Gul, 2010)

Shared authority is vital for effective governance in higher education institutions (HEIs). Traditionally, decision-making rested solely with administrators. However, diverse tasks, such as participation in university extracurricular activities, require collaboration among students, faculty, administrative staff, and

support personnel. Inclusive processes such as ECA have been refined over time, recognising that decisions made on campus impact everyone involved, including the teaching and learning process, particularly students. This highlights the importance of active involvement in all student and university relationship processes. (Dundar, 2013)

In a separate research involving university students revealed that those who had either graduated from their undergraduate program or were in their final year had engaged in extracurricular activities outside their coursework. The students noted these activities' significance in their academic success. (King et al., 2021a).

Discussions

The current state of research literature aids in examining various aspects of student participation in higher education institutions by systematically condensing the existing body of literature and separating it into three topic areas.

It became intriguing that student voice is critical in decision-making. Student engagement and extracurricular activities also contribute to student participation in HEIs. The literature concerns more than just genuine student input; it focuses on learning and teaching and encompasses the broader student experience. Student participation is contingent upon institutional requirements, indicating that the institution's parameters constrain participation.

Decision-making goes along with student participation, whether as individuals or as part of the institution, in areas such as student governance or involvement in the structure of university governance through the decision-making process or by demanding more student inclusiveness in university governance (Student Voice).

The literature in this category on student engagement clearly shows the necessity for a harmonious blend of student involvement in shaping the academic framework of higher education institutions. It advocates for increased student participation in designing and structuring the teaching and learning processes within the higher education system.

Also, participation in extracurricular activities particularly emphasises the connection between engagement in social activities and academic performance. Therefore, the literature review in this area explores the correlation between students' academic achievements and their level of participation.

Conclusions

This article explores the common considerations among scholars regarding the influence of student participation in the decision-making processes of higher education institutions (HEI). Through the analysis of various cases and scenarios, the influence of student participation is categorized into four main areas: governance within HEIs, the increasing demands from the perspective of students as consumers, the communitarian-based influence that views students as integral community members, and the democratic approach that grants students citizenship rights to participate in voting and decision-making processes.

Instead of viewing these perspectives as mutually exclusive, the article proposes integrating them into a comprehensive framework to comprehensively analyze student participation across different levels and domains of HEIs. This holistic approach will provide a more inclusive understanding of the various dimensions of student participation and engagement. (Luescher-Mamashela, 2013)

The article also aimed to address areas of students' interest in participating in the HEI identified by scholars. To that end, it was established that the absence of clear roles for students, or the perception that roles vary depending on the context, dramatically contributes to these uncertainties throughout the higher education landscape of areas of interest. This ranges from national or student regulatory bodies providing vague guidance on the concept of 'student participation' to the risk of marginalising student perspectives or areas of interest within academic-related boards and councils related to the teaching and learning process. Hence, relatively limited attention is given to student roles in academic literature focusing on student engagement and participation outside of methods that include teaching and learning procedures. (Naylor et al., 2020)

Therefore, we should draw from the diverse factors identified and create a conclusion to optimise

and understand the areas of student interest for participation. By doing so, we can dissect areas of participation into three parts: decision-making in governance in HEI, student engagement, which in itself encompasses the teaching and learning process, and participation in extra-curricular activities. Achieving an optimal understanding of all three areas for student participation necessitates implementing changes at both national and institutional levels, which can effectively motivate and empower students to engage actively and positively. (Palma et al., 2023)

In addition, some of the literature utilized for this paper highlights a positive connection between involvement in certain extracurricular activities and students' confidence in their academic success at university. Recognizing extracurricular activities as essential to the higher education framework is crucial for student success both inside and outside the classroom. Decisions about these activities must involve students to maintain credibility and effectiveness. Shared governance, including collaboration among students, faculty, and administrators, is critical to effective management. Students who had graduated or were nearing graduation highlighted the significant role of extracurricular activities in their academic achievements. (Griffiths et al., 2021; King et al., 2021)

Conflict of interests

The authors declare no conflict of interest.

Authors Contributions

Conceptualisation, E.R.P., A.L., and R.Z.; methodology, E.R.P., A.L.; software, E.R.P., A.L., and R.Z.; formal analysis, E.R.P., A.L., and R.Z.; writing—original draft preparation, E.R.P., A.L., and R.Z.; writing—review and editing, E.R.P., A.L., and R.Z.; All authors have read and agreed to the published version of the manuscript.

References

Ashwin, P., & Mcvitty, D. (2015). The meaning of Student Engagement: Implications for Policies and Practices. *The European Higher Education Area*, 343–359. https://doi.org/10.1007/978-3-319-20877-0

Blair, E., & Valdez, N. K. (2014). Improving higher education practice through student evaluation systems: Is the student voice being heard? *Assessment and Evaluation in Higher Education*, *39*(7), 879–894. https://doi.org/10.1080/02602938.2013.875984

Buckley, A. (2014). How radical is student engagement? (And what is it for?). *Student Engagement and Experience Journal*, *3*(2), 1–23. https://strathprints.strath.ac.uk/58102/

Carey, P. (2018). The impact of institutional culture, policy and process on student engagement in university decision-making. *Perspectives: Policy and Practice in Higher Education*, *22*(1), 11–18. https://doi.org/10.1080/13603108.2016.1168754

Cook-Sather, A. (2010). Students as learners and teachers: Taking responsibility, transforming education, and redefining accountability. *Curriculum Inquiry*, *40*(4), 555–575. https://doi.org/10.1111/j.1467-873X.2010.00501.x

de Bie, A. (2022). Respectfully distrusting 'Students as Partners' practice in higher education: applying a Mad politics of partnership. *Teaching in Higher Education*, *27*(6), 717–737. https://doi.org/10.1080/13562517.2020.1736023

Dickinson, J., Griffiths, T. L., & Bredice, A. (2021). 'It's just another thing to think about': encouraging students' engagement in extracurricular activities. *Journal of Further and Higher Education*, *45*(6), 744–757. https://doi.org/10.1080/0309877X.2020.1813263

Dundar, S. (2013). Students' participation to the decision-making process as a tool for democratic school. *Kuram ve Uygulamada Egitim Bilimleri*, *13*(2), 867–875.

Enright, E., Coll, L., Ní Chróinín, D., & Fitzpatrick, M. (2017). Student voice as risky praxis: democratising physical education teacher education. *Physical Education and Sport Pedagogy*, *22*(5), 459–472. https://doi.org/10.1080/17408989.2016.1225031

Fletcher, A. (2017). *Student voice revolution: The meaningful student involvement handbook*. Common Action Publishing.

Flint, A., & O'Hara, M. (2013). Communities of practice and 'student voice': engaging with student representatives at the faculty level. *Student Engagement and Experience Journal*, *2*(1). https://journals.shu.ac.uk/index.php/seej/article/view/63

Freeman, R. (2016). Is student voice necessarily empowering? Problematising student voice as a form of higher education governance. *Higher Education Research and Development*, *35*(4), 859–862. https://doi.org/10.1080/07294360.2016.1172764

Gourlay, L. (2015). *"Student engagement" and the tyranny of participation*.

Griffiths, T. L., Dickinson, J., & Day, C. J. (2021). Exploring the relationship between extracurricular activities and student self-efficacy within university. *Journal of Further and Higher Education*, *45*(9), 1294–1309. https://doi.org/10.1080/0309877X.2021.1951687

Gul, H. (2010). Partcipation of Students councils in Decision making at Uni in Turkey. *Collage Student Journal*, *44*(2), 568–578.

Gvaramadze, I. (2011). Student engagement in the Scottish quality enhancement framework. *Quality in Higher Education*, *17*(1), 19–36. https://doi.org/10.1080/13538322.2011.554310

Holen, R., Ashwin, P., Maassen, P., & Stensaker, B. (2021). Student partnership: exploring the dynamics in and between different conceptualizations. *Studies in Higher Education*, *46*(12), 2726–2737. https://doi.org/10.1080/03075079.2020.1770717

Islam, M., Burnett, T.-L., & Collins, S.-L. (2021). Trilateral partnership: An institution and students' union collaborative partnership project to support underrepresented student groups. *International Journal for Students as Partners*, *5*(1), 76–85. https://doi.org/10.15173/ijsap.v5i1.4455

Jungblut, J., & Weber, R. (2012). National student governance in Germany: the case of fzs. *European Journal of Higher Education*, *2*(1), 47–62. https://doi.org/10.1080/21568235.2012.683701

Kennedy, J., & Pek, S. (2023). Mini-publics, student participation, and universities deliberative capacity. *Studies in Higher Education*, *48*(1), 63–82. https://doi.org/10.1080/03075079.2022.2111551

King, A. E., McQuarrie, F. A. E., & Brigham, S. M. (2021a). Exploring the Relationship Between Student Success and Participation in Extracurricular Activities. *SCHOLE: A Journal of Leisure Studies and Recreation Education*, *36*(1–2), 42–58. https://doi.org/10.1080/1937156X.2020.1760751

King, A. E., McQuarrie, F. A. E., & Brigham, S. M. (2021b). Exploring the Relationship Between Student Success and Participation in Extracurricular Activities. *SCHOLE: A Journal of Leisure Studies and Recreation Education*, *36*(1–2), 42–58. https://doi.org/10.1080/1937156X.2020.1760751

Klemenčič, M. (2012a). European Higher Education at the Crossroads. *European Higher Education at the Crossroads*, 631–653. https://doi.org/10.1007/978-94-007-3937-6

Klemenčič, M. (2012b). Student representation in Western Europe: introduction to the special issue. *European Journal of Higher Education*, *2*(1), 2–19. https://doi.org/10.1080/21568235.2012.695058

Kuruuzum, A., Asilkan, O., & Cizel, R. B. (2005). Student participation in higher education institutions in Turkey. *Higher Education in Europe*, *30*(3–4), 345–355. https://doi.org/10.1080/03797720600625077

Liang, Y., & Matthews, K. E. (2021). Students as partners in China: Investigating the potentials and possibilities for growing practices across universities. *International Journal for Students as Partners*, *5*(2), 28–47. https://doi.org/10.15173/ijsap.v5i2.4767

Luescher-Mamashela, T. M. (2010). From university democratisation to managerialism: The changing legitimation of university governance and the place of students. *Tertiary Education and Management*, *16*(4), 259–283. https://doi.org/10.1080/13583883.2010.529161

Luescher-Mamashela, T. M. (2013). Student representation in university decision making: good reasons, a new lens? *Studies in Higher Education*, *38*(10), 1442–1456. https://doi.org/10.1080/03075079.2011.625496

Matthews, K. E. (2016). Students as partners as the future of student engagement. *Student Engagement in Higher Education Journal*, *1*(1), 1–5.

Matthews, K. E., & Dollinger, M. (2023). Student voice in higher education: the importance of distinguishing student representation and student partnership. *Higher Education*, *85*(3), 555–570. https://doi.org/10.1007/s10734-022-00851-7

Mendes, A. B., & Hammett, D. (2023). The new tyranny of student participation? Student voice and the paradox of strategic-active student-citizens. *Teaching in Higher Education*, *28*(1), 164–179. https://doi.org/10.1080/13562517.2020.1783227

Mercer-Mapstone, L., Dvorakova, S. L., Matthews, K. E., Abbot, S., Cheng, B., Felten, P., Knorr, K., Marquis, E., Shammas, R., & Swaim, K. (2017). A Systematic Literature Review of Students as Partners in Higher Education. *International Journal for Students as Partners*, *1*(1), 1–23. https://doi.org/10.15173/ijsap.v1i1.3119

Miles, J. M., Miller, M. T., & Nadler, D. P. (2008). Student Governance: Toward Effectiveness and the Ideal. *College Student Journal*, *42*.

Miller, M. T., Nadler, D. P., & Miles, J. M. (2012). *Are you voting today? Student participation in self-government elections*. *December*.

Moyo, C. S., & Boti, Z. (2020). Perceptions of students on factors that constrain their involvement in quality assurance and promotion in two comprehensive universities in South Africa. *South African Journal of Higher Education*, *35*(4), 35–47. https://doi.org/10.20853/34-5-4239

Mugume, T., & Luescher, T. M. (2015). The politics of student housing: Student activism and representation in the determination of the user-price of a public–private partnership residence on a public university campus in South Africa. *Journal of Student Affairs in Africa*, *3*(1), 1–17. https://doi.org/10.14426/jsaa.v3i1.89

Nowell, L., Keogh, B., Laios, E., Mckendrick-Calder, L., Lucas Molitor, W., & Wilbur, K. (2024). Public participation in healthcare students' education: An umbrella review. *Health Expectations*, *27*(1). https://doi.org/10.1111/hex.13974

Palma, A., Mourato, J., Vinagre, J., Almeida, F., & Pessoa, A. M. (2023). Student Participation: Issues for the Governance of Higher Education. *Societies*, *13*(5), 1–15. https://doi.org/10.3390/soc13050115

Planas, A., Soler, P., Fullana, J., Pallisera, M., & Vilà, M. (2013). Student participation in university governance: The opinions of professors and students. *Studies in Higher Education*, *38*(4), 571–583. https://doi.org/10.1080/03075079.2011.586996

Ramsden, P. (2008). The future of higher education teaching and the student experience part 1: Responding to evolving stu-

dent expectations. *Swedish National Agency for Higher Education*, 1–21.

Seale, J. (2010). Doing student voice work in higher education: An exploration of the value of participatory methods. *British Educational Research Journal*, *36*(6), 995–1015. https://doi.org/10.1080/01411920903342038

Taylor, C., & Robinson, C. (2009). Student voice: Theorising power and participation. *Pedagogy, Culture and Society*, *17*(2), 161–175. https://doi.org/10.1080/14681360902934392

Tight, M. (2013). Students: Customers, clients or pawns? *Higher Education Policy*, *26*(3), 291–307. https://doi.org/10.1057/hep.2013.2

Tranfield, D., Denyer, D., & Smart, P. (2003). Towards a Methodology for Developing Evidence-Informed Management Knowledge by Means of Systematic Review. *British Journal of Management, 14*, 207–222. https://doi.org/10.1111/1467-8551.00375

Trogden, B. G., Kennedy, C., & Biyani, N. K. (2023). Mapping and Making Meaning from Undergraduate Student Engagement in High-Impact Educational Practices. Innovative Higher Education, 48(1), 145–168. https://doi.org/10.1007/s10755-022-09608-7

White, M. (2018). Student partnership, trust and authority in universities. Educational Philosophy and Theory, 50(2), 163–173. https://doi.org/10.1080/00131857.2016.1153451

Appendix

Table A1. *41 articles identified for the Literature Review*

Number	Title of Project	Country	Category
1.	(Seale, 2010)	UK	DM/SV
2.	(Taylor & Robinson, 2009)	UK	DM/SV
3.	(Freeman, 2016)	UK	DM/SV
4.	(Flint & O'Hara, 2013)	UK	DM/SV
5.	(Islam, Burnett & Collins, 2021)	UK	DM/SV
6.	(Fletcher, 2017)	UK	DM/SV
7.	(Carey, 2018)	UK	DM/SV
8.	(Mendes & Hammett 2023)	UK	DM/SV
9.	(Griffiths, Dickinson & Day 2021)	UK	P. in ECA
10.	(Dickinson, Griffiths & Bredice, 2021)	UK	P. in ECA
11.	(King, McQuarrie & Brigham, 2021)	UK	P. in ECA
12.	(Gourlay, 2015)	UK	Stud. Eng.
13.	(White, 2018)	UK	Stud. Eng.
14.	(Ashwin & Mcvitty 2015)	UK	Stud. Eng.
15.	(Gul, 2010)	Tükye	DM/SV
16.	(Kuruuzum, Asilkan & Cizel 2005)	Tükye	DM/SV
17.	(Dundar, 2013)	Tükye	DM/SV
18.	(Miles, Miller & Nadler 2008)	USA	DM/SV
19.	(Miller, Nadler & Miles 2012)	USA	DM/SV
20.	(Trogden, Kennedy & Biyani 2023)	USA	Stud. Eng.
21.	(Mercer-Mapstone et al. 2017)	USA	Stud. Eng.
22.	(Cook-Sather, 2010)	USA	Stud. Eng.
23.	(Blair & Valdez, 2014)	Trinidad and Tobago	DM/SV
24.	(Kennedy & Pek, 2023)	Canada	DM/SV
25.	(de Bie, 2022)	Canada	DM/SV
26.	(Nowell et al. 2024)	Canada	P. in ECA
27.	(Liang & Matthews, 2021)	China	Stud. Eng.
28.	(Moyo & Boti, 2020)	South Africa	DM/SV
29.	(Mugume & Luescher, 2015)	South Africa	DM/SV
30.	(Luescher-Mamashela, 2010)	South Africa	DM/SV
31.	(Luescher-Mamashela, 2013)	South Africa	DM/SV
32.	(Klemenčič, 2012a)	Slovenia	DM/SV
33.	(Klemenčič, 2012b)	Slovenia	DM/SV
34.	(Planas et al. 2013)	Spain	DM/SV
35.	(Matthews & Dollinger, 2023)	Australia	DM/SV
36.	(Naylor et al., 2020)	Australia	DM/SV
37.	(Enright et al., 2017)	Australia	Stud. Eng.
38.	(Matthews, 2016)	Australia	Stud. Eng.
39.	(Holen et al. 2021)	Norway	Stud. Eng.
40.	(Palma et al. 2023)	Portugal	DM/SV
41.	(Jungblut & Weber, 2012)	Germany	DM/SV

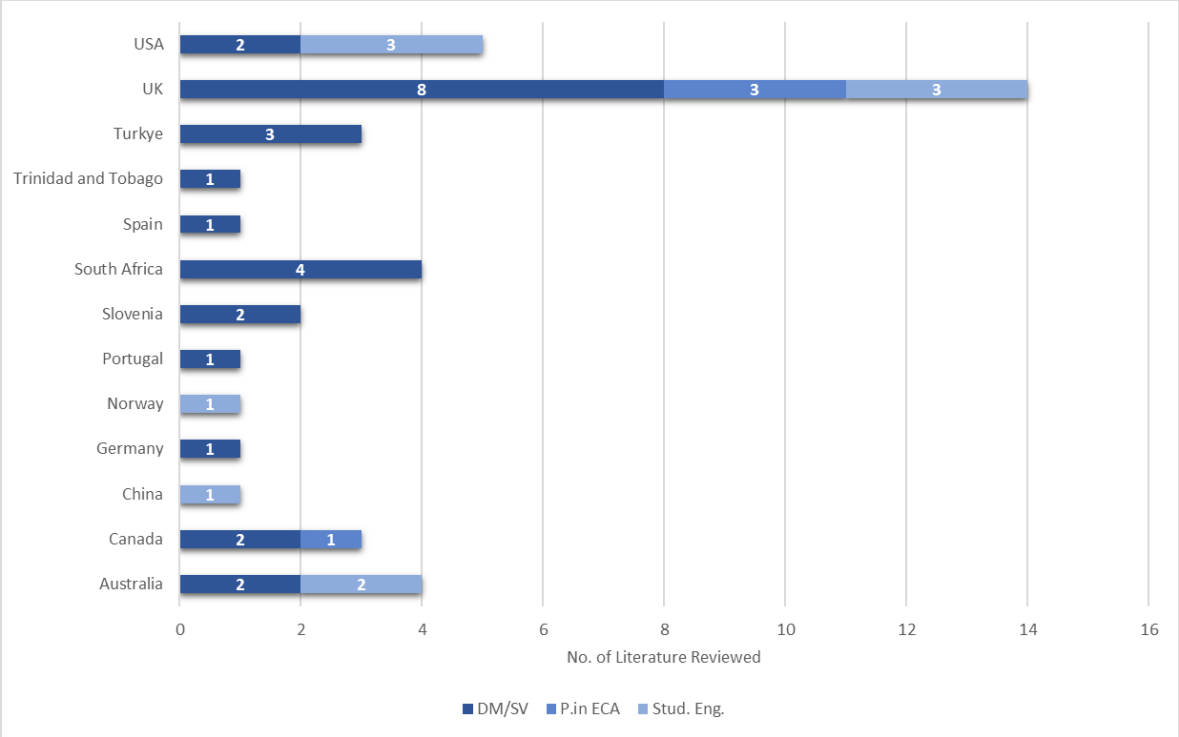

Figure A1. *Chart showing the topic areas under student participation differentiated by Country*

Original scientific paper

UDC: 001.8

Received: December 13, 2024.
Revised: May 07, 2024.
Accepted: May 15, 2024.

10.23947/2334-8496-2024-12-2-451-465

Check for updates

Literature Review: A Snapshot of Research on the Argumentation of Bibliometric Analysis in the Period 2015-2023

Asep Mulyani[1,2*], *Hartono Hartono*[2], *Bambang Subali*[2]

[1] IAIN Syekh Nurjati Cirebon, Cirebon, Indonesia,
e-mail: asep_mulyani@syekhnurjati.ac.id
[2] Universitas Negeri Semarang, Semarang, Indonesia,
e-mail: hartono_sukorejo@mail.unnes.ac.id, bambangfisika@mail.unnes.ac.id

Abstract: Argumentation has an important role in science education. One of the aims of science education is to develop argumentation skills as a basis for building scientific characterization. The role of argumentation in science education is one of the research topics that has received a lot of attention from academics. The purpose of this study was to analyze the research trend of argumentation in science education from 2015-2023. The research method used preferred reporting items for systematic reviews and meta-analyses and network meta-analyses, or PRISMA for short, which consists of identification, screening, eligibility, and inclusion. The articles analyzed were obtained using the publish or perish search engine from Scopus and Google Scholar, as many as 340 articles from a total search of 1013 articles. The analysis was conducted using content analysis and bibliometric using VOSviewer, which was reviewed based on network visualization, overlay visualization, and density visualization. The results were analyzed based on country of origin, research area, research method, research subject, research instrument, learning intervention, and argumentation type. The conclusion of this study shows that argumentation skills are one of the important topics in research that are linked with several other variables in science education and have received attention from researchers in recent years. Recommendations for future argumentation research should identify the characteristics of argumentation types and their relationship with teaching materials, learning models, and assessments in science education.

Keywords: *Argumentation skills, science education, bibliometric analysis, PRISMA, VOSviewer*

Introduction

Argumentation is one of the important elements in science education (Lazarou et al., 2016; Osborne et al., 2016; Wang and Buck, 2016) that should be taught in science classes as part of scientific literacy (Erduran et al., 2015), making it one of the core competencies of every school worldwide (Henderson et al., 2018). Education reform has encouraged every school to focus on practical science through scientific endeavors (McNeill, González-Howard, et al., 2016). Students should be engaged in both theoretical and practical science so that they are able to apply science knowledge in new situations (McNeill, González-Howard, et al., 2016). Science education seeks to develop scientific skills to prepare a generation capable of dealing with complex real-life issues. Therefore, it requires an important role of the teacher as a facilitator to develop students' argumentation (Kilinc et al., 2017). Teachers have an important role in applying argumentation in learning so that the main objectives of learning are achieved (McNeill, Katsh-Singer, et al., 2016). In addition, teachers have an essential role in implementing a dialectical learning process according to the nature of education (Simonović, 2021).

The ability to argue based on scientific facts is needed to develop the ability to communicate scientifically. Scientific argumentation skills emphasize the importance of students' social and epistemic

*Corresponding author: asep_mulyani@syekhnurjati.ac.id

interactions to develop and critique knowledge (Grooms et al., 2018). Several studies on scientific argumentation show that the topic of argumentation has a central role in science education research. The development of science education research trends over the years has undergone a significant shift. Research trends related to context in science learning have increased compared to other research topics in science education (Lee et al., 2009; T.-C. Lin et al., 2014; T.-J. Lin et al., 2019). 21st-century skills have fueled several research topics that develop individuals' ability to solve real-life problems. Argumentation skills, as an important part of science education, have become one of the research topics of great interest to academics.

The curriculum influences Science learning starting from the availability of teaching materials and the way teachers plan the learning process (McNeill et al., 2017). 21st-century skills have encouraged learning that is able to develop higher-order thinking skills and argumentation skills in science learning (Putri et al., 2021). Understanding the material and improving individual scientific skills are needed to deal with the complexity of real problems that will be faced. Argumentation skills play a role in science learning, improving conceptual understanding, developing critical thinking skills, and encouraging inquiry (Faize et al., 2018). The evolution of research trends in science education has shifted from conceptual understanding to individual scientific skills that are contextualized.

The development of the times, accompanied by various global problems, whether environmental or humanitarian issues, has demanded the development of higher-order thinking skills. High-level thinking skills can be encouraged through argumentation methods both in learning and in daily life(Cankaya and Aydogan, 2022). Argumentation skills are one of the skills needed to deal with various complex problems. Science education has an important task in creating learning experiences that will develop argumentation skills so that individuals are able to face various problems that exist. Therefore, it is important for future generations to develop argumentation skills as part of the goals of science education.

Along with the development of technology, research trends can be carried out more optimally by using the Publish or Perish search application (Dewi et al., 2021; Muhammad et al., 2022) and applications to visualize bibliometric data using VOSviewer (Abdullah, 2022; Arruda et al., 2022; Cheng et al., 2021; Dede and Ozdemir, 2022; Nordin, 2022; Ubaidillah et al., 2023). Argumentation research trends will provide an overview for academics to determine the direction of further research has been done by (Erduran et al., 2015). Bibliometric ally analyzed research trends will provide an overview of argumentation trends as well as an overview of argumentation research areas that are of much concern to researchers. In addition, researchers will also be able to find gaps in some areas of argumentation research that are still not widely researched.

Research on the development of argumentation in science education has been conducted by several researchers before. Argumentation research has gained attention in science education, especially in terms of cognitive processes, communicative competence, critical thinking, and the development of reasoning skills (Erduran et al., 2015). Argumentation research in science education was identified by T.-J. Lin et al., 2019 placed articles on argumentation into the top 10 most cited articles from 1998-2017 based on articles from three top journals, namely Science Education, International Journal of Science Education, and Journal of Research in Science Teaching. Furthermore, Erduran et al. (2015) researched argumentation research trends from three top journals, namely Science Education, International Journal of Science Education, and Journal of Research in Science Teaching from 1998-2014, regarding aspects of argumentation in science education. Admoko et al. (2021) showed the development of argumentation research in science education from theoretical and philosophical to practical based on articles from the Scopus database from 2010 to 2020. Although there has been a lot of research on argumentation in science education, there are still some uncharted areas in which to understand the application of argumentation in science education.

Based on the explanation of the development of argumentation research in science education that has been carried out above, it is necessary to conduct further research to enrich the existing information. The sources of articles analyzed are not only from the top journals from Scopus but are expanded from the database from Google Scholar. In addition, the contribution of this research will enrich information about argumentation research, which is focused not only on aspects of argumentation but also on the number of scientific publications, country of origin, type of publication, area of science, research subjects, research methods used, types of research instruments, types and elements of argumentation and visualization of argumentation research trends based on bibliometric analysis.

Therefore, the aim of this study was to investigate the research trends on argumentation in science education between 2015-2023. The research focused on several aspects, namely the number of scientific publications, country of origin, type of publication, area of science, research subjects, research methods used, types of research instruments, types and elements of argumentation, and visualization of argumentation research trends based on analysis using VOSviewer.

Materials and methods

The research method used is a systematic review through bibliometrics to see research trends (Silber-Varod et al., 2019) to obtain information from the complete research results as a basis for decision-making (Higgins et al., 2019). Systematic review research using two computer application aids, namely Publish or Perish, to search for articles and VOSviewer, to visualize the data obtained.

Data sources were obtained through the Scopus and Google Scholar databases on PoP from 2015 to 2023 in September. The search used the keywords "journal," "argumentation," AND "science education." The total number of articles obtained was 1013, derived from the Scopus database 112 and the Google Scholar database 901 articles. Article analysis was carried out after all articles obtained were selected using a list of inclusion and exclusion lists (Chalkiadaki, 2018; Ilma et al., 2023; Suwandi et al., 2023).

Table 1. *Inclusion and exclusion criteria.*

Type of Criteria	Inclusion	Exclusion
Type of publication	Journals and conferences	Book, dissertation, other
Year of publication	2015-2023	Less than 2015
Data source	Scopus and google scholar	Other than Scopus and google scholar
Area	Natural science, chemistry, physics & biology	Outside natural science, chemistry, physics & biology
Research subject	Elementary, junior high, high school students, university students & teachers	Other
Research method	Empirical, position, theory, review, other	Other
Research instrument	Test, non-test and both	Other
Type of argumentation	Argument-specific epistemic, general epistemic & linguistic	Other

Researchers use systematic review research stages, namely Preferred Reporting Items for Systematic reviews and Meta-Analyses and network meta-analyses, abbreviated as PRISMA (Moher et al., 2009; Rodrigues-Silva and Alsina, 2023; van Laar et al., 2020), which includes four stages, namely Identification, Screening, Eligibility and Included. The identification stage begins with a search for articles that will be analyzed using PoP. The screening stage is carried out to select articles that are duplicated or inaccessible. The eligibility stage uses inclusion and exclusion criteria based on the criteria in Table 1. The included stage is the final stage, which analyses the articles that have been selected. Bibliometric data analysis using the VOSviewer application to visualize all information from the research articles obtained was analyzed in three aspects, namely network visualization, overlay visualization, and density visualization.

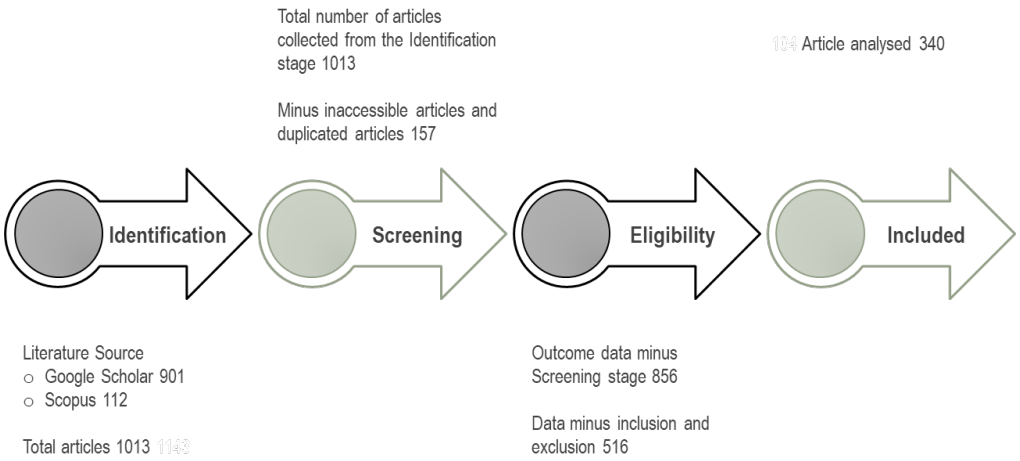

Figure 1: Stages of the PRISMA model.

Results

The results of the analysis of scientific publications on argumentation research trends in science education were identified based on the number of scientific publications, country of origin, type of publication, area of science, research methods used, research subjects, type of instrument used, and type of argumentation. Analysis using VOSviewer focused on three types of analysis, namely network visualization, overlay visualization, and density visualization.

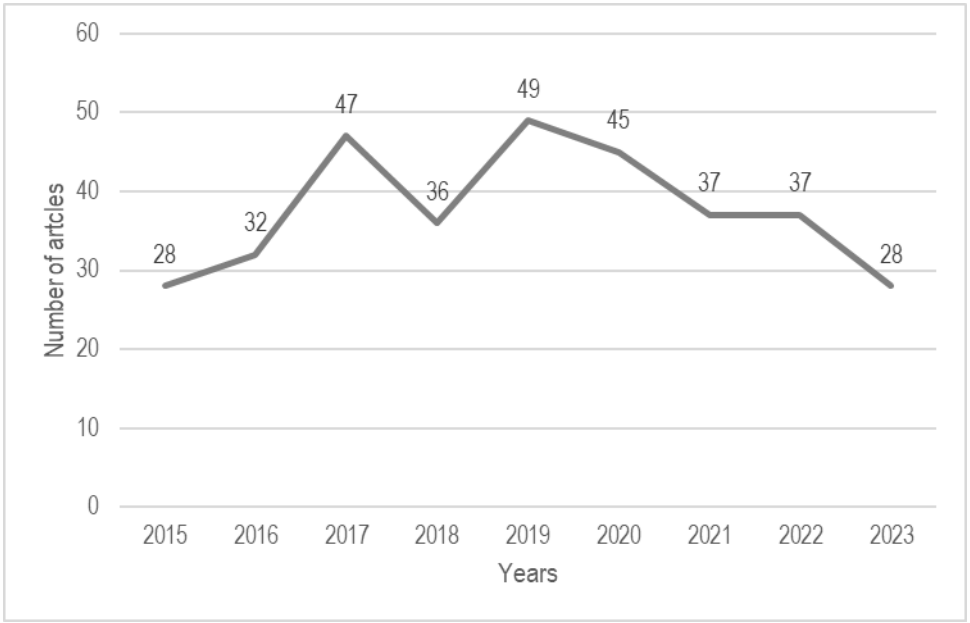

Figure 2. Scientific publications on the topic of argumentation in science learning analyzed from 2015-2023 by number of articles.

Based on Figure 2, the number of articles published between 2015-2023 experienced fluctuations in the number of articles published. The number of published articles has increased from 2015 to 2017 and peaked in 2019 but has decreased in recent years.

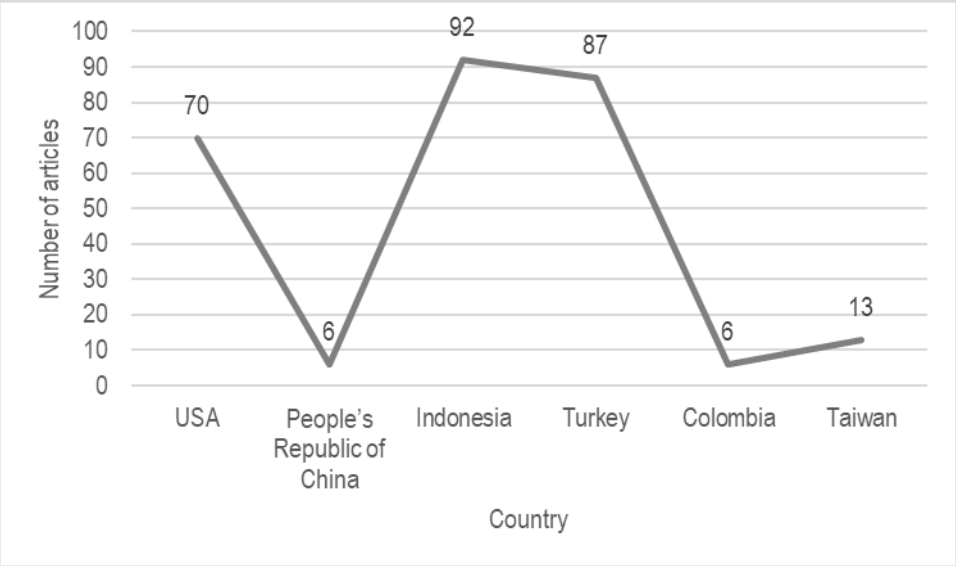

Figure 3. Scientific publications on the topic of argumentation in science learning analyzed from 2015-2023 by country of origin.

The number of scientific articles based on the country of origin is mostly from Indonesia, Turkey, and the United States, as can be seen in Figure 3. However, the number of scientific publications originating from Indonesia is mostly from conferences. The number of scientific publications in the form of journals dominates more than in the form of proceedings.

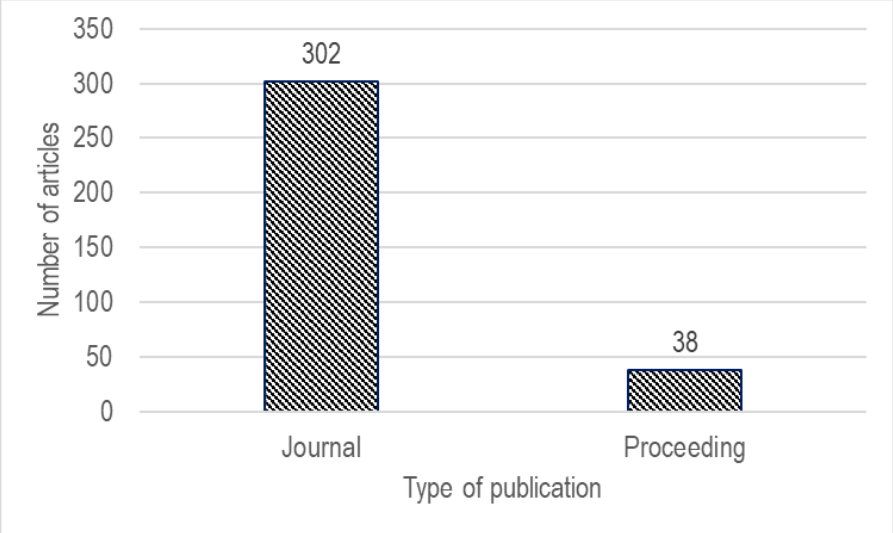

Figure 4. Scientific publications on the topic of argumentation in science learning analyzed from 2015-2023 by publication type.

The most research on argumentation in science education by area of science, based on Figure 5. is in natural science compared to biology, physics, and chemistry. Research on argumentation in biology, chemistry, and physics is still uneven when compared to research in natural science.

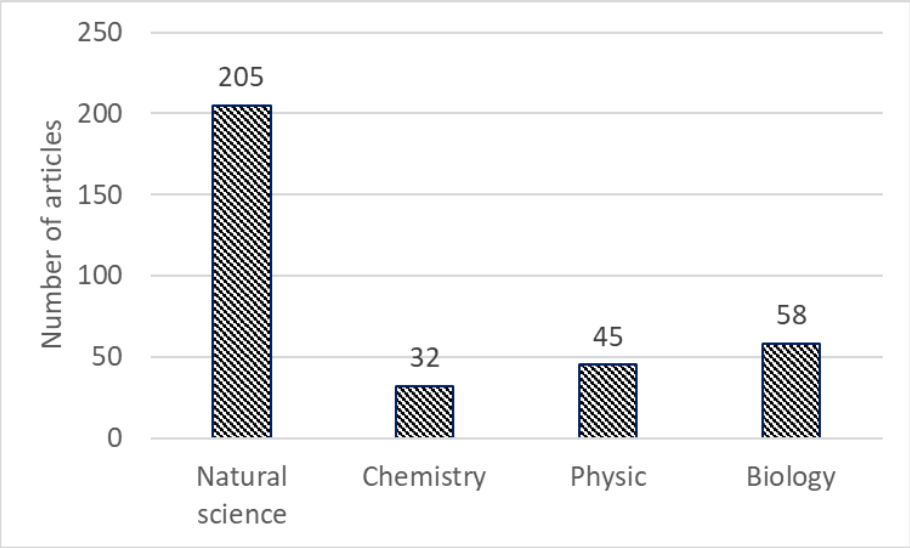

Figure 5. Scientific publications on the topic of argumentation in science learning analyzed from 2015-2023 by area of science.

The research subjects in argumentation research in science education are still based on Figure 6. Most of them are university students. The least research subjects are elementary school students. These data show that research on argumentation must still be improved on other research subjects so that it will provide complete information about the war of argumentation in education.

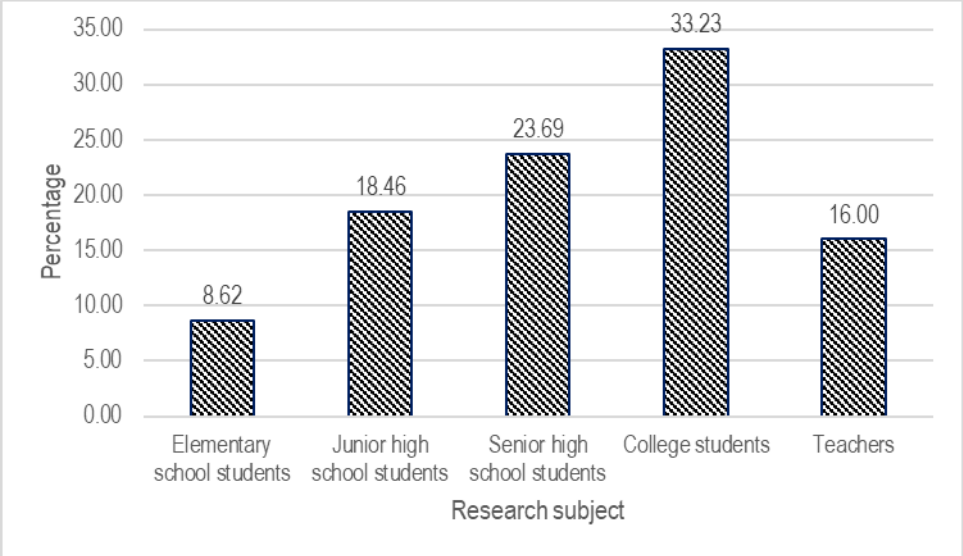

Figure 6. Scientific publications on the topic of argumentation in science learning analyzed from 2015-2023 by research subject.

The type of research conducted in argumentation research is mostly carried out in the empirical type, while other types of research are very different, as can be seen in Figure 7. Empirical research is a type of research that includes qualitative and quantitative approaches. Based on Figure 8, the most common types of empirical research are case study research and experimental research, as well as descriptive research. Grounded theory and exploratory research are the least used research.

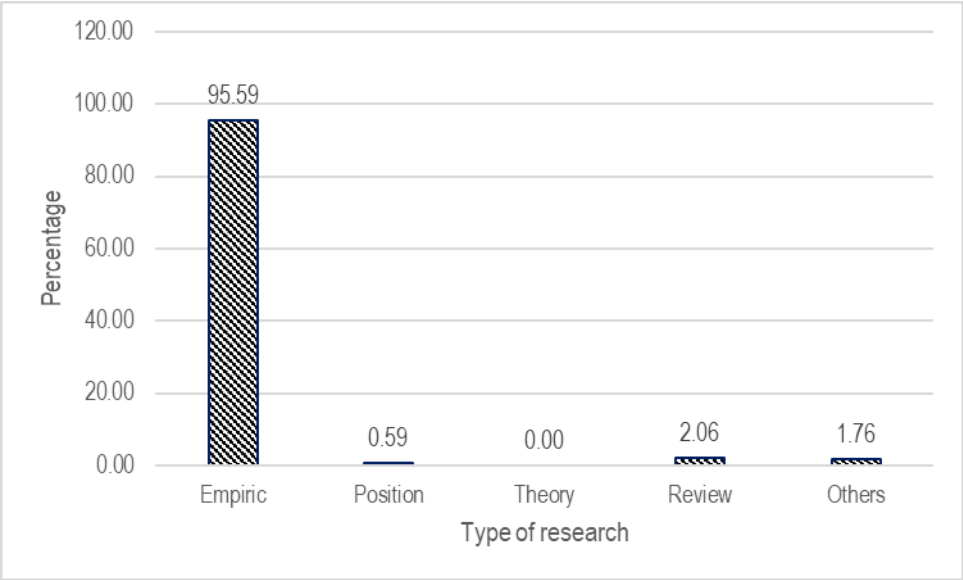

Figure 7. Scientific publications on the topic of argumentation in science learning analyzed from 2015-2023 by type of research.

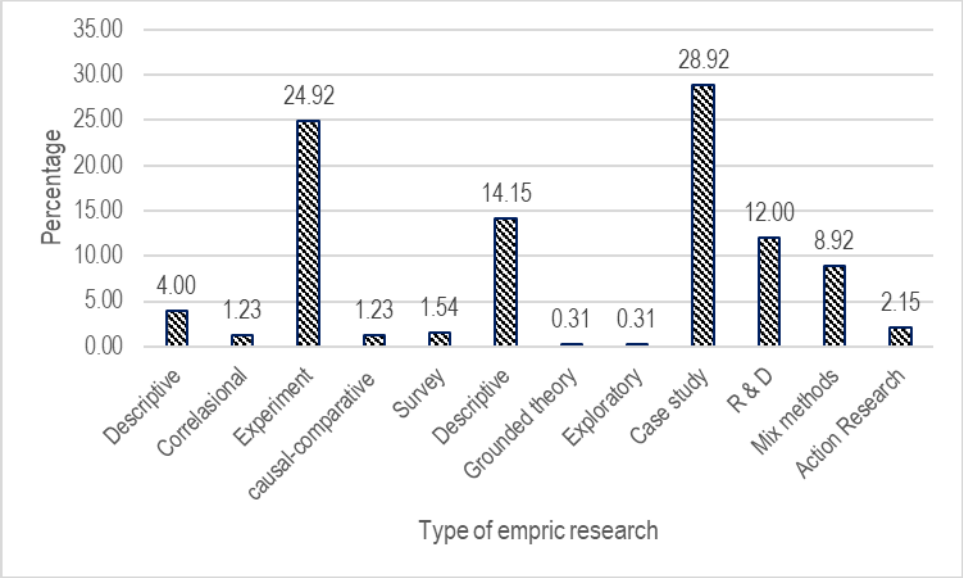

Figure 8. Scientific publications on the topic of argumentation in science learning analyzed from 2015-2023 based on type of empirical research.

The most widely used research instrument in argumentation research, based on Figure 9, is the non-test type, followed by the test form and a combination of both. The test type used as a research instrument is a form of description or multiple-choice test. The non-test type is a research instrument that uses rubrics, observation of activity sheets, and other tools. Researchers use a variety of research instruments to obtain complete information related to the research conducted. The use of appropriate research instruments will provide accurate information in a study.

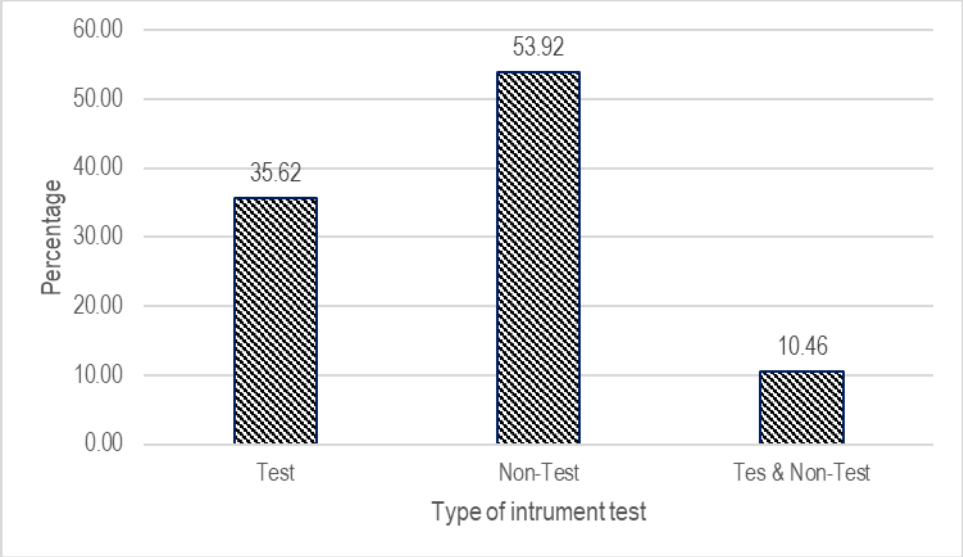

Figure 9. Scientific publications on the topic of argumentation in science learning analysed from 2015-2023 by type of instrument test.

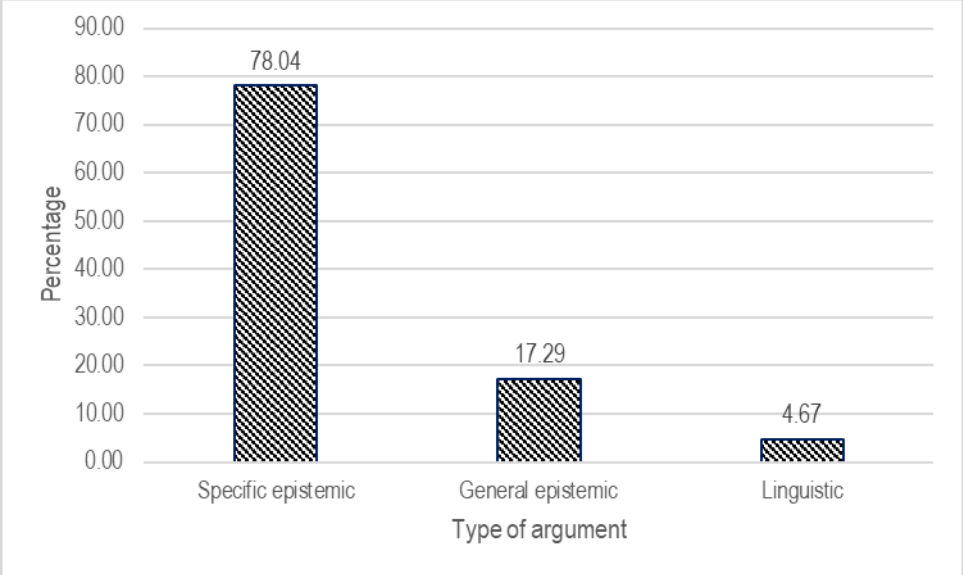

Figure 10. Scientific publications on the topic of argumentation in science learning analyzed from 2015-2023 by type of argument.

Based on Figures 10 and 11, the types of arguments that can be identified in the analyzed articles are mostly special epistemic types. The specific epistemic type relates to the structure of the argument elements that can be identified in the analyzed articles. The broader epistemic type is an argument related to inquiry and explanation . The linguistic type is the type of argument that relates to dialogue, discussion, and negotiation. The elements in the argument structure based on Figure 11. are mostly claims, while the least are grounds.

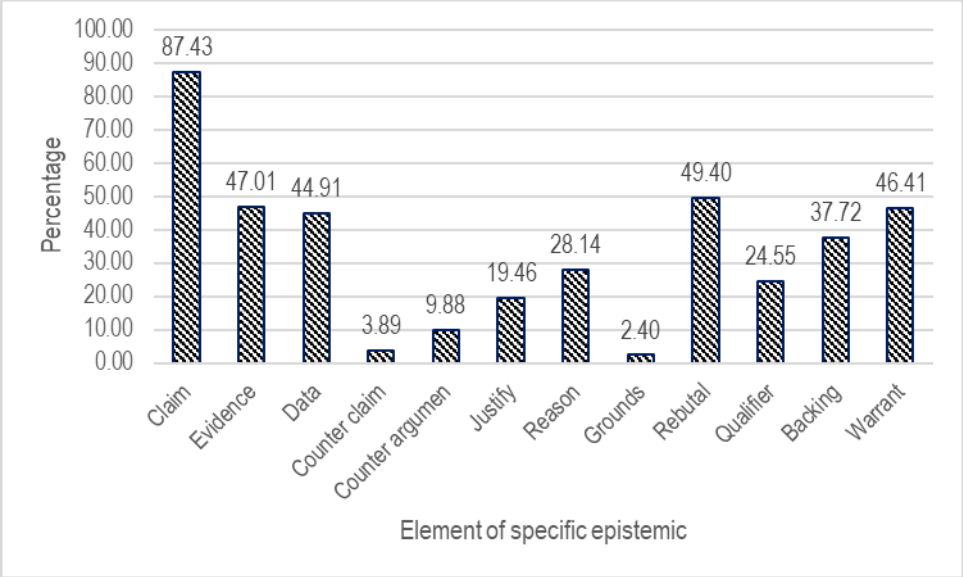

Figure 11. Scientific publications on the topic of argumentation in science learning analyzed from 2015-2023 based on elements of argument.

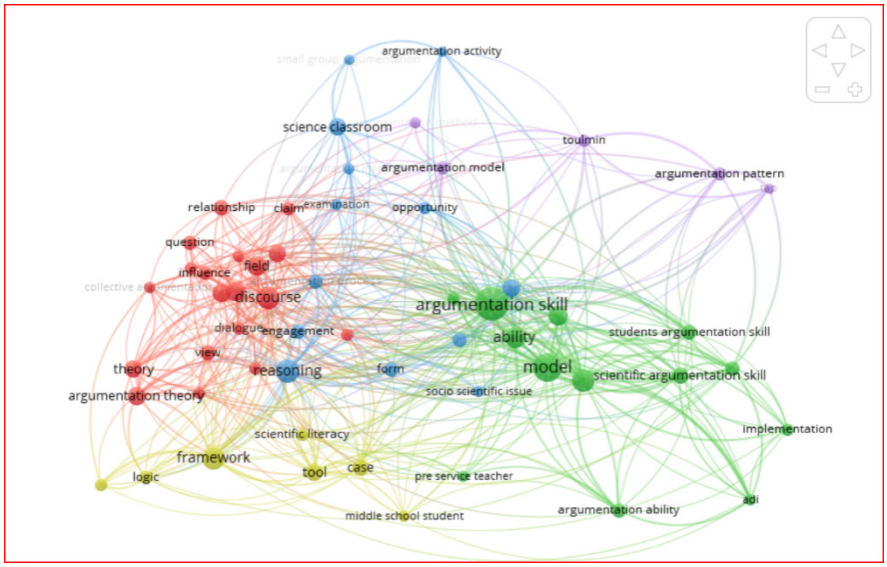

Figure 12. Network visualization of argumentation research in science education in 2015-2023.

Based on Figure 12, the results of analysis based on Network visualization give us an idea of some topics that are widely cited and have a close relationship with other topics. In general, there are five major groups of topics that can be distinguished by color, namely green, red, yellow, blue, and purple. Argumentation skills have many connections with other topics, so we can determine if argumentation skills are popular in many research articles.

The results of the analysis, based on overlay visualization Figure 13, show two main areas that are quite contrasting, namely yellow and dark blue. Argumentation skills can be described as a research topic that has been widely researched in recent years, indicated by the yellow or yellowish color. The difference between the two areas shows us that some of the tropics in the yellow-colored area mean that these topics are current topics.

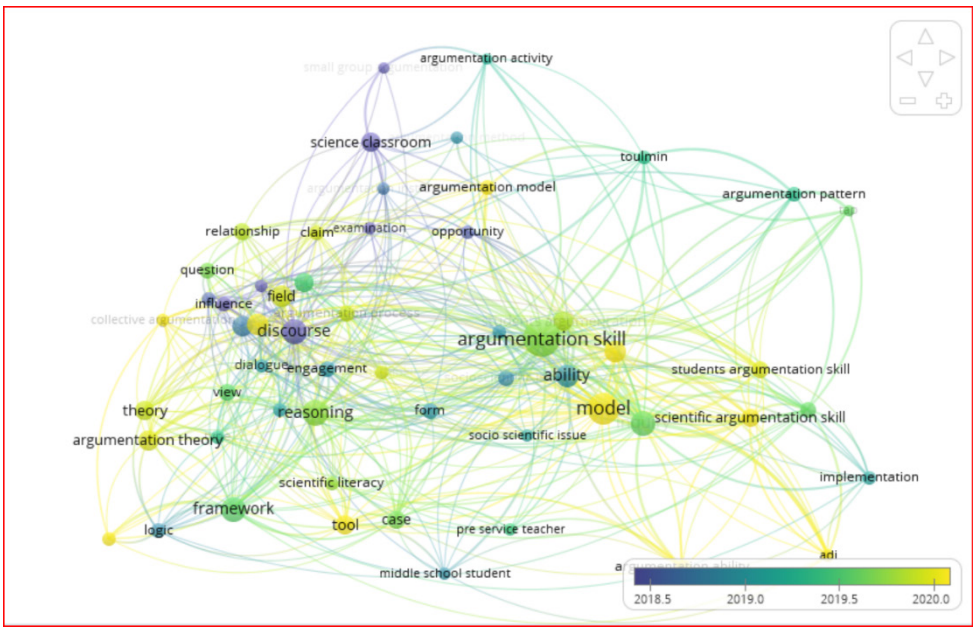

Figure 13. Overlay visualization of argumentation research in science education in 2015-2023.

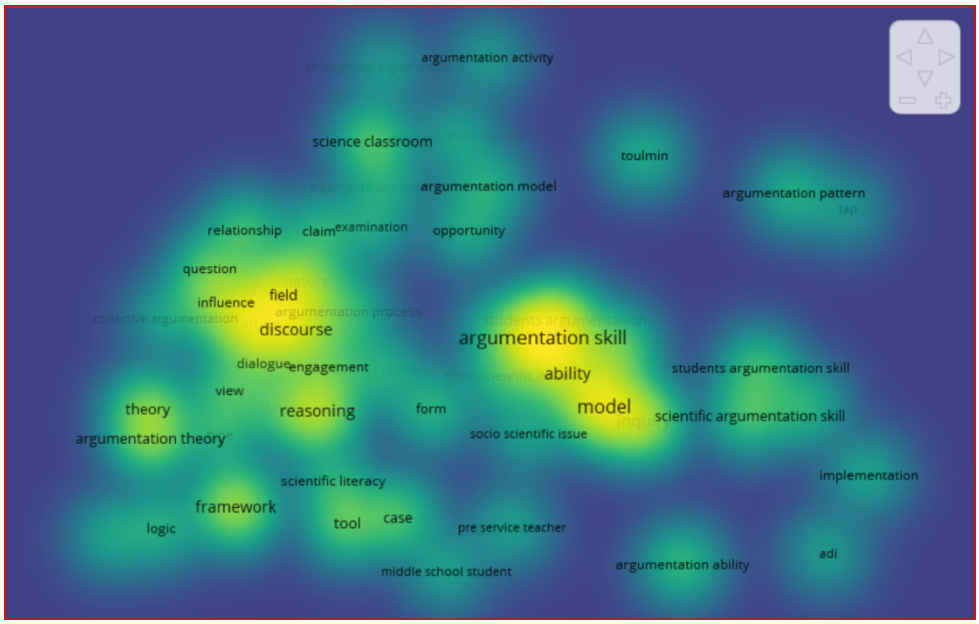

Figure 14. Density visualization of argumentation research in science education in 2015-2023.

In general, we can distinguish the analysis results based on Figure 14 from the colors. The yellow area shows that the term contained in that color has received a lot of attention from researchers, while the blue area shows the area that has received less attention from researchers. Researchers pay a lot of attention to argumentation research, including argumentation skills, abilities, models, discourse, reasoning, argumentation theory, and others. These results provide us with information regarding research gaps that we can develop in relation to current research trends.

Discussions

The study aimed to investigate argumentation research trends in science education. Research trends will provide an overview of the researchers' research interests, approaches, and shared knowledge

(T.-C. Lin et al., 2014). Based on the data obtained, the research trend has increased from 2015-2023. However, the increase in the number of publications fluctuated, especially due to the ups and downs in the number of publications during this period. Scientific publication is one of the important tasks for researchers (T.-J. Lin et al., 2019) to disseminate the results of their research either in the form of journals or proceedings.

Several countries have contributed to argumentation research in science education, including Indonesia, Turkey, the USA, Taiwan, Colombia, and the People's Republic of China, either in the form of journals or proceedings. Argumentation research in science education has attracted researchers around the world in the last decade (Yilmaz et al., 2017). Science education research has been conducted through various learning environments that support argumentation skills (Erduran et al., 2015; Lazarou et al., 2016). Argumentation has been researched at various levels of education and in various subjects to identify the role of argumentation in science learning. Students' argumentation skills in science learning need to be supported by language skills to receive and understand information and express their learning (González-Howard et al., 2017).

The most argumentation research areas based on science fields are in the natural science area compared to the areas in chemistry, physics, and biology. This is due to the large number of studies conducted at the primary school to university level and teachers who focus their research on science subjects. Argumentation is one of the main areas of research in science education (Erduran et al., 2019). Based on the research subject, most arguments are made in universities. Universities are centers of educational development and innovation, so it is natural that the trend of argumentation research is mostly carried out in universities. Argumentation skills are one of the main generic skills that must be possessed by a student studying in college (Kleemola et al., 2022).

In general, the most widely used type of research is empirical research. Empirical research using either quantitative or qualitative approaches dominates all research to identify the role of argumentation in science education. Argumentation attracts a lot of researchers' attention, especially in some cases the role of argumentation in learning is widely studied. In addition, teachers have an important role in creating epistemologically rich and productive learning experiences to develop students' skills (Sengul et al., 2020).

The use of various instruments in research is an effort to obtain more accurate and comprehensive information. The type of research instrument that is widely used is the non-test type. Assessment criteria using rubrics is one form of instrument that is widely used to measure the quality of argumentation skills, including in the research of González-Howard et al. (2017), Chen et al. (2016), Short et al. (2020), and Özçinar (2015). The development of appropriate rubrics to measure argumentation skills has been widely developed. Some assessment instruments refer to Toulmin's theory of argumentation, although some of its basic elements have been developed. Argumentation assessment using research rubrics has developed along with many studies on argumentation.

Arguments can be categorized into three groups, namely epistemic specific argumentation, epistemic general / broader, and linguistic (Erduran et al., 2015). The specific epistemic type of argument is the most identified aspect in research, especially related to the elements of argument. Research on argumentation has attracted many researchers to specifically examine the elements of argumentation in various fields of science and education. In particular, the most important element of argumentation is the claim argumentation element, followed by a rebuttal and a warrant. Argumentation refers to the process of making an argument (Namdar and Shen, 2016) which is one of the main objectives of science learning (Wang and Buck, 2016). Many researchers have examined argumentation, especially the argumentation structure based on Toulmin (Heng et al., 2015). The argumentation structure, according to Toulmin (2003), consists of claims, data, warrants, qualifiers, backing, and rebuttals. Claim, data, and warrant are the most widely used elements in Toulmin's argumentation (Erduran, 2007; Moon et al., 2017).

Science requires the construction of models or theories that can explain natural phenomena rather than just a set of facts (Pabuccu and Erduran, 2017). Argumentation is one of the important elements that must be developed in science learning to develop scientific literacy, critical thinking, reasoning, communicative and metacognitive skills, and other supporting skills (Erduran et al., 2015; Lazarou et al., 2016). Teacher-student interactions in the classroom play an important role in promoting productive argumentation (Sandoval et al., 2019). Scientific argumentation is included by science teachers as one of their learning objectives. In addition, dialogic interaction between students in argumentation will improve the

argumentation ability of students who have different initial knowledge (Liu et al., 2019). Argumentation skills are fundamental to developing communication skills and building scientific explanations. The scientific argumentation learning approach has a great influence on students' science process skills, which are the basis of scientific literacy (Gultepe and Kilic, 2015).

Argumentation research trends in science education can provide evidence-based indicators of where more emphasis needs to be placed in future research on argumentation(Erduran et al., 2015). Argumentation in science learning will impact the understanding of scientific concepts (Heng et al., 2015). Information about argumentation research will provide an overview for researchers to find gaps in research topics related to argumentation. Argumentation research for both students and teachers is important to provide an overview for researchers or other educational practitioners to conduct research.

Argumentation skills based on the results of analysis using VOSviewer have a close relationship with several other research topics. Argumentation research is still getting a lot of attention from researchers, especially in recent years, and has become an objective in the curriculum in various countries (Yilmaz et al., 2017). Argumentation research will be one of the interesting research topics in the future, especially for science learning in relation to its relationship with scientific literacy and level thinking skills. Researchers based on this information will get an idea of how to develop further argumentation research.

Conclusions

Based on the data obtained, it can be concluded that argumentation research in science education between 2015 and 2023 can provide important information about the application of argumentation that has been applied in science education, as well as certain variables of the application of argumentation that need further research in the future. Research on argumentation in science education has increased from year to year from various countries in the world, especially from Indonesia, Turkey, and the USA. Most scientific publications are in the form of journals compared to proceedings. Argumentation research is widely applied to various fields of science, especially natural science, with religious research subjects from primary education to higher education and science teachers. The type of research used is empirical, mainly in the form of case studies, experiments, and descriptive. In particular, the type of argumentation identified is more focused on epistemic specifically, namely related to the type of argument, especially referring to Toulmin's argument structure. Based on the results of the analysis using VOSviewer, it can provide information that argumentation skills are an important topic in research that has a relationship with several other variables in science education and has received attention from researchers in recent years. The implications of the findings of this study provide information about the application of argumentation in science education, especially for researcher.

Conflict of interests

The authors declare no conflict of interest.

Author Contributions

All persons who meet authorship criteria A.M., H.H., B.S. are listed as authors, including participation in the conceptualization, formal analysis, methodology: A.M., H.H. and B.S.; software, A.M.; investigation, A.M.; visualization: A.M., H.H. and B.S.; writing—original draft preparation, A.M.; and writing—review and editing: A.M., H.H. and B.S.. All authors have read and agreed to the published version of the manuscript.

References

Abdullah, K. H. (2022). Publication trends in biology education: a bibliometric review of 63 years. *Journal of Turkish Science Education*, *19*(2), 465–480. https://tused.org/index.php/tused/article/view/1190

Admoko, S., R J, M. N., Hariyono, E., & Madlazim. (2021). Bibliometric profile of science education research on argumentation and the contribution of Indonesia. *Advances in Engineering Research*, *209*(Ijcse), 502–509. https://www.atlantis-press.com/proceedings/ijcse-21/125966505

Arruda, H., Silva, E. R., Lessa, M., Proença, D., & Bartholo, R. (2022). VOSviewer and bibliometrix. *Journal of the Medical Library Association*, *110*(3), 392–395. https://doi.org/10.5195/jmla.2022.1434

Cankaya, O., & Aydogan, N. (2022). The relationship between argumentation skills and cognitive flexibility of pre-service science teachers. *Asian Journal of Education and Training*, *8*(2), 51–59. https://doi.org/10.20448/edu.v8i2.3963

Chalkiadaki, A. (2018). A systematic literature review of 21st century skills and competencies in primary education. *International Journal of Instruction*, *11*(3), 1–16. https://doi.org/10.12973/iji.2018.1131a

Chen, H. T., Wang, H. H., Lu, Y. Y., Lin, H. S., & Hong, Z. R. (2016). Using a modified argument-driven inquiry to promote elementary school students' engagement in learning science and argumentation. *International Journal of Science Education*, *38*(2), 170–191. https://doi.org/10.1080/09500693.2015.1134849

Cheng, P., Tang, H., Dong, Y., Liu, K., Jiang, P., & Liu, Y. (2021). Knowledge mapping of research on land use change and food security: A visual analysis using citespace and vosviewer. *International Journal of Environmental Research and Public Health*, *18*(24). https://doi.org/10.3390/ijerph182413065

Dede, E., & Ozdemir, E. (2022). Mapping and performance evaluation of mathematics education research in Turkey: A bibliometric analysis from 2005 to 2021. *Journal of Pedagogical Research*. https://doi.org/10.33902/jpr.202216829

Dewi, P. S., Widodo, A., Rochintaniawati, D., & Prima, E. C. (2021). Web-Based Inquiry in Science Learning: Bibliometric Analysis. *Indonesian Journal of Science and Mathematics Education*, *4*(2), 191–203. https://doi.org/10.24042/ijsme.v4i2.9576

Erduran, S. (2007). Methodological foundations in the study of argumentation in science classrooms. In S. Erduran & M. P. Jiménez-Aleixandre (Eds.), *Argumentation in science education* (pp. 47–69). Springer, Science and Technology Education Library. https://doi.org/http://dx.doi.org/10.1007/978-1-4020-6670-2

Erduran, S., Guilfoyle, L., Park, W., Chan, J., & Fancourt, N. (2019). Argumentation and interdisciplinarity: reflections from the Oxford Argumentation in Religion and Science Project. *Disciplinary and Interdisciplinary Science Education Research*, *1*(1), 1–10. https://doi.org/10.1186/s43031-019-0006-9

Erduran, S., Ozdem, Y., & Park, J. Y. (2015). Research trends on argumentation in science education: a journal content analysis from 1998–2014. *International Journal of STEM Education*, *2*(1), 1–12. https://doi.org/10.1186/s40594-015-0020-1

Faize, F. A., Husain, W., & Nisar, F. (2018). A critical review of scientific argumentation in science education. *Eurasia Journal of Mathematics, Science and Technology Education*, *14*(1), 475–483. https://doi.org/10.12973/ejmste/80353

González-Howard, M., McNeill, K. L., Marco-Bujosa, L. M., & Proctor, C. P. (2017). 'Does it answer the question or is it French fries?': an exploration of language supports for scientific argumentation. *International Journal of Science Education*, *39*(5), 528–547. https://doi.org/10.1080/09500693.2017.1294785

Grooms, J., Sampson, V., & Enderle, P. (2018). *How concept familiarity and experience with scientific argumentation are related to the way groups participate in an episode of argumentation*. *February*, 1–23. https://doi.org/10.1002/tea.21451

Gultepe, N., & Kilic, Z. (2015). Effect of scientific argumentation on the development of scientific process skills in the context of teaching chemistry. *International Journal of Environmental and Science Education*, *10*(1), 111–132. https://eric.ed.gov/?id=EJ1060989

Henderson, J. B., McNeill, K. L., González-Howard, M., Close, K., & Evans, M. (2018). Key challenges and future directions for educational research on scientific argumentation. *Journal of Research in Science Teaching*, *55*(1), 5–18. https://doi.org/10.1002/tea.21412

Heng, L. L., Surif, J., & Seng, C. H. (2015). Malaysian students' scientific argumentation: Do groups perform better than individuals? *International Journal of Science Education*, *37*(3), 505–528. https://doi.org/10.1080/09500693.2014.995147

Higgins, J. P. T., Thomas, J., Chandler, J., Cumpston, M., Li, T., Page, M. J., & Welch, V. A. (2019). *Cochrane Handbook for Systematic Reviews of Interventions* (2nd ed., Vol. 2). The Cochrane Collaboration and John Wiley & Sons Ltd.

Ilma, A. Z., Wilujeng, I., Widowati, A., Nurtanto, M., & Kholifah, N. (2023). A systematic literature review of STEM education in Indonesia (2016-2021): Contribution to improving skills in 21st century learning. *Pegem Egitim ve Ogretim Dergisi*, *13*(2), 134–146. https://doi.org/10.47750/pegegog.13.02.17

Kilinc, A., Demiral, U., & Kartal, T. (2017). Resistance to dialogic discourse in SSI teaching: The effects of an argumentation-based workshop, teaching practicum, and induction on a preservice science teacher. *Journal of Research in Science Teaching*, *54*(6), 764–789. https://doi.org/10.1002/tea.21385

Kleemola, K., Hyytinen, H., & Toom, A. (2022). The Challenge of Position-Taking in Novice Higher Education Students' Argumentative Writing. *Frontiers in Education*, *7*(May), 1–14. https://doi.org/10.3389/feduc.2022.885987

Lazarou, D., Sutherland, R., & Erduran, S. (2016). Argumentation in science education as a systemic activity: An activity-theoretical perspective. *International Journal of Educational Research*, *79*, 150–166. https://doi.org/10.1016/j.ijer.2016.07.008

Lee, M. H., Wu, Y. T., & Tsai, C. C. (2009). Research trends in science education from 2003 to 2007: A content analysis of publications in selected journals. *International Journal of Science Education*, *31*(15), 1999–2020. https://doi.org/10.1080/09500690802314876

Lin, T.-C., Lin, T.-J., & Tsai, C.-C. (2014). Research trends in science education from 2008 to 2012: A systematic content analysis of publications in selected journals. *International Journal of Science Education*, *36*(8), 1346–1372. https://doi.org/10.1080/09500693.2013.864428

Lin, T.-J., Lin, T.-C., Potvin, P., & Tsai, C.-C. (2019). Research trends in science education from 2013 to 2017: A systematic content analysis of publications in selected journals. *International Journal of Science Education*, *41*(3), 367–387. https://doi.org/10.1080/09500693.2018.1550274

Liu, Q. T., Liu, B. W., & Lin, Y. R. (2019). The influence of prior knowledge and collaborative online learning environment on students' argumentation in descriptive and theoretical scientific concept. *International Journal of Science Education*, *41*(2), 165–187. https://doi.org/10.1080/09500693.2018.1545100

McNeill, K. L., González-Howard, M., Katsh-Singer, R., & Loper, S. (2016). Pedagogical content knowledge of argumentation: Using classroom contexts to assess high-quality PCK rather than pseudoargumentation. *Journal of Research in Science Teaching*, *53*(2), 261–290. https://doi.org/10.1002/tea.21252

McNeill, K. L., GonzÁlez-Howard, M., Katsh-Singer, R., & Loper, S. (2017). Moving beyond pseudoargumentation: teachers' enactments of an educative science curriculum focused on argumentation. *Science Education*, *101*(3), 426–457. https://doi.org/10.1002/sce.21274

McNeill, K. L., Katsh-Singer, R., González-Howard, M., & Loper, S. (2016). Factors impacting teachers' argumentation instruction in their science classrooms. *International Journal of Science Education*, *38*(12), 2026–2046. https://doi.org/10.1080/09500693.2016.1221547

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. In *British Medical Journal* (Vol. 339, Issue 7716, pp. 332–336). https://doi.org/10.1136/bmj.b2535

Moon, A., Stanford, C., Cole, R., & Towns, M. (2017). Analysis of inquiry materials to explain complexity of chemical reasoning in physical chemistry students' argumentation. *Journal of Research in Science Teaching*, *54*(10), 1322–1346. https://doi.org/10.1002/tea.21407

Muhammad, U. A., Fuad, M., Ariyani, F., & Suyanto, E. (2022). Bibliometric analysis of local wisdom-based learning: Direction for future history education research. *International Journal of Evaluation and Research in Education*, *11*(4), 2209–2222. https://doi.org/10.11591/ijere.v11i4.23547

Namdar, B., & Shen, J. (2016). Intersection of argumentation and the use of multiple representations in the context of socio-scientific issues. *International Journal of Science Education*, *38*(7), 1100–1132. https://doi.org/10.1080/09500693.2016.1183265

Nordin, N. A. H. M. (2022). A bibliometric analysis of computational mapping on publishing teaching science engineering using VOSviewer application and correlation. *Indonesian Journal of Teaching in Science*, *2*(2), 127–138. https://ejournal.upi.edu/index.php/IJoTis/article/view/47038

Osborne, J. F., Henderson, J. B., MacPherson, A., Szu, E., Wild, A., & Yao, S. Y. (2016). The development and validation of a learning progression for argumentation in science. *Journal of Research in Science Teaching*, *53*(6), 821–846. https://doi.org/10.1002/tea.21316

Özçinar, H. (2015). Scaffolding computer-mediated discussion to enhance moral reasoning and argumentation quality in pre-service teachers. *Journal of Moral Education*, *44*(2), 232–251. https://doi.org/10.1080/03057240.2015.1043875

Pabuccu, A., & Erduran, S. (2017). Beyond rote learning in organic chemistry: the infusion and impact of argumentation in tertiary education. *International Journal of Science Education*, *39*(9), 1154–1172. https://doi.org/10.1080/09500693.2017.1319988

Putri, W. E., Sunarno, W., & Marzuki, A. (2021). Analysis of the students' argumentative skills of senior high school in covid-19 pandemic using problem based learning in static fluid. *Jurnal Penelitian Pendidikan IPA*, *7*(3), 335–343. https://doi.org/10.29303/jppipa.v7i3.735

Rodrigues-Silva, J., & Alsina, Á. (2023). Systematic review about students' conceptions of engineering accessed through drawings: Implications to STEAM education. *International Journal of Cognitive Research in Science, Engineering and Education*, *11*(2), 199–211. https://doi.org/10.23947/2334-8496-2023-11-2-199-211

Sandoval, W. A., Enyedy, N., Redman, E. H., & Xiao, S. (2019). Organising a culture of argumentation in elementary science. *International Journal of Science Education*, *41*(13), 1848–1869. https://doi.org/10.1080/09500693.2019.1641856

Sengul, O., Enderle, P. J., & Schwartz, R. S. (2020). Science teachers' use of argumentation instructional model: linking PCK of argumentation, epistemological beliefs, and practice. *International Journal of Science Education*, *42*(7), 1068–1086. https://doi.org/10.1080/09500693.2020.1748250

Short, R. A., Van der Eb, M. Y., & McKay, S. R. (2020). Effect of productive discussion on written argumentation in earth science classrooms. *Journal of Educational Research*, *113*(1), 46–58. https://doi.org/10.1080/00220671.2020.1712314

Silber-Varod, V., Eshet-Alkalai, Y., & Geri, N. (2019). Tracing research trends of 21st-century learning skills. In *British Journal of Educational Technology* (Vol. 50, Issue 6, pp. 3099–3118). Blackwell Publishing Ltd. https://doi.org/10.1111/bjet.12753

Simonović, N. (2021). Teachers' key competencies for innovative teaching. *International Journal of Cognitive Research in Science, Engineering and Education*, *9*(3), 331–345. https://doi.org/10.23947/2334-8496-2021-9-3-331-345

Suwandi, T., Rahmat, A., Jamil, M. W., & Nurkhalishah, S. (2023). Research trends on biology digital modules: A bibliometric analysis. *Biosfer*, *16*(1), 13–24. https://doi.org/10.21009/biosferjpb.31361

Toulmin, S. E. (2003). *The uses of argument, updated edition* (2nd ed.). Cambridge University Press.

Ubaidillah, M., Marwoto, P., Wiyanto, W., & Subali, B. (2023). Problem solving and decision-making skills for ESD: A bibliometric analysis. *International Journal of Cognitive Research in Science, Engineering and Education*, *11*(3), 401–415. https://doi.org/10.23947/2334-8496-2023-11-3-401-415

van Laar, E., van Deursen, A. J. A. M., van Dijk, J. A. G. M., & de Haan, J. (2020). Determinants of 21st-century skills and 21st-century digital skills for workers: a systematic literature review. *SAGE Open*, *10*(1), 1–14. https://doi.org/10.1177/2158244019900176

Wang, J., & Buck, G. A. (2016). Understanding a high school physics teacher's pedagogical content knowledge of argumentation. *Journal of Science Teacher Education*, *27*(5), 577–604. https://doi.org/10.1007/s10972-016-9476-1

Yilmaz, Y. Ö., Cakiroglu, J., Ertepinar, H., & Erduran, S. (2017). The pedagogy of argumentation in science education: science teachers' instructional practices. *International Journal of Science Education*, *39*(11), 1443–1464. https://doi.org/10.1080/09500693.2017.1336807

Original scientific paper

UDC: 656.2:004.8

Received: July 16, 2024.
Revised: August 02, 2024.
Accepted: August 10, 2024.

10.23947/2334-8496-2024-12-2-467-476

Check for updates

Educational Application of Artificial Intelligence for Diagnosing the State of Railway Tracks

Dobrivoje Dubljanin[1*], *Filip Marković*[2], *Gabriela Dimić*[3], *Dragan Vučković*[4], *Martina Petković*[5], *Lazar Mosurović*[6]

[1] Tehcnical Faculty in Bor, University of Belgrade, Republic of Serbia, e-mail: ddubljanin@tfbor.bg.ac.rs
[2] Faculty of Technical Sciences, University of Priština in Kosovska Mitrovica, Republic of Serbia, e-mail: filip.markovic@pr.ac.rs
[3] Academy of Technical and Art Applied Studies, Belgrade, Serbia, e-mail: gabrijela.dimic@viser.edu.rs
[4] Alfa BK University, Faculty of information technologies, Belgrade, Republic of Serbia, e-mail: dragan.vuckovic@alfa.edu.rs
[5] Academy of Applied Studies of Kosovo and Metohija, Department Zvečan, Republic of Serbia, e-mail: martina.petkovic@akademijakm.edu.rs
[6] Director of the Serbian Railways Directorate, Belgrade, Republic of Serbia, e-mail: lazar.mosurovic@raildir.gov.rs

Abstract: The aim of the work is to present an innovative solution based on artificial intelligence for examining the condition of railway tracks in real time. The system, based on fuzzy logic and metaheuristics such as Fuzzy Logic, Neural Networks and Bee Behavior Optimization, combines hardware and software to provide reliable data on the technical characteristics of the railway. Installed in rail vehicles, hardware collects this data, while software uses artificial intelligence to improve operational reliability and safety. The aforementioned technology is not only useful for infrastructure diagnostics, but also for urban railways such as trams and metros, ensuring a high level of passenger safety. The introduction of artificial intelligence in the railway sector is a key step towards modernisation, improving efficiency, resource optimization and safety. Although still in its infancy, artificial intelligence already shows great potential in transforming the railway sector towards a more efficient, reliable and sustainable future.

Keywords: *hardware, artificial intelligence, intelligent measurement system, MMC/SD cards, educational processes, sensors, security*

Introduction

The introduction of artificial intelligence (AI) in the railway sector represents a key step towards modernization and improvement of efficiency. With the increasing application of AI in various sectors, it is becoming clear that AI has a huge potential to revolutionize the way maintenance and management are done. AI is becoming an indispensable part of everyday life, and its influence on the railway sector is ubiquitous. Its ability to optimize complex rail systems, improve safety and efficiency, as well as improve user experience, makes it a key tool for modernizing and improving the efficiency of the rail sector. (Bešinović, et. al., 2021).

In order to better understand the potential of AI in the rail sector, it is important to look at the current infrastructure and the specific needs of different regions. For example, the application of AI can significantly improve performance and maintenance in areas with a large rail network and traffic frequency, such as Europe and the Balkans. The use of advanced data analysis algorithms can help identify critical network points that require regular maintenance, thereby preventing failures and improving security. Also, AI can optimize the use of resources and energy, which is of particular importance for the sustainability of rail traffic (Tang, et. al., 2022).

Currently, the total length of the railway network in Europe is about 208,000 km. Balkan countries contribute to the network as follows: Bulgaria with 4,030 km, Bosnia and Herzegovina with 1,018 km,

*Corresponding author: ddubljanin@tfbor.bg.ac.rs

Croatia with 2,617 km, Hungary with 7,588 km, Montenegro with 249 km, North Macedonia with 683 km, and Romania with 10,759 km. In addition, there are around 9,000 high-speed lines in Europe where trains can exceed a speed of 250 km/h (Bauranov, 2016). In the Republic of Serbia, the length of normal gauge railways is 3,735.8 km, of which 3,441.1 km are single-track and 294.7 km are double-track. A total of 1,278.4 km of railways were electrified, of which 984.0 km are single-track and 294.4 km are double-track. This network of railways provides vital infrastructure for the transport of passengers and goods across the region. The railway network in the Republic of Serbia is shown in Figure 1 (Ministry of Construction, Transport and Infrastructure).

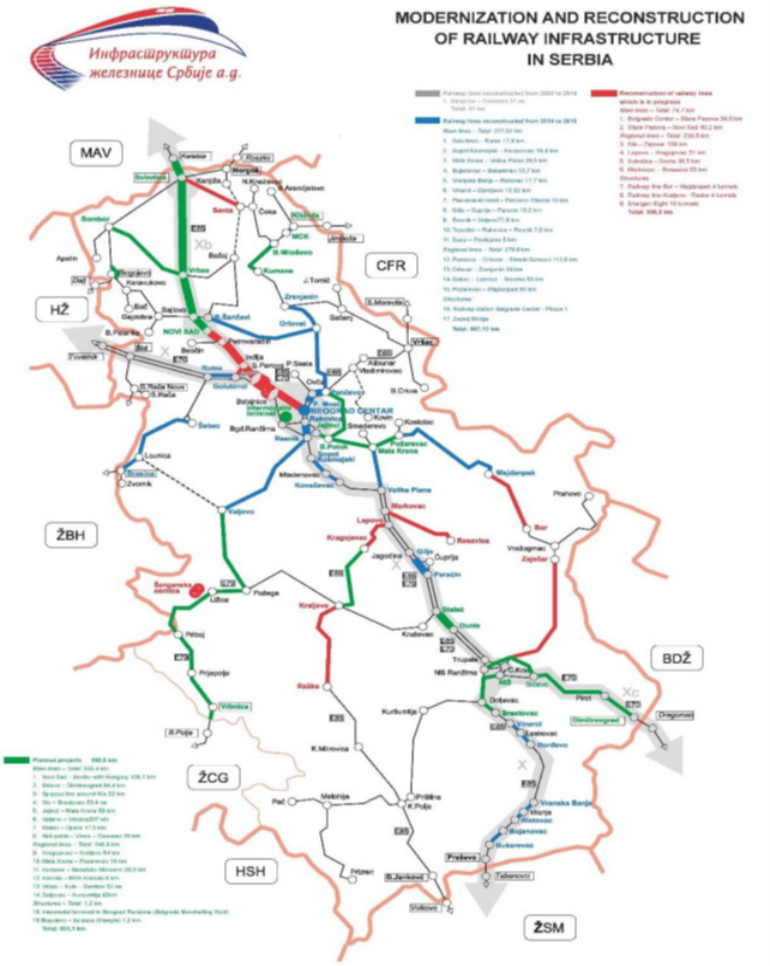

Figure 1. Railway network in the Republic of Serbia (Ministry of Construction, Transport and Infrastructure)

The Republic of Serbia is facing ambitious plans to modernize its railway infrastructure in order to meet the increasingly demanding needs of the transport sector. The completion of the Belgrade-Novi Sad high-speed railway, which covers 76 km, is the first step in this process. It is planned to complete the Novi Sad-Subotica-border with Hungary high-speed rail line by 2024, which will cover 136 km, as well as the Belgrade-Nis high-speed rail line, which will stretch for 204 km, by 2030. In parallel, the construction of metro lines in Belgrade is planned, which will cover a total of 60 km, also by 2030 (Compass Lexecon and Karanović and Partners, 2020).

However, this ambitious development plan faces numerous challenges. The current state of railway infrastructure in the Republic of Serbia is not satisfactory. As much as 55% of the rails date from the 19th century (Ministry of Construction, Transport and Infrastructure), which indicates long-term neglect of maintenance and modernization. The average age of the railway network in the Republic of Serbia exceeds 91 years, with main lines being on average around 85 years old, regional lines slightly more than 98 years old, while local lines are older than a century, Figure 2. This long-term neglect of the infrastructure resulted is due to the relatively poor condition of the tracks and the limited speed of the trains (Compass

Lexecon and Karanović and Partners, 2020).

Progress towards set goals, such as achieving the status of part of the Trans-European Transport Network by 2030, will require serious investment and change. It is necessary to improve the quality of rail transport services, implement much more efficient maintenance of the infrastructure of railway tracks and harmonize with European standards for environmental protection. This will require not only financial investments, but also profound structural changes in order to achieve the goal of modernizing and improving the efficiency of the railway sector in the Republic of Serbia.

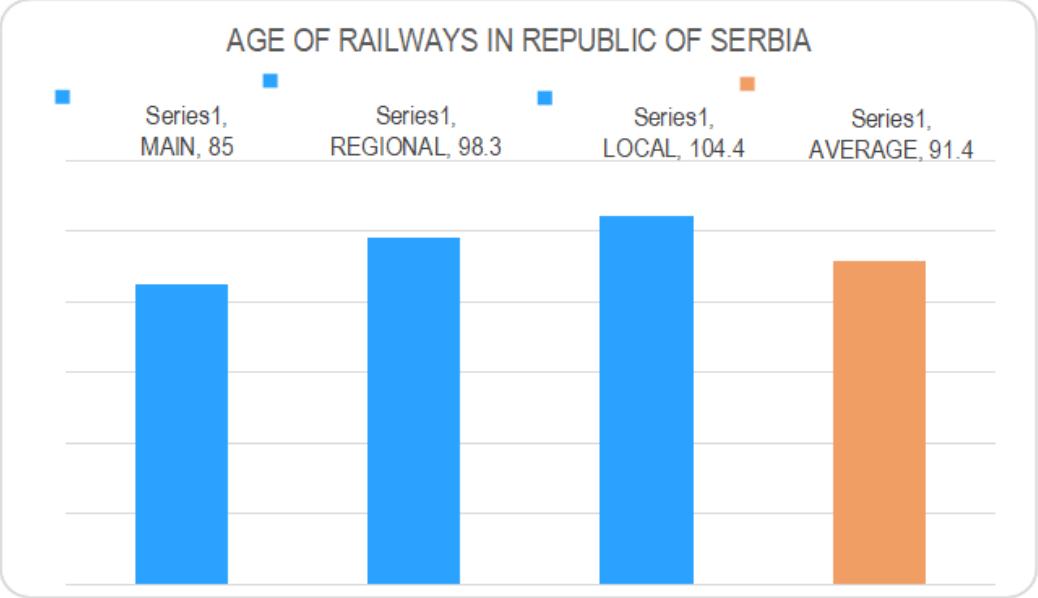

Figure 2. Age of railways in the Republic of Serbia

Artificial Intelligence in the railway sector: optimization, safety and innovation

Today, AI has become one of the most important research areas in almost all fields of academia and industry. While in many other sectors mature applications of AI are flourishing, it is noted that AI is still in its infancy in the railway sector (Tang, et. al., 2022).

AI's potential to optimize complex rail systems, improve safety and efficiency, as well as improve user experience, makes it a key tool for modernizing and improving performance in the rail industry (Bešinović, et. al., 2021; International Railway Yournal, 2019).

Guibert et al predict that AI will soon become a standard tool in the rail industry. This holistic perspective suggests that AI will be integrated into all aspects of rail operations, including operations management and customer interaction, resulting in overall improvements in efficiency, safety and customer satisfaction (Gibert, et. al., 2015).

Recent developments in the application of AI for the rail sector have already shown significant results. For example, an AI system implemented to improve train schedules for certain rail operators has shown effectiveness in optimizing schedules and improving customer experience. These examples illustrate the possibilities of applying AI for diagnosing the condition of the railway sector and indicate the potential for further development (Fragnelli and Sanguineti, 2014).

In order to understand the complexity and variety of AI applications in the railway sector, it is important to establish a clear definition and structure. This includes identifying key techniques, research areas, applications and disciplines that rely on AI. Consideration of these aspects allows a better understanding of AI in the context of the application of diagnostics of the state of the railway sector and the identification of key points for further research and development (Bešinović, et. al., 2021).

The development of AI in the railway sector opens the door to new innovations and improvements on many levels. The application of AI in train scheduling optimization has already shown significant results in system efficiency and improved user experience. However, the potential of AI does not stop only in this

field. Its application can be extended to diagnostics of the condition of the railway sector, identification of critical points for maintenance and improvement of safety, as well as prediction and prevention of breakdowns and incidents. The further development of AI technologies will enable the creation of increasingly intelligent systems that will be key to the transformation of the railway sector towards a more efficient, reliable and sustainable future (Fragnelli and Sanguineti, 2014).

The influence of the condition of the railway infrastructure on safety

The state of the main and regional lines of the public railway network in the Republic of Serbia indicates long-standing insufficient investment in maintaining the reliability of infrastructure elements. This contributed to a significant decrease in reliability, and therefore to a decrease in speeds on the most important railways. A decrease in the reliability of the infrastructure results in a decrease in the competitiveness of railway traffic in relation to other types of traffic. Observing the complete railway network of the Republic of Serbia, it can be concluded that the situation is far from optimal, because a very small part of the network is in a satisfactory condition (Compass Lexecon and Karanović and Partners, 2020). The manager, due to the lack of other solutions, most often when diagnosing the poor condition of the infrastructure, applies the introduction of slow driving - reducing the speed of traffic, as a risk control measure. Due to the above, the average speeds are similar and even lower than what was the case 20 years ago, despite significant investments in the rehabilitation and reconstruction of certain sections in the previous period.

It was established that the poor condition of the railway infrastructure is the most common cause of accidents and incidents that occur on the public railway network in the Republic of Serbia. Based on the final accident investigation reports and annual reports published by the Traffic Accident Research Center, a large number of significant accidents occurred on the territory of the public railway network in the Republic of Serbia in 2017 alone (Traffic Accident Research Center, 2018). The most common causes of accidents are skids, i.e. poor condition of the elements of the upper machine - sleepers and fastening accessories, as well as deformations in the track geometry (Directorate for Railways, 2023). There is a high probability that a large number of accidents would have been avoided if the diagnostics of the condition of the track geometry had been carried out in a timely manner, significant deviations from the exploitation limit values had been determined and the necessary mechanized maintenance had been carried out.

Methodology for diagnosing the condition of railway tracks

In accordance with the heritage of joint railways from the era of the Socialist Federal Republic of Yugoslavia, the characteristics of the tracks that are measured are defined by the Instruction on unique criteria for controlling the condition of the tracks on the JŽ network ("Sl. glasnik", br. 6/01). These instructions are adapted to the technical characteristics of measuring circuits, such as EM-80L, which were used at that time, and which are currently available to the manager of the public railway infrastructure in the Republic of Serbia. The parameters measured by the measuring circuits include track width, windage, track direction, overhang of the outer rail in a curve and track stability.

These parameters, in combination with the size of the deviation and the length of the section on which the deviations were noted, are used to determine the groups of errors: A, B and C. Group A indicates values according to the parameters up to which it is not necessary to plan and carry out work, while errors in groups B and C require planning and execution of works, whereas errors in group C require immediate elimination or reduction of speed.

The evaluation of the condition of the track is done on the basis of the total length of defects in groups B and C over a length of one kilometer. Track condition can be classified as very good, good, satisfactory or unsatisfactory, depending on the total length of defects in meters (Hronik, 1970).

This described procedure is still applied today on the entire public railway network, as well as on all industrial railways and industrial tracks.

With the introduction of technical specifications for interoperability (TSI) in order to implement European regulations, the track parameters that are measured, as well as the entire track condition diagnosis procedure, are defined by the group of standards SRPS EN 13848. Specifically, the parameters for

measuring track geometry are defined by the standard SRPS EN 13848-1 (Institute for Standardization of Serbia, 2019; Institute for Standardization of Serbia, 2017):

- track width - is the distance between the inner sides of two opposite rails in the track, measured 14 mm below the running surface of the rail,
- vertical profile – represents the profile of the rail head, the relative height of the rail is measured along the lengths 35-70 m,
- horizontal profile – measures the deviation of the middle line of the track in the longitudinal vertical plane from the projected direction of the track,
- height difference between rails (cantilever) - difference in height between two running rails at any point of measurement (can also be called cantilever, although it is a term characteristic of the difference in rail height in horizontal curves),
- track steepness - the algebraic difference between two normal sections of the track at a defined distance, usually expressed as a slope (in percent or mm/m) between two measurement points.

Each parameter has a defined measurement method, measurement wavelength range, measurement resolution, allowable measurement uncertainty, measurement range, analytical method, output data requirements, and other characteristics.

Tolerances for each parameter are given in three groups of track quality levels: Alert limit (AL), Intervention limit (IL) and Immediate action limit (IAL). AL refers to the value that requires an analysis of the condition of the track geometry when planning regular maintenance, IL refers to the value that requires corrective maintenance to prevent reaching the IAL before the next inspection, while IAL refers to the value that requires measures to be taken to reduce the risk of derailment derailed to an acceptable level. These tolerances are prescribed by the standard based on experience and theoretical considerations of wheel-rail interaction (Hodas, et. al., 2022; Yazawa, 2003).

An intelligent measuring system for examining the condition of railway tracks in real time

The motivation that initiated the development of this solution stemmed from worrying data on railway safety in the Republic of Serbia. During 2017 and 2018, over 140 risky incidents were recorded, while in 2019 alone, their number reached 95. More than 90% of these incidents happened on railway tracks. In order to solve this problem, an innovative system was developed for measuring and analyzing the geometric condition of the tracks. The track is tested in both directions of travel. In this way, without the presence of personnel for control and supervision, the operational reliability of railway tracks is increased and improved, and maximum safety is achieved in the railway sector (Tararychkin, 2020).

The innovative system for measuring and analyzing the geometric condition of the track consists of a device that contains a number of sensors and assemblies for measuring the condition of the railway track, as well as computer applications for graphical display and diagnostics of the obtained results. The data is recorded (saved) on an MMC/SD card, and then can be transferred to a computer, laptop, tablet or permanently stored in the monitoring center's computer base. The data can also be delivered to the central monitoring computer center through an ONLINE connection (Internet), so that there is an overview of the state of the track in real time. The geometric condition of the track on the screen can be displayed in the form of diagrams, graphs or numerically on different surfaces.

Track data is collected during train movement. The device is placed on the train, and the software is written on the basis of AI (Fuzzy Logic, Neural Networks and Bee Colony Optimization). Based on the received data from the sensors, the software analyzes track errors, defines priority among errors and makes suggestions for eliminating all identified track defects by priority (Yaman, et. al., 2017; Shafieenejad, et. al. 2021).

Functionality has been implemented in the software that enables the display of the total number of errors (deformations) on a specific section or on the entire track, for all parameters defined by the group standard SRPS EN 13848. These errors are classified into three groups - A, B and C, in accordance with standard SRPS EN 13848-1, as described earlier.

Each railway infrastructure manager can set limit values of track parameters in accordance with

their track maintenance policy. The software package that was developed on the basis of AI analyzes the data from the sensors and makes decisions about the condition of the tracks and about the priorities for removing any identified track defects (breaks, cracks, damage...).

For the analysis of the obtained results, selected longitudinal dimensions are used that are harmonized with GPS, on the basis of which, in addition to the display of individual elements of the geometric condition of the tracks, other necessary data about the condition of the tracks can be seen (Espinosa, et. al., 2018). In perspective, the possibility of installing special HD cameras, which would show the image of tracks, objects and terrain, is foreseen. Those images would be stored on the MMC/SD card and then permanently stored in the computer database. The cameras would be synchronized with certain transmitters so that recording would not be done continuously, but only when necessary, i.e. when detecting critical conditions, which were initially set.

During the movement of the train, the device examines and measures the geometrical parameters of the track, such as: longitudinal level of the left and right rails, alignment of the left and right rails, transverse level of the track, torsion, curvature, slope radius and the slope itself.

Compared to similar devices such as measuring circuits, the device is many times more economical and practical to use. In practice, measuring circuits are most often used to test track geometry. However, they are very expensive, in the order of several million euros, and require regular maintenance, training of a certain number of workers for their use, their speeds are lower, they take up the track during measurement, and thus affect regular services on the railway network. Less than a year ago, Infrastructura Železnice Srbije a.d. they bought one such measuring car whose price was 2.2 million euros.

There are similar devices on the market that are installed in the railway vehicle itself and serve to diagnose the track condition during regular driving, but they are not based on AI. Some of these devices are: ENSCO (USA), ASC German Sensor Engineering (Germany), Aarsleff Rail A/S (Denmark), etc. (Railway Gazette International).

The device consists of 9 optical/ultrasonic sensors, GPS receivers and circuits for measuring the track condition, as well as computer applications for graphic display and diagnostics of the obtained results:

- sensors for measuring the horizontal and vertical distance between the rails,
- sensors for measuring the slope of the railway embankment,
- sensors for detecting acceleration and deceleration,
- laser track temperature gauge,
- for noise measurement,
- sensors for detecting unnatural depressions or elevations on the track,
- sensors for the longitudinal level of the left and right rails,
- left and right rail alignment sensors,
- sensors for measuring the curvature of the rails,
- GPS receiver.

The visual appearance of the device is shown in Figure 3.

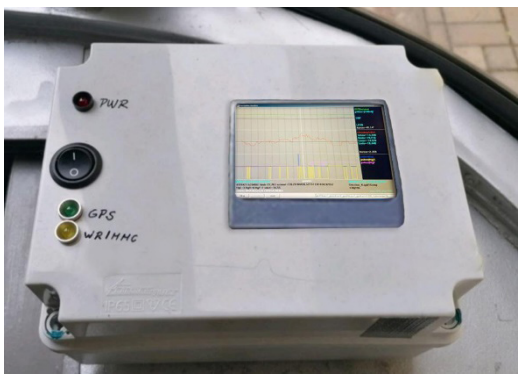

Figure 3. Visual appearance of the device

One of the components of the device is the gyroscopic module NEO-6. Figure 4 shows the physical appearance of the NEO-6 gyro module together with the patch antenna (Betke, 2000).

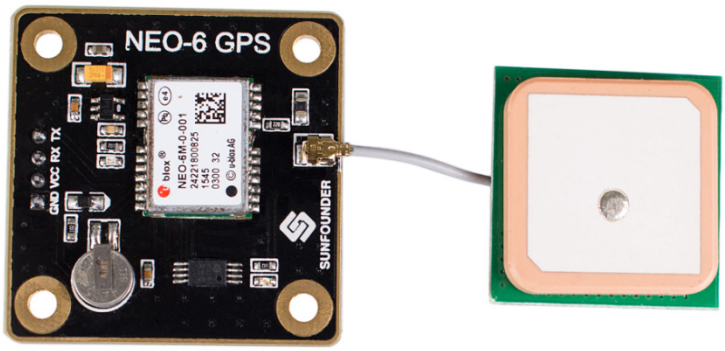

Figure 4. Gyro module NEO-6 (*Sreenivvas, et. al., 2023*)

The module also contains a rechargeable battery that enables long-term storage of configuration settings. The module works with DC voltage in the range of 3.3-5 V. An algorithm for data protection was also developed and implemented in the microcontroller (Saleh, 2016; Zohari and Nazri, 2021).

An AI-based software application was developed for data processing, which stores and processes data obtained from sensors. On the screen, it is possible to display the number of errors (deformations) on a certain segment of the section, as well as on the entire track for all parameters determined by the standard SRPS EN 13848. Display of errors is possible in different colors, through different images, graphs, numerical or geographical maps.

The layout of the graph obtained by testing the device in Bosnia and Herzegovina on the Doboj-Živinice section is shown in Figure 5.

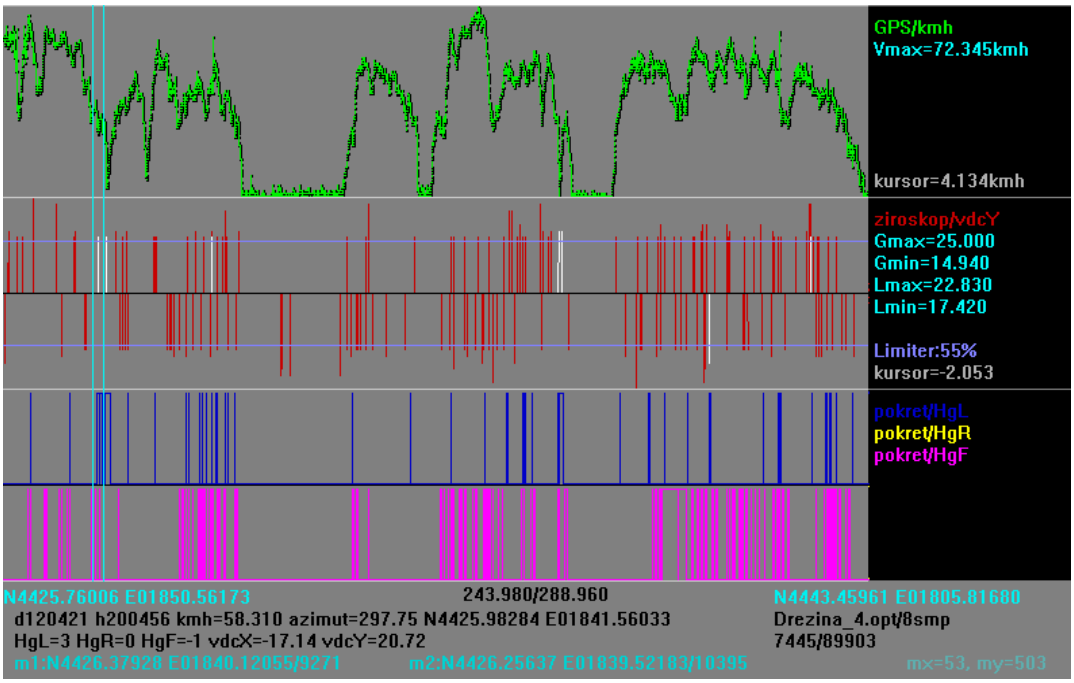

Figure 5. Graphs-values from transmitters and sensors

Figure 5 shows four horizontal graphs in different colors.

The first graph (green) shows the function of changing the movement azimuth and the speed of the locomotive.

The second graph (red) shows the changes in the Y-axis value of the gyroscope. The response threshold is flexible and can be set to different disturbance values. The currently selected value is 55% of the maximum recorded deformation on the route.

The third and fourth graphs (blue and purple) show the mercury's FORWARD/BACKWARD and

LEFT/RIGHT motion sensors.

From the diagram, two vertical light blue lines can be seen, which represent the place of deformation on the route. The software independently places these two vertical lines as the place of potential deformation of the rails on the route. In order to see the details of the deformation of the rails on the route, it is necessary to zoom in on these two vertical lines and the software will display the details of the information.

Showing the deformation of tracks on different surfaces

The display of the location on the topographic map on the Doboj-Živinica section based on the GPS position is shown in Figure 6. The top segment of the topographic map shows the exact and precise GPS position where the deformation of the rails occurred. The position is marked with blue pointers p21 and p22.

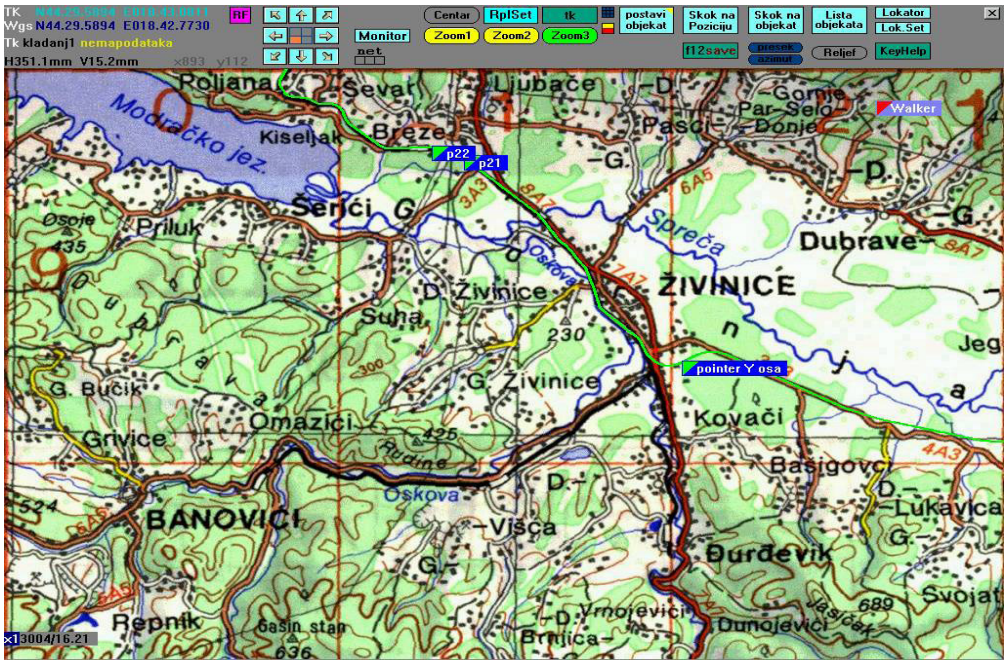

Figure 6. Display of rail deformations on the topographic map

Figure 7 shows the deformation of the tracks on the Google earth surface. The yellow marker represents the position of the track deformation.

Figure 7. View of the route and pointer on the Google Earth surface

Figure 8 shows the deformation of the tracks on the Google Maps surface. The blue marker represents the position of the track deformation.

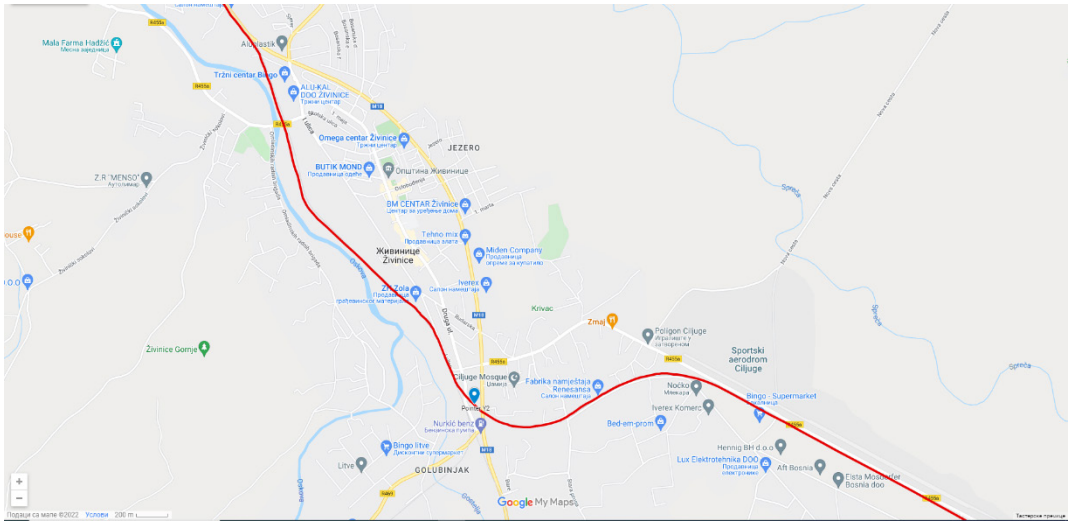

Figure 8. Pointer displays on Google Maps

The locations of track deformations along the Doboj-Živinice section are identified in detail by showing them on the topographic map. Precise GPS positions marked with markers enabled the exact location of the problem. This analysis provides a basis for effective intervention and damage repair, ensuring the safety and stability of rail traffic on a given section.

Conclusions

The proposed solution is an intelligent measuring device that can be used to diagnose the state of the railway tracks, thereby improving the operational reliability and safety of the railway infrastructure. It is implemented in digital technology and uses artificial intelligence. It can be used to diagnose the deformation of rails on which fast/slow trains, trams, subway vehicles, freight trains and trains for the transportation of dangerous goods travel. The device is reliable, economical and easy to use. Compared to similar devices (measuring circuits), its price is several times lower.

Data from the device is recorded (saved) on an MMC/SD card or via an ONLINE connection (Internet). They can be delivered to the central monitoring computer center where there is a current overview of the condition on the track. With it, railway maintenance operations are more easily managed, there is no need for a physical inspection of the rails, and in the event of an accident or incident, all data on the actual condition of the railway tracks are available. It can be used in all climatic conditions and does not pollute the environment.

Conflict of interests

The authors declare no conflict of interest.

Author Contributions

Conceptualization: D.D. and F.M., Formal Analysis: D.V. and M.P., Investigation: F.M. and P.S., Methodology: D.D., F.M. and P.S., Writing – original draft: D.D. and D.V., Writing – review & editing: D.V. and M.P. All authors have read and agreed to the published version of the manuscript.

References

Bauranov, A. (2016). *The Port of Piraeus – Opportunity for Railways in South East Europe*. Retrieved from https://www.global-railwayreview.com/article/29672/port-piraeus-railways-south-east-europe/

Betke, K. (2000). *The NMEA-0183 Protocol*. Retrieved from https://www.tronico.fi/OH6NT/docs/NMEA0183.pdf

Bešinović, N., Tang, R., Lin, Z., Liu, R., Tang, T., Donato, L.D., Vittorini, V., Wang, Z., Flammini, F., Pappaterra, M.J., Goverde, R.M.P. (2021). Deliverable D1.2: Summary of existing relevant projects and state-of-the-art of AI application in railways. *RAILS Project*. https://doi.org/10.13140/RG.2.2.11353.03686

Centar za istraživanje nesreća u saobraćaju (2018). Sektor za istraživanje nesreća u železničkom saobraćaju i međunarodnu saradnju, *Godišnji izveštaj za 2017. godinu*, br. 340-00-4/2018-2-40-1. Retrieved from https://www.cins.gov.rs/doc/zeleznicki-saobracaj/Godisnji-Izvestaj-za-2017godinu.pdf

Compass Lexecon and Karanović & Partners (2020). Tržište prevoza robe u železničkom saobraćaju u Republici Srbiji. Izveštaj. https://www.kzk.gov.rs/kzk/wp-content/uploads/2020/08/Tr%C5%BEi%C5%A1te-prevoza-robe-u-%C5%BEelezni%C4%8Dkom-saobra%C4%87aju-u-Republici-Srbiji.pdf

Direkcija za železnice, Republika Srbija (2023). Izveštaj Direkcije za železnice o stanju bezbednosti u železničkom saobraćaju za 2022. godinu. Retrieved from https://www.raildir.gov.rs/doc/izvestaji/Godisnji_izvestaj_o_bezbednosti_za_2022_godinu.pdf

Espinosa, F., García, J.J., Hernández, A., Mazo, M., Ureña, J., Jiménez, J.A., Fernández, I., Pérez, C., García, J.C. (2018). Advanced monitoring of rail breakage in double-track railway lines by means of PCA techniques. *Applied Soft Computing*, 63, 1-13. https://doi.org/10.1016/j.asoc.2017.11.009

Fragnelli, V., Sanguineti S. (2014). A game theoretic model for re-optimizing a railway timetable. *European Transport Research Review*, 6(2), 113-125. https://doi.org/10.1007/s12544-013-0116-y

Gibert, X., Patel, V.M., Chellappa, R. (2015). Robust Fastener Detection for Autonomous Visual Railway Track Inspection. *IEEE Winter Conference on Applications of Computer Vision*. https://doi.org/10.1109/WACV.2015.98

Hronik, R.H. (1970). Apparatus for high-speed measurement of track geometry, patent. https://patentimages.storage.googleapis.com/ed/20/e4/3b40165f0510e3/US3517307.pdf

Hodas, S., Izvoltova, J., Chromcak, J., Bacova, D. (2022). Monitoring the Geometric Position of Transition Zones to Increase the Quality and Safety of Railway Lines, *Appllied Sciences*, 12, 6038. https://doi.org/10.3390/app12126038

Institut za standardizaciju Srbije (2019). SRPS EN 13848-1:2019. https://iss.rs/sr_Cyrl/project/show/iss:proj:62968

Institut za standardizaciju Srbije (2017). SRPS EN 13848-5:2017. https://iss.rs/sr_Cyrl/project/show/iss:proj:60555

International Railway Yournal (2019). The future of intelligence is artificial. https://www.railjournal.com/in_depth/future-intelligence-artificial/

Ministarstvo građevinarstva, saobraćaja i infrastructure. Retrieved from https://www.mgsi.gov.rs/cir/projekti/term/195

Railway Gazette International. https://www.railwaygazette.com/

Saleh, S. (2016). *Spherebot Design and testing of a robot inside of a sphere*. Examensarbete inom teknik. https://kth.diva-portal.org/smash/get/diva2:957832/FULLTEXT01.pdf

Shafieenejad, I., Rouzi, E.D., Sardari, J., Araghi, M.S., Esmaeili, A., Zahedi, S. (2021). Fuzzy logic, neural-fuzzy network and honey bees algorithm to develop the swarm motion of aerial robots. Evolving Systems, 13, 319-330, https://doi.org/10.1007/s12530-021-09391-4

Sreenivvas, U., Drakshayani, E., Basha, D., Vardhan, M.H., Jhansi, Y.S., Naik, P.B. (2023). Multi-functional blind stick by using solar charging system. *International Research Journal of Engineering and Technology*, 10 (3), 1282-1287, Retrieved from https://www.irjet.net/archives/V10/i3/IRJET-V10I3205.pdf

Tararychkin, I.A. (2020). Selection of network structures of pipeline systems resilient to mixed damage. *Dependability*, 20(2), 12-17. https://doi.org/10.21683/1729-2646-2020-20-2-12-17

Tang, R., Donato, L.D., Bešinović, N., Flammini, F., Goverde, R.M.P., Lin. Z., Liu, R., Tang, T., Vittorini, V., Wang, Z. (2022). A literature review of Artificial Intelligence applications in railway systems. *Transportation Research Part C* 140, 103679, https://doi.org/10.1016/j.trc.2022.103679

Uputstvo o postupku verifikacije proizvoda i proveri podobnosti proizvođača kočne opreme ("Sl. glasnik Zajednice JŽ", br. 6/01). https://www.srbcargo.rs/sr/biblioteka-propisa/?script=lat

Yaman, O., Karakose, M., Akin, E. (2017). A Vision Based Diagnosis Approach for Multi Rail Surface Faults Using Fuzzy Classificiation in Railways. *International Conference on Computer Science and Engineering*. https://doi.org/10.1109/UBMK.2017.8093511

Yazawa, E. (2003). Track inspection technologies, *Railway Technology Avalanche*, 1(1), 3. https://www.rtri.or.jp/eng/publish/newsletter/pdf/01/RTA-01.pdf

Zohari, M.H.B., Nazri M.F.B.M. (2021). GPS Based Vehicle Tracking System. *International Journal of Scientific & Technology Research*, 10(04), 278-282. https://www.researchgate.net/publication/352559892_GPS_Based_Vehicle_Tracking_System

Original scientific paper

UDC: 316.64-057.875:378.147

Received: January 14, 2024.
Revised: July 24, 2024.
Accepted: August 26, 2024.

10.23947/2334-8496-2024-12-2-477-488

Check for updates

Sociodemographic Factors and Students' Attitudes towards Integrated Instruction

Snezana P. Perišić[1*], *Vesna Lj. Minić*[1]

[1] University of Pristina - Kosovska Mitrovica, Faculty of Teacher Education in Prizren – Leposavic,
e-mail: snezana.perisic@pr.ac.rs, vesna.minic@pr.ac.rs

Abstract: The primary objective of the study was to ascertain the attitudes of final-year students in undergraduate academic and master's academic studies at the University of Nis Faculty of Sport and Physical Education and the University of Pristina - Kosovska Mitrovica Teacher Education Faculty in Prizren - Leposavic toward the possibilities of integrating the learning contents of the subjects Serbian Language and Physical Education. The study aims to investigate views about integrated instruction and the incorporation of Serbian Language and Physical Education in the integrative curriculum based on several demographic criteria such as gender, age, faculty major, overall grade point average, and socioeconomic status. The research was conducted on a sample of 179 students. Descriptive techniques were used to determine the level of expression of basic variables, while a Linear Regression Model was employed for statistical inference testing of established hypothesis. The results obtained indicate a statistically significant correlation between attitudes towards integrated instruction and the incorporation of the Serbian Language in the integrative curriculum in relation to sociodemographic characteristics (Hypothesis 1 and 2). However, no statistically significant associations were found for attitudes towards the incorporation of Physical Education in the integrative curriculum concerning sociodemographic variables (Hypothesis 3).

Keywords: *integrated instruction, Serbian language, physical education, sociodemographic characteristics, students' attitudes*

Introduction

Since the modern societal development demands progress in all its aspects, the necessity for innovating the education process has become an inevitability of the 21 st century. The programmatic concepts and contents of primary school subjects, especially in the younger grades of primary school, are encompassed by new regulations dedicated, year after year, to raising awareness and refreshing educational activities. Technological advancement implies acquiring interdisciplinary knowledge and skills with opportunities for further development in the conditions of rapid progress in information technologies. As Cekic-Jovanovic and Milanovic (2020) cite, recent research and scientific analyses show that the "quality of knowledge acquired by students in schools is insufficient, and that students do not have sufficiently developed competencies necessary for further education and everyday life" (Cekic-Jovanovic and Milanovic, 2020: 84, according to: Strategy for the Development of Education in Serbia by 2020, 2012; Maghnouj et al. 2020). Traditional models of teaching and learning often do not provide opportunities for the development of interdisciplinary competencies and, as such, are frequently formalized and authoritarian, impacting the practical application of knowledge and the connection of theory with real-life situations (Mandić, 2003). Recognizing the need to strengthen these competencies, modern instruction concepts have embraced various models of developmental instruction, including integrative approach to learning.

According to Lukić Radojičić (2011), integrated instruction is one of the innovative models that involves linking educational content from multiple subjects. In the Glossary of EducationalTerms, integrated instruction is defined as a "a teaching model in which the content of various topic areas is linked into meaningful units arranged around a central theme, with the goal of enabling students to acquire com-

*Corresponding author: snezana.perisic@pr.ac.rs

prehensive knowledge of occurrences and events in their everyday lives, regardless of subject divides" (Glossary of Educational Terms, 2014: 252). Buljubašić Kuzmanović emphasizes that the integrative approach to learning "emphasizes intellectual, social, emotional, and aesthetic development, supporting the holistic development of students" and that it is "centered around an individualized program directed towards the student, rather than a program focused on the subject and guided by the teacher" (Buljubašić Kuzmanović, 2007: 148).

Similar views and reflections are observed in the research by foreign authors (Cone et al. 2009), who define interdisciplinary education, on which integrative learning is based, as a process in which two or more thematic areas are integrated to promote enhanced learning in each area. The implementation of interdisciplinary knowledge provides all participants in the learning process with opportunities to discover new ways of organizing and implementing program content. The concept of interdisciplinary education recognizes the integrity and uniqueness of each subject while acknowledging the interrelationships among subjects, which points to the closer determinants of the mentioned teaching model, according to the authors.

As we have already highlighted, the development of society and technology in the modern age indicates challenges in acquiring interdisciplinary competencies among students. Additionally, the technological era has led to a reduction in physical activity among people (Lee et al., 2017). According to Sekeljić and Stamatović (2018), existing research shows that students' activity during class is very low, necessitating improvements in instruction to achieve its effectiveness and quality. Hence, integrated instruction, which does not limit knowledge acquisition and skill development with disciplinary boundaries but enables problem-solving, critical thinking, and teamwork through an interdisciplinary approach, provides numerous opportunities for the holistic development of students, especially in the context of instruction in the younger grades of primary school.

While the curricula in faculties educating future pedagogy professionals have been modernized in recent years, it is assumed that students have knowledge about planning, organizing, and conducting integrated instruction. According to research in the field of integrating subjects in younger grades (Popeska and Jovanova-Mitkovska, 2016; Zdravković, 2017; Ratković, 2018; Novković-Cvetković, 2017; Miloradović, 2019), it is evident that the most suitable subjects for integration are Music Education and Physical Education. This research is intended to study students' attitudes about integrative teaching in the domain of the Serbian language and physical education in the teaching programs implemented in the Republic of Serbia. Language teaching can be harmonized, integrated and jointly improved with other subjects (music, mathematics etc.), as shown by similar studies conducted in other countries (Greci, 1997; Buchanan et al., 2002; De Francesco, 2004; Hatch and Smith, 2004; Solomon, 2008; Coral and Lleixa, 2016). However, there is imited research on integrating Serbian Language and Physical Education content, and there is a lack of information on the attitudes of students, future teachers, and physical education teachers towards such integration.

Methodological framework of the paper

Subject of Research

The main subject of the research is to examine the correlation between the attitudes of final-year undergraduate and master's students and their sociodemographic characteristics regarding the integration of content between the Serbian Language and Physical Education subjects. Additionally, the study aims to explore the mutual influence of the investigated variables.

Research Objectives

To determine whether there is a correlation between the sociodemographic characteristics of the participants and their attitudes toward traditional/integrated instruction.

To investigate if there is a correlation between the sociodemographic characteristics of the participants and the attitudes of students towards incorporating the Serbian language into integrative planning.

To examine whether there is a correlation between the sociodemographic characteristics of the participants and the attitudes of students towards incorporating physical education into integrative planning.

Research Hypotheses

General Research Hypothesis

The attitudes of final-year students of undergraduate studies and master's studies at the University of Niš, Faculty of Sports and Physical Education, and the University of Priština - Kosovska Mitrovica, Teacher Education Faculty in Priština-Leposavić, regarding the possibilities of integrating content from Serbian language and Physical Education subjects, are connected with a set of sociodemographic characteristics of students.

Specific Research Hypotheses

H1: Students' attitudes toward traditional/integrated instruction are linked to a set of sociodemographic characteristics of students;

H2: Students' attitudes toward the incorporation of Serbian language subject in the integrated instruction plan are associated with a set of sociodemographic characteristics of students;

H3: Students' attitudes toward the incorporation of Physical education subject in the integrated instruction plan are associated with a set of sociodemographic characteristics of students.

Research Sample

The research sample consisted of a total of 179 participants from the final years of undergraduate and master's studies at the University of Niš Faculty of Sport and Physical Education (72 participants) and the University of Priština-Kosovska Mitrovica Teacher Education Faculty in Prizren-Leposavic (107 participants). The sample was made up of students of the aforementioned faculties, chosen according to the nature of the study, that is, the study program for the education of physical education teachers and classroom teaching. The survey was conducted anonymously as part of a scientific paper. The data collected from the survey will be used only for scientific research purposes in accordance with the Law on personal data protection of the Republic of Serbia (https://www.paragraf.rs/propisi/zakon_o_zastiti_podataka_o_licnosti.html) and Declaration of Helsinki ethical principles (https://www.wma.net/policies-post/wma-declaration-of-helsinki-ethical-principles-for-medical-research-involving-human-subjects/). There were no difficulties in carrying out the survey of the respondents' attitudes, and the same was carried out with the author's own material efforts.The gender distribution comprised 43 male participants and 136 female participants, indicating an uneven gender representation in the sample. The gender disproportionate sample is also determined by the nature of the studies, because in the Republic of Serbia for generations, female respondents have a pronounced preference for studies for teaching professions of various profiles. Regarding age distribution, the majority of participants were between 23 and 25 years old (50.8%), followed by participants under 22 years old (30.7%). Additionally, 14% of participants were between 26 and 35 years old, while the smallest proportion of participants fell into the age range of 36 to 45 years old (4.5%). When considering the educational level, 98 participants were enrolled in undergraduate academic studies, and 81 were pursuing master's academic studies. The majority of participants had an average grade between 7 and 8 (61.5%), followed by those with an average grade between 8 and 9 (21.8%), and the least number of participants had an average grade between 6 and 7 (5%). Regarding the socioeconomic status, the largest group of students had parents earning between 25,000 and 40,000 (35.8%), followed by an equal distribution below 25,000 (22.3%) and above 65,000 (22.3%). The smallest group of students had parents earning between 40,000 and 65,000 (19.6%).

Table 1. *Representation of Sample Structure*

Control/independent variables		Number of participants	%
Gender	Male	43	24.0%
	Female	136	76.0%
Age	up to 22 years of age	55	30.7%
	between 23 and 25 years old	91	50.8%
	between 26 and 35 years old	25	14.0%
	between 36 and 45 years old	8	4.5%
Faculty Majors	University of Niš Faculty of Sport and Physical Education	72	40.2%
	University of Priština-Kosovska Mitrovica Teacher Education Faculty in Prizren-Leposavic	107	59.8%
Level of Studies	Undergraduate studies	98	54.7%
	Master's studies	81	45.3%
Average grade	6-7	9	5.0%
	7-8	110	61.5%
	8-9	39	21.8%
	9-10	21	11.7%
Socioeconomic status	Under 25.000	40	22.3%
	25.000 - 45.000	64	35.8%
	40.000 – 65.000	35	19.6%
	Over 65.000	40	22.3%

Dependent variable: scores on the questionnaire measures of general atitude, traditional/integreted instructions, atutide towards the integrated educational plan of the Serbian language and physical education.

Research instrument

The instrument utilized in this research was specifically designed for the purposes of this study, and its psychometric characteristics were evaluated through the work of Snežana Perišić (Perišić, 2022). The questionnaire consists of 30 items. Students expressed their level of agreement on a five-point Likert scale with statements (completely agree, mostly agree, uncertain, mostly disagree, completely disagree), examining their attitudes towards the integrated instruction of the Serbian language and physical education. Responses to all questions are summed, and higher scores on the scale indicate a more negative attitude towards the use of integrative approach in everyday schooling and vice versa. Based on the mentioned work, the results suggest satisfactory but relatively low reliability (Cronbach's Alpha > 0.7).

The items are organized into three scales:

- General attitude towards traditional/integrated instruction;
- Attitude towards the incorporation of the Serbian language in the integrated education plan;
- Attitude towards the incorporation of physical education in the integrated education plan.

Data collection

The data used in this research were collected using the Google Forms tool and directly distributed into an Excel spreadsheet. Data analysis was conducted using the statistical analysis program SPSS 23. For the purpose of data analysis, statistical parameters such as frequency, percentage, measures of central tendency (mean and standard deviation), and linear regression analysis were used. Linear regression analysis was employed to calculate the predictive power of the model, considering that the distribution of

respondents' answers to the used scales did not statistically differ from a normal distribution ($p > 0.05$). As for sociodemographic indicators, they were also collected with the questionnaire and used as predictive variables.

Results

The results of the frequency statistical test are presented in Table 2 to determine the descriptive indicators of each item separately (mean, standard deviation) in the scale of general attitude towards traditional/integrated instruction. As mentioned in the previous chapter, higher mean scores indicate a more negative attitude and vice versa. As shown in the table, the item with the highest mean score, and consequently the most negative attitude of participants (Mean = 3.78; SD = 1.08), is "The application of the traditional instruction method in younger grades of primary school enables better focus of children on learning subjects and objectives." On the other hand, the lowest mean score and a positive attitude of participants (Mean = 1.64; SD = 0.71) is for the item "Integrated instruction in younger grades of primary school encourages integrity in development." Considering other items and their mean scores, it seems that participants have a more positive attitude towards the implementation of integrated instruction compared to traditional instruction.

Table 2. *Descriptive indicators for a scale item - The general attitude towards traditional/integrated instruction*

General attitude towards traditional/integrated instruction	Min	Max	M	SD
The application of the traditional instruction method in younger grades of primary school enables better focus of children on learning subjects and goals.	1	5	3,78	1,08
Integrated instruction in younger grades of primary school encourages integrity in development.	1	5	1,64	0,71
I believe that integrated instruction in younger grades of primary school contributes to acquiring comprehensive knowledge.	1	4	1,70	0,76
I believe that integrated instruction is more effective than traditional instruction.	1	5	2,04	0,89
Instruction should not be burdened with constantly linking content.	1	5	3,34	1,19
I enjoy listening to lectures delivered in a traditional way.	1	5	3,59	1,19
I am willing to apply content integration in the school where I will work.	1	5	1,73	0,75
I believe that integrated instruction should be part of the mandatory curriculum for younger grades of primary school.	1	4	1,94	0,84
I believe that every school should have a team for planning and implementing integrated instruction.	1	5	1,73	0,89
I only acknowledge the application of traditional instruction.	1	5	2,90	1,36

M- mean; SD - standard deviation

By analyzing the results presented in Table 3, which show the items of the scale "Attitude towards the incorporation of Serbian language in the integrated instruction plan", we can see that the item with the lowest score, indicating the most positive attitude of the participants, is "The instruction process I plan to apply in working with younger primary school children will involve integrating the learning content of Serbian language" (M=1.74, SD=0.76). On the other hand, participants have the most negative attitude towards the item "I enjoy preparing integrated content in Serbian language for younger primary school children" (M=3.39, SD=1.18). These two items are contradictory, but considering all the items representing the attitude towards the incorporation of the Serbian language in the integrated instruction plan, there are more positive attitudes towards the incorporation of Serbian language in the integrated instruction plan. Therefore, we can conclude that the participants are more inclined towards the application of integrated instruction compared to traditional instruction methods.

Table 3. *Descriptive indicators for a scale item - The incorporation of Serbian language in the integrated instruction plan*

The attitude towards the incorporation of Serbian language in the integrated instruction plan	Min	Max	M	SD
1. I am not willing to plan the incorporation of Serbian language content in younger grades of primary school.	1	5	2,27	0,92
2. Implementing integrated instruction that includes the implementation of Serbian language content in younger grades of primary school is familiar to me.	1	5	1,92	0,90
3. The teaching process I plan to apply in working with younger primary school children will involve integrating the learning content of the Serbian language.	1	4	1,74	0,76
4. Integrating Serbian language content in younger grades of primary school allows children to create a comprehensive picture.	1	4	1,80	0,84
5. Connecting the learning content of the Serbian language subject with other learning content should be a feature of the methodical approach to children in younger grades of primary school.	1	5	2,89	1,27
6. The Serbian language learning content for children in younger grades of primary school can only be presented in a traditional way.	1	5	3,17	1,26
7. Traditional instruction of Serbian language is the only valid method for children in younger grades of primary school.	1	5	1,85	0,75
8. It is desirable to apply the integration of Serbian language learning content in your work.	1	5	2,19	1,00
9. I enjoy preparing integrated content in Serbian language for younger primary school children.	1	5	3,39	1,18
10. I will organize my methodical work in such a way that I present the Serbian language learning content through traditional approaches to children in younger grades of primary school.	1	5	2,27	0,92

M - Mean; SD - standard deviation

As for the participants' answers on the scale regarding the attitude toward the incorporation of physical education in the integrated education plan, as shown in Table 4, we can see that participants had the most negative attitudes toward the statement: "Integrating the physical education learning content can shift the focus from the main learning objectives of the subject" (M=3.42; SD=1.15). On the other hand, participants had the most positive attitudes toward the statement: "Integration of physical education content in younger grades of primary school is stimulating for children's development" (M=1.40; M=0.74). Once again, as in the previous two tables showing two different sets of attitudes for this scale, we observe a positive attitude toward the application of integrative methods compared to traditional instruction.

Table 4. *Descriptive indicators for a scale item – The attitude towards the incorporation of Physical education in the integrated instruction plan*

The attitude towards the incorporation of Physical education in the integrated instruction plan	Min	Max	M	SD
1. Integrating the physical education learning content in younger grades of primary school is stimulating for children's development.	1	5	1,40	0,74
2. I am willing to conduct/implement integrated physical education lessons in the younger grades of primary school.	1	5	1,68	0,82
3. I am interested in implementing integrated physical education lessons for children in the younger grades of primary school.	1	5	1,65	0,85
4. Integrating the physical education learning content can shift the focus from the main learning objectives of the subject.	1	5	3,42	1,15
5. It is more appropriate to convey the physical education learning content using traditional instruction methods.	1	5	3,39	1,07
6. I can identify learning content suitable for integration through the subject of Physical Education in the younger grades of primary school.	1	4	1,95	0,79

The attitude towards the incorporation of Physical education in the integrated instruction plan	Min	Max	M	SD
7. Integrating the physical education learning content into the instruction process for children in the younger grades has its positive aspects for the teaching staff.	1	4	1,78	0,76
8. The content of the physical education subject cannot be presented to children in the younger grades of primary school through integrated instruction methods.	1	5	3,11	1,19
9. Physical education for children in the younger grades of primary school should be presented in an integrated way through another content.	1	5	2,16	0,90
10. It is challenging for me to present the physical education learning content in an integrated way to children in the younger grades of primary school.	1	5	3,16	1,14

M - Mean; SD - standard deviation

In order to highlight and verify which of the attitude scales has the most positive attitude among participants, we summed up the scores of individual items and applied recoding analysis to ensure uniform response direction. A higher score on the scale indicates a more positive attitude towards the integrated approach and vice versa. As shown in Table 5, the most positive attitude towards the integrated instruction approach is observed on the scale regarding the incorporation of physical education in the integrative learning plan (M=2.63; SD=0.58), while the results for the other two scales are not significantly different, and the scores are quite similar. This suggests that participants have more positive attitudes towards the integrative approach, and the attitudes are homogeneous, as indicated by the low standard deviation scores.

Table 5. *The descriptive indicators of scores on the test examining attitudes towards integrated instruction*

	Min	Max	M	SD
General attitude towards traditional/integrated instruction	1	3,70	2,56	0,50
Attitude towards the incorporation of Serbian language in the integrated instruction plan	1	3,70	2,58	0,47
Attitude towards the incorporation of Physical education in the integrated instruction plan	1	3,10	2,63	0,58

M - Mean; SD - standard deviation

H1: Students' attitudes toward traditional/integrated instruction are linked to a set of sociodemographic characteristics of students- testing

Linear regression analysis was applied to examine the impact of sociodemographic variables on the formation of attitudes toward integrated instruction. Sociodemographic variables were used as predictors, and the criterion was the attitude toward traditional/integrated instruction, attitude toward the incorporation of Serbian language in the integrated instruction plan, and attitude toward the incorporation of physical education content in the integrated instruction plan. The data in Table 6 show that the general attitude toward traditional/ integrated instruction can be predicted based on the sociodemographic characteristics of the participants (gender, age, faculty, level of study, average grade in studies, financial status). This is indicated by the statistical significance of the regression coefficient correlation, which is lower than the critical value of 0.05 (0.00; $p < 0.05$). A special contribution is made by the predictor of age, which negatively, lowly, and statistically significantly correlates with the criterion (-0.21; p=0.01), the faculty major, which also negatively correlates with the criterion (-0.22; p=0.01), and the average grade, which also negatively correlates with the criterion (-0.28; p=0.00). These data tell us that younger participants, those in undergraduate studies with lower average grades, have a positive attitude toward traditional/integrated instruction.

The obtained data indicates that the set of sociodemographic variables correlates significantly with the criterion and that they influence the formation of attitudes towards traditional and integrated instruction.

Table 6. *The regression model, the criterion - the general attitude towards traditional/ integrated instruction*

$R = 0,35$ $R^2 = 0,12$ $p = 0,00$	The standardized beta coefficient	P
Gender	-0,05	0,52
Age	-0,21	0,01
Faculty major	-0,22	0,01
Level of studies	0,11	0,21
Average grade	-0,28	0,00
Socioeconomic status	-0,02	0,84

p- statistical significance; R- regression coefficient of correlation; R^2- coefficient of determination

H2: Students' attitudes toward the incorporation of Serbian language subject in the integrated instruction plan are associated with a set of sociodemographic characteristics of students-testing

Just as in the previous table, in Table 7, based on the presented results, we see that the attitude towards the incorporation of Serbian language in the integrated education plan can be statistically significantly predicted based on the sociodemographic characteristics of the participants (gender, age, faculty, study level, average grade, and financial status). This is indicated by the regression correlation coefficient, which is 0.00 (0.52; $p < 0.05$). We conclude that sociodemographic variables have an impact on the formation of attitudes towards the incorporation of Serbian language in the integrated education plan, as the set of sociodemographic variables correlates significantly with the criterion. A special contribution is made by the predictor of gender, which negatively correlates with the criterion (-0.21; $p = 0.01$), age, which negatively, moderately, and statistically significantly correlates with the criterion (-0.18; $p = 0.02$), and the faculty major, which also negatively and statistically significantly correlates with the criterion (-0.24; $p = 0.00$). These data indicate that males, younger individuals, and those from the University of Niš - Faculty of Sport and Physical Education have a more positive attitude towards the incorporation of Serbian language in the integrated education plan.

Table 7. *The regression model, the criterion - Attitude towards the incorporation of Serbian language in the integrated education plan.*

$R = 0,52$ $R^2 = 0,28$ $p = 0,00$	The standardized beta coefficient	P
Gender	-0,21	0,01
Age	-0,18	0,02
Faculty major	-0,24	0,00
Level of studies	-0,04	0,63
Average grade	-0,06	0,40
Socioeconomic status	-0,01	0,92

p- statistical significance; R- regression coefficient of correlation; R^2- coefficient of determination

H3: Students' attitudes toward the incorporation of Physical education subject in the integrated instruction plan are associated with a set of sociodemographic characteristics of students-testing

Unlike the previous two results presented in Tables 6 and 7, the attitudes towards the incorporation of physical education in the integrated education plan are somewhat different in Table 8. The attitude cannot be statistically significantly predicted based on sociodemographic characteristics of the participants (gender, age, faculty major, level of study, average grade, financial status) because the statistical significance of the regression correlation coefficient is higher than the critical value of 0.05 (0.26; p=0.06). These data indicate that there is no influence of sociodemographic variables on the attitude towards the incorporation of physical education in the integrated education plan.

Table 8. *The regression model, the criterion - Attitude towards the incorporation of Physical education in the integrated education plan*

$R = 0,26$ $R^2 = 0,07$ $p = 0,06$	The standardized beta coefficient	P
Gender	0,04	0,68
Age	-0,05	0,59
Faculty major	-0,09	0,31
Level of studies	-0,16	0,09
Average grade	-0,08	0,33
Socioeconomic status	-0,11	0,16

p- statistical significance; R- regression coefficient of correlation; R^2- coefficient of determination

Discussions

Educational institutions, or schools, are seen as crucial entities in shaping students' knowledge and habits. They also shape their views about numerous everyday topics and urge them to make their own judgments. The integration process is an important aspect that permits students to develop cognitive abilities that are required for integrating different views encountered in the educational system.

Interactive learning is regarded as a modern model that connects learning contents from different subjects with the goal of acquiring full understanding about concepts and events in students' daily lives. Previous research has validated the incorporation of Serbian language material in the teaching of disciplines such as Social Studies, Music, Visual Arts, and Mathematics (Đorđević, 2007). In terms of sociodemographic variables, they can be very useful for forming opinions and drawing conclusions about the influence of non-operationally dependent and uncontrollable factors on the formation of attitudes toward the integration of Serbian language content and physical education into the integrated instruction plan, as well as on integrative teaching in general. This is precisely the subject of our research.

The study's primary objective was to investigate the correlation between students' views and sociodemographic variables about the integration of Serbian language and physical education material in the final years of undergraduate academic and master's studies. A survey of 179 students, heterogeneous in terms of gender, age, faculty major, study level, average grade, and financial status, was done using a scale of attitudes toward educational materials integration. We discovered that students have a positive view toward integrated education by using statistical tests such as descriptive statistics and a linear regression model. Regarding the impact of sociodemographic variables, where attitudes towards integrated instruction, attitudes towards incorporating Serbian language in the integrated education plan, and attitudes towards incorporating physical education in the integrative approach were taken as criteria, and sociodemographic indicators (gender, age, faculty major, study level, average grade, financial status) as predictors, we have concluded that the general attitude towards integrated instruction and the attitude towards incorporating Serbian language in the integrated instruction plan can be predicted based on the sociodemographic variables of the participants (Hypothesis 1 and 2). On the other hand, the attitude towards including physical education in the integrated instruction plan cannot be predicted based on sociodemographic characteristics, as confirmed by the regression coefficient and the level of significance (Hypothesis 3).

Based on the abovementioned, and considering the hypotheses set, the general hypothesis, as well as the specific hypotheses H1 and H2, can be confirmed, as a statistically significant correlation was found at the significance level of 0.00. This leads us to the conclusion that sociodemographic variables play a role in forming 25% of the attitude towards the integration plan and the incorporation of Serbian language in the integrated instruction plan. It is also important to note that younger students, from undergraduate studies, with lower grades, have more positive attitudes towards integrated instruction.

Given the lack of previous research on the subject, the acquired results are very significant indicators and starting points for additional studies. Future studies should include teachers working in educational institutions to examine actual implementation and real attitudes toward integrated instruction. It

would also be suitable to increase the number of participants, standardize them based on sociodemographic variables, and broaden the scope of attitudes toward integrated instruction.

Author Contributions

Conceptualization, S.P. and V.M; methodology, S.P.; software, S.P.; formal analysis, S.P. and V.M.; writing—original draft preparation, S.P. and V.M.; writing—review and editing, S.P. All authors have read and agreed to the published version of the manuscript.

References

Buljubašić-Kuzmanović, V. (2007). Studentska prosudba učinkovitosti integrativnog učenja [Student evaluation of the effectiveness of integrative learning]. *Odgojne znanosti*, vol. 9 (2),47–160, Zagreb: Sveučilište u Zagrebu Učiteljski fakultet. https://hrcak.srce.hr/clanak/37106

Buchanan, A. M., Martin, E., Childress, R., Howard, C., Williams, L., Bedsole, B., & Ferry, M. (2002). Integrating Elementary Physical Education and Science: A Cooperative Problem-Solving Approach. *Journal of Physical Education, Recreation & Dance*, *73*(2), 31–36. https://www.researchgate.net/profile/Alice-Buchanan-2/publication/273645502_Integrating_Elementary_Physical_Education_and_Science_A_Cooperative_Problem-Solving_Approach/links/55ad887f08aed614b097b755/Integrating-Elementary-Physical-Education-and-Science-A-Cooperative-Problem-Solving-Approach.pdf

Цекић-Јовановић, О. и Милановић, С. (2020). Утицај интегративне наставе Физичког васпитања и Природе и друштва на квалитет знања ученика у области природних наука [The Impact of Integrative Approach to Physical Education and Nature and Society Subject on the Quality of Students; Knowledge in the Field of Natural Sciences], *Иновације у настави*, 32, 2020/3, (83–97). https://scindeks-clanci.ceon.rs/data/pdf/0352-2334/2020/0352-23342003083C.pdf

Cone, T. P., Werner, P. H., Cone, S. L. (2009), *Models for interdisciplinary teaching in physical education*. http://www.humankinetics.com/excerpts?ccs=441&cs=4239

Coral., J. & Lleixa, T. (2016). Physical education in content and language integrated learning: successful interaction between physical education and English as a foreign language. *International Journal of Bilingual Education and Bilingualism*, 19(1),108–126. https://www.researchgate.net/publication/268802657_Physical_education_in_content_and_language_integrated_learning_Successful_interaction_between_physical_education_and_English_as_a_foreign_language

De Francesco, B. C. (2004). Elementary Physical Education and Math Skill Development, Strategies: A Journal for Physical and Sport Educators, 18(2), 21–23.

Greci, J. (1997). Make Physical Education Fun and Exciting – Use Music. *Journal of Physical Education*, Recreation & Dance, 68(5), 12–13.

Hatch, M.G., & Smith, D. R. (2004). Integrating Physical Education, Math, and Physics, *Journal of Physical Education, Recreation & Dance*, 75(1), 42–50.

Лексикон образовних термина [Glossary of Educational Terms] (2014). Београд: Учитељски факултет.

Lee, B. Y., Adam, A., Zenkov, E., Hertenstein, D., Ferguson, M. C., Wang, P. I., Wong, M. S., Wedlock, P., Nyathi, S., Gittelsohn, J., Falah-Fini, S., Bartsch, S. M., Cheskin, L.J., Brown ST. (2017). *Modeling The Economic And Health Impact Of Increasing Children's Physical Activity In The United States.* New York: Health affairs. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5563819/

Лукић Радојичић, Ж. (2011). Насушна потреба савременог образовног процеса [The urgent need for a modern educational process]. *Образовна технологија*, 4/2011, 367-378.

Здравковић, В. (2007). Ставови учитеља и студената о интегративном приступу као фактору успешне музичке наставе у основној школи. [The views of teachers and students on the integrative approach as a factor of successful music teaching in elementary school]. Годишњак Педагошког факултета у Врању, 8(1), 333–342.

Maghnouj, S. et al. (2020). *OECD Reviews of Evaluation and Assessment in Education: Serbia*, OECD Reviews of Evaluation and Assessment in Education, Paris: OECD Publishing. https://doi.org/10.1787/225350d9-en.

Mandić, D. (2003). Didaktičko-informatičke inovacije u obrazovanju. [Didactic-informatics innovations in education]. Beograd: Mediagraf.

Милорадовић, Б. (2019). Интегративна настава физичког васпитања и математике [Integrated Instruction of Physical Education and Mathematics]. *Узданица*, 16/2, 263-273. https://pefja.kg.ac.rs/uzdanica-decembar-2019/

Новковић-Цветковић, Б. (2017). Иновативни модели рада у настави у функцији унапређивања наставног процеса. [Innovative models of work in teaching in order to improve the teaching process].Годишњак Педагошког факултета у Врању, 8 (1), 177–190.

Перишић, С. (2022). Конструкција скале интеграције садржаја српског језика и физичког васпитања [Design of the Scale for Integration of Serbian Language and Physical Education Learning Content], *Баштина,* 32 (58), 71–82. https://doi.org/10.5937/bastina32-39963

Popeska, B. & Jovanova-Mitkovska, S. (2016). Integration and Correlation Concepts in Physical Education. *Research in Kinesiology*, 44 (2), 262-269. https://core.ac.uk/download/pdf/80818362.pdf

Ratković, D. (2018). Integracija muzičkih aktivnosti u razrednoj nastavi [Integration of Musical Activities in Class Teaching]. *Naša škola*, 7(2), 51–69. https://doisrpska.nub.rs/index.php/NASK/article/view/5736

Solomon, N. M. (2008). Physical Education and Language Arts: An Interdisciplinary Teaching Approach, Strategies: *A Journal for Physical and Sport Educators*, 21(6), 19–23.

Шекељић, Г. и Стаматовић, М. (2018). Обим и интензитет моторне активности на часовима физичког васпитања [The Scope and Intensity of Motor Activity in Physical Education Classes]. *Иновације у настави*, 31, 2018/2, (29-40). https://scindeks-clanci.ceon.rs/data/pdf/0352-2334/2018/0352-23341802029S.pdf

ANNEX

Questionnaire

In front of you is a questionnaire that examines students' attitudes towards integrative teaching in Early Primary Education. Please read the manual carefully before answering questions, and circle the answer that best expresses your degree of agreement with the statement. Round up the answers according to the following principle:

1. If you completely agree with the statement, circle *x* in column ***I totally agree***.
2. If you agree with the statement, circle *x* in column ***I mostly agree***.
3. If you are not sure whether you agree or disagree with a statement, circle the sign *x* in a column ***I'm not sure***.
4. If you don't agree with the statement, circle *x* in column ***For the most part, it doesn't I agree***.
5. If you don't agree with the statement at all, circle *x* in column ***I don't agree at all***.

Thank you for your cooperation!

CLAIMS

1. The application of the method of classical teaching, in the younger grades of primary school, allows better focus on the subjects and objectives. 1 2 3 4 5
2. I am not ready to plan the integration of Serbian language content in younger grades of primary school. 1 2 3 4 5
3. Integration of the content of physical education, in the younger grades of primary school, it's good for children's development. 1 2 3 4 5
4. Integrative teaching, in the younger grades of primary school, encourages integrity in the development. 1 2 3 4 5
5. I'm ready to take / implement integrative physical education classes upbringing in the junior grades of elementary school. 1 2 3 4 5
6. I am interested in conducting integrative physical education classes for children in the younger grades of elementary school. 1 2 3 4 5
7. Conducting integrative teaching that includes the implementation of teaching content the Serbian language in the younger grades of elementary school is close to me. 1 2 3 4 5
8. I believe that integrative teaching, in the younger grades of primary school, contributes to the a full range of knowledge. 1 2 3 4 5
9. The teaching process that I plan to apply in my work with children in the younger grades of primary school schools will include the integration of the teaching content of the Serbian language. 1 2 3 4 5
10. Integrating the teaching content of physical education can shift the focus from the main objectives of the course. 1 2 3 4 5
11. I believe that integrative teaching is more effective than traditional teaching. 1 2 3 4 5
12. It is more appropriate to convey the teaching content of the subject Physical Education traditional methods of teaching. 1 2 3 4 5
13. Integration of the content of the Serbian language in the younger grades of primary school enables

kids want to create a complete picture. 1 2 3 4 5

14. I can recognize the teaching content suitable for integration through the subject of Physical Education upbringing in the younger grades of elementary school. 1 2 3 4 5
15. Linking the Curriculum of Serbian Language with Other Teaching Content it should be a feature of a methodical approach to children in the younger grades of elementary school. 12 3 4 5
16. The teaching content of the Serbian language, for children in the younger grades of primary school, can be it's only done in the traditional way. 1 2 3 4 5
17. There is no need to burden oneself with constant linking of content in class.1 2 3 4 5
18. Integration of the Physical Education Curriculum into the Teaching Process of Children inyounger grades also have its positive sides for the teaching staff. 1 2 3 4 5
19. I enjoy listening to a lecture given by someone in the traditional way. 1 2 3 4 5
20. Traditional teaching of Serbian language in children in the younger grades of primary school, it's the only valid one. 1 2 3 4 5
21. It is desirable to apply in one's work the integration of the teaching content of the Serbian language. 1 2 3 4 5
22. I am ready to implement content integration in the school where I will be working. 12 3 4 5
23. The content of the subject of physical education cannot be served to children in younger grades of primary school with integrative methods of work. 1 2 3 4 5
24. I enjoy the preparation of integrated content of the Serbian language intended for younger children grades of primary school. 1 2 3 4 5
25. I believe that integrative teaching should be part of the compulsory curriculum and programs for the younger grades of elementary school. 1 2 3 4 5
26. Physical education should be presented to children in the younger grades of primary school integrated into other content. 1 2 3 4 5
27. I will organize my methodological work in such a way that I present the teaching content of the Serbian language through traditional approaches to children in the lower grades of elementary school. 1 2 3 4 5
28. I believe that every school should have a team to plan and carry out an integrative continue. 1 2 3 4 5
29. It is a problem for me to present the teaching content of physical education in an integrated way children from the lower grades of elementary school. 1 2 3 4 5
30. Only the application of traditional teaching I recognize. 1 2 3 4 5

The key to the test:
Inverse items are marked with an asterisk

GENERAL ATTITUDE TOWARDS TRADITIONAL/INTEGRATIVE TEACHING: 1*, 4, 8, 11 , 17*, 19*, 22, 25, 28, 30*;

ATTITUDE TOWARDS THE INCLUSION OF THE SERBIAN LANGUAGE IN THE INTEGRATIVE PLAN: 2*, 7, 9 , 13, 15, 16*, 20*, 21, 24, 27*;

ATTITUDE TOWARDS THE INCLUSION OF PHYSICAL EDUCATION IN THE INTEGRATIVE PLAN: 3, 5, 6, 10*, 12*, 14, 18, 23*, 26, 29*.

Original scientific paper

UDC: 373.2.011.3-051:005.963

Received: May 24, 2024.
Revised: August 02, 2024.
Accepted: August 09, 2024.

10.23947/2334-8496-2024-12-2-489-496

Check for updates

Designing Digital Resources for Multimodal Composition in the Kindergarten Environment

Nikolay Tsankov[1], *Sofia Dermendzhieva*[2*]

[1] Trakia University, Faculty of Education, Stara Zagora, Bulgaria, e-mail: nikolay.tsankov@trakia-uni.bg
[2] South-West University "Neofit Rilski", Faculty of Pedagogy, Blagoevgrad, Bulgaria, e-mail: sofger@swu.bg

Abstract: In the contextual field of environmental composition in kindergarten, transforming it into a space for cognitive, social, emotional, i.e., holistic formation and development of the child, multimodality operates with authenticity, magnetism, multilevelity, multidimensionality, and dynamism to overcome schematicity and linearity of thinking, thus stimulating imagination. Leading the way is the understanding that the environmental composing of multimodality in kindergarten is the foundation of quality for the child's cognitive, affective, sensory cognition and self-knowledge. This paper outlines the parameters of evaluating multimodal digital resources designed by students preparing for future kindergarten teachers. The starting points for their expertise in the relations of autonomy, coherence, justification, adequacy and authenticity as subjectively significant and objective wholes of multimodal composing are argued. Criteria and indicators for the expert evaluation of digital resources for multimodal environmental composing in kindergarten, as modeling and provoking and enriching the individual sensory experience of the child, as an opportunity to stimulate cognitive and personal activity are derived. It is necessary to conclude that through the design of multimodal digital resources, the existing contradictions in the starting conditions of the pedagogical interaction in the kindergarten will be overcome. The main recommendation points to the need for specific training of future children's teachers for multimodal environmental composition of educational practices in kindergarten, synergizing different modalities, rather than their linear sequential environmental combination.

Keywords: *preschool, multimodal educational environment, multiliteracy, multisemiosis*

Introduction

Every education system, in all its stages and levels, should have as its focus the inclusion of adolescents in the current social context. It is a worrying observation that, while recognising the specificities of contemporary society, educational institutions still function as systems of closed communities and find it difficult to adapt to the networked logic of the information society. The concepts, theories and methodologies presented in this study reveal the relationship between multimodality and multiliteracy and its importance for the social development of the preschool child.

Its functional role in the transfer of knowledge, skills and attitudes is conceptualised and analysed through the lens of the intensive development of information and communication technologies, given the needs of the 'digital' generations of children.

The child's engagement with the world is a process of mutual influence between the environment and the individual psyche. In psychological theories, this process is defined as "interiorization and exteriorization; accommodation and assimilation; periods in which the creation of cognitive schemes (intelligence) predominates and those in which emotionality predominates (affectivity)" (Madzarov, 2018: 12).

The mutually reinforcing periods of sensitivity denote the specific functions of the child's psyche: plasticity (the psyche changes under the influence of reality), elasticity (the psyche changes reality) and reveal the so-called "developmental fluidity". Thus, "in each period of childhood, either the idea of reality (knowledge) or the idea of the ways of influencing it (skills) increases predominantly, and as a result,

*Corresponding author: sofger@swu.bg

towards its end, these two elements of interaction between an individual and the environment become sufficiently adequate to reality and thus – sufficient for independent existence" (Madzarov, 2018: 123).

It becomes clear that, as a product of childhood, subject autonomy depends on the quality of sociosemiotic practices in which human intelligence is not only reproduced, but also stimulates the child towards a new personal meaning.

Awareness of this relativization underscores the need for:

- Making sense of the particularities of the sociocultural contextual framework in which contemporary children grow and develop;
- supporting the child's mastery of intelligent behaviour through involvement in resource-rich real and digital interactions;
- acceptance and understanding of difference as a basis for building on children's semiotic repertoire, given the prospect of embodied participation in society.

The term "semiosis" refers to the process of creating meaning. Each sign situation distinguishes four main components in semiosis: the sign carrier, the designee (signified object); the interpretant (mental, ideal image of the designee); the interpreter (the subject who constructs, interprets and uses the sign). Or, the sign is a synthetic expression, uniting the basic components of semiosis into a unity, and the meaning of the sign appears as a basic factor for any information-communicative act, because it contains the fixed information of the designe (Morris, 1964). That is, the designated sign (name) fulfills the function of representing (substituting) the designated object in the act of communication.

In turn, communication as a process, takes place in observance of strictly defined rules:

a) syntactic (formal) – for orders or formation of sign constructs;

b) semantic (meaningful) – for making sense of signs and sign constructs;

c) pragmatic – for the use of signs and sign constructs.

The mastery of these rules, however, is subject to the unqualified condition that the creation of meaning (semiosis) is the result of the interaction of the subject who produces and interprets signs (interpreter) and the group of interpreters among whom there is agreement on the rules of interpretation (interpretation).

In the context of pre-school education, the manipulation of signs, their constant articulation and multiplication, is at the heart of children's endless experiences. Their narrative transformation into verbal, playful, pictorial, musical, and constructive activities in kindergarten is perceived as a means for the child's personal presentation and representation, serving as an indicator of their functional development.

In a broad sense, narrative is "a semiotic representation of a series of events, meaningfully related in a temporal and causal way". In contemporary sociocultural contexts, narratives are constructed using an unlimited range of semiotic media: written and spoken speech, gestures and movements, images, moving images, or in combination. Any semiotic construct that is created from signs is called a text. In the aspect of pedagogical interactions, signs and sign systems serve the process of cognition. But signs also refer, that is, they embed meaning and specify meanings. Or sign referencing is a communicative process of sharing and understanding. The transfer of signs in a variety of meaning contexts (family, educational, social) reflects the transfer of knowledge and skills in which the permanent construction and reconstruction of personal identity takes place.

Defined as culturally conditioned, semiotic resources highlight the dynamic nature of mechanisms for processing and composing messages. In the course of their internalization, individual forms of expression are extrapolated as a communicative resource, sealing the child's integration into "the emergent techno-social environment in which technology and nature are one and the same, as in the case of one inhabiting the electronic web as a social medium" (Stone, 2001: 50).

Moving beyond the strict confines of speech (spoken and written), "social semiotics analyses the ways in which people use semiotic resources both to create artefacts and communicative events and to interpret them in social interactions; it compares semiotic ways of using signs; and it discovers the ways in which semiotic resources are regulated in particular spatio-temporal environments and in particular communicative situations" (Gavrilova, 2016: 106).

This staging establishes multimodal practices as the organising principle of sociosemiotic interactions in childhood.

Preschool education in a contemporary context: multimodal construction of the social

Communication in the contemporary world is changing cardinally, given the ongoing "transition from paper to screen/monitor/display" (Kress, 2003:190) and is defined as multimodal because of the "simultaneous use of more than one sign system" (Genova, 2019: 154).

Social semioticians have broadened the focus on understanding literacy: in addition to the knowledge and skills required for reading and writing, literacy now includes a variety of activities and practices relevant to sociocultural contexts: "reading, writing and language are not decontextualised, rather reading, writing and language are embedded in "culture-specific ways of knowing" (Bass, 2018: 10). Literacy in the contemporary world is a social practice that generates multiple literacies (multiliteracies) and is interpreted as a product of certain external and internal factors (Kress, 2011; Crafton, Silvers and Brennan, 2009). Multimedia symbolic forms are also accepted as inseparable from literacy because of the combination of diverse semiotic resources (Hill, 2007).

The growing heterogeneity in the kindergarten educational environment includes diverse cultures, languages, and beliefs. It is consideration of this condition that reveals the dialectic of the multimodality-multiliteracy relationship in the process of meaning construction (multisemiosis) and highlights its defining role in sign-transmitted messages.

Inherent in preschool is spontaneity – children assert themselves through impulsive expression and in the course of this presentation communicate with the world, make sense of relationships and model behaviours to connect with others.

Determining the modes of expression, the styles of learning and cognition, are the similarities in their community traditions - in other words, "funds of knowledge" whose content "carries" many and varied types of literacy.

Observation of children in interactions with peers and adults, as well as a special aperture on family culture, provides authentic data about their experiences and is a major guide for how teachers can build on these experiences. The study of community modes of communication (the use of language and its visualization in print and electronic media; the practices of embedding meaning and specifying meaning; the place of real and virtual play in children's everyday lives) highlights the sociocultural framework of development – or the extent to which adolescents are involved in the communication of a multimodal world.

Dyankova and Nikolova emphasize that "in the context of the new social data, there should be a redefinition of education as it determines the cultural and intellectual capital of society" (Dyankova and Nikolova, 2023: 258). Key in this direction is the issue of providing culturally appropriate education to minority communities, and as a result the number of programmes that promote multilingualism and multiliteracy among minorities is increasing. There has been an acceleration in proposing "new educational policies that affirm and protect linguistic diversity, new models of development that meet the needs of all segments of society and that promote the integration of ethnic minority groups, new educational strategies that enable learners to achieve their educational goals without being forced to sacrifice their linguistic and cultural heritage" (Malone, 2005:1).

Recognizing culturally, communicatively, linguistically, artistically, and technologically diverse forms of expression, multimodal educational environments in kindergarten focus "on community and social practices, [and] on multimodal means of representing and constructing meaning" (Crafton, Silvers, and Brennan, 2009:35) to achieve its inclusive function.

By assigning a special status to intersubjectivity in preschool age, the teacher supports the child's "embodied experience" of expressing themselves in ways that function quite differently and further develops this experience in joint activities by simultaneously using multiple semiotic resources. Based on qualitative experiences in real and digital educational environments, multimodal practices for design and redesign, for construction and deconstruction, for contextualization and recontextualization, encourage the child to identify, reproduce, and improvise meanings in sign-mediated messages.

Design of multimodal digital resources – conceptual foundations

The application of information technology in preschool is a factor of personal development and is associated with the development of skills in children:

- to welcome change and to influence change;
- think critically and make choices;

- to identify and solve problems;
- develop their creative imagination;
- to be proactive in sharing their practical experiences of dealing with multimodal designs;
- respond to the invitation to collaborate.

The preschool child's refined exposure to digital resources provides ample opportunities to encode and interpret information, resulting in a dialogue between them and the child and the formation of a thinking style and ability to communicate that is appropriate to modern communication media. In an environment enriched by multimodal digital resources, the child learns to solve problems by strategizing independently and avoiding a dependent state on outcomes. In this way, children are more motivated to develop their skills to work in a digital environment for longer and increase their self-esteem. Activating creative thinking triggers positive emotional processes, i.e. – by having fun, children achieve early digital literacy development.

In her research on multimodal visual literacy, Ariel Friedman used a population of 3-4-year old children and found that those of them "who learn with and about digital images improve their ability to perceive details and significantly expand their language parameters, including vocabulary, use of complex sentences, asking questions, and storytelling" (Friedman, 2018: 1). The cited study provides grounds for an important conclusion regarding the preschool age: activities with digital technologies based on visual images have a progressive effect on stimulating decision-making in choosing image designs and improving children's verbal interpretation of self-taken photographs. Specialized studies in the field of video games unequivocally establish "causal relationships between playing video games and high performance in cognitive tasks such as mental rotation and memory tasks" (Tasevska, 2023: 122).

Sylvia Woolf and Rosie Floyd point to the undeniable impact of new multimodal practices on early literacy and metacognitive development in 3-4-year old children. Fundamental to this is their thesis that "multimodal experiences are critical to children's abilities to act strategically in future situations" (Wolfe and Flewitt, 2010: 387).

Research work focused on the design of digital resources by preschool education students should be tailored to address tasks dictated by the needs for early multiliteracy development in digital environments, namely: (1) pedagogical situations that support preschoolers' practices related to early multiliteracy development in a digital environment; (2) pedagogical situations that promote children's curiosity, problem-solving skills, creative thinking, and collaboration with peers through the use of digital media; (3) pedagogical situations introducing transmedia play* with a focus on developing "children's multiliteracy through their interactions with contemporary media that connect stories and structures across platforms" (Alper and Herr-Stephenson, 2013); (4) pedagogical situations based on the multimodal functions of iPods and iPads technologies, providing children with educational practices different from traditional forms of literacy. These practices influence the child's self-assessment of his or her positioning as an active learner.

In terms of the methodological preparation of students – future preschool teachers, their ability to design and adapt digital multimodal resources suggesting and structuring multimodal pedagogical interactions proves essential.

Taking into account the multilayered nature of (multi)literacy, conceptually, in the design of multimodal educational environments in kindergarten, the following are emphasized: (1) the multifaceted forms of children's expression as the main interactant in social interactions; (2) the multifaceted signification of language as a communicative being, respectively in the digital environment; (3) the dynamic connectivity of information media as expressors of meanings and prerequisite for understanding; (4) the dialogical communication with the child and his community to enhance visual, informational, multicultural, media and digital individual experiences in preschool age.

Expertise and quality assessment of multimodal digital ensembles for kindergarten composition

The pedagogical aspects of evaluating the multimodal digital resources created by students in the course of their studies are related to the conceptual model (as meaning structure) and the approach to design as pedagogically meaningful ones. The pedagogical aspects are conceptualized from the position of approaches to the realization of the specific cognitive, social, emotional, technological solu-

tion indicated by the specific digital multimodal resource and the possibilities of its categorization and standardization, namely: (1) goal-oriented, (2) process-oriented, (3) outcome-oriented, (4) child-centered (facilitation-centered) – learning-centered, (5) teaching-centered (coaching-centered), (6) collaborative or interaction-centered, (7) hermeneutic-centered (toward interpretation), (8) behaviorist-centered, (9) cognitivist-centered, (10) constructivist-centered, (11) connectivist-centered, etc. The context of expertise of digital multimodal resources broadly encompasses the set of tools for effective use of e-learning resources in the following areas: (1) managerial-regulatory, (2) intellectual-cognitive, (3) informational-communicative, (4) practical-applied, (5) heuristic-exploratory, (6) socio-cognitive, (7) evaluative-results-oriented, (8) situational-constructive, (9) intuitive-associative, (10) problem-based, (11) adaptive, inclusive.

The concretization of the proposed aspects as a basis for a conceptual evaluation framework of multimodal digital educational resources is the basis for deriving a set of basic criteria and indicators for their expert evaluation, following the example of Tsankov and Damyanov (2019), presented in Table 1.

Table 1. *Evaluative Conceptual Framework of Electronic Educational Resources as Integrated Multilayered Polyfunctional Products.*

Criteria	Indicators for Assessment
Technical feasibility	• hardware and software compatibility; • accessibility (remote, identification-authorization, autonomous access); • necessary infrastructure for storage and maintenance; • access time; • accessible to external users; • platform/media dependency.
Functionality and reliability	• options for searching and extracting information; • export and download availability options; • options for annotation (tagging), sorting and classification; • intuitiveness of the interface; • appropriate navigation; • content licensing conditions; • degree of functional and technical customization; • applicability to persons with SEN; • relevant level in terms of gender, ethnic, cultural and social integration; • use through embedding or interaction.
Access to the electronic resource (opportunities and transformations)	• It is not online – offline; • Provision of information only; • One-way interaction; • Two-way interaction; • Transaction and integration of capabilities; • Multi-channel access.
Overall design of the electronic resource	• Usefulness of the content; • Degree of concretization; • Degree of integrability; • Constructive grouping; • Number of media integrated into the course.
Design of learning through the electronic resource	• Predominant learning strategy (satisficing/minimizing; optimizing, maximizing, algorithmic, heuristic, prospective, situational); • Incentives; • Potential response opportunities; • Support; • Level of customization.
Content Design – Organization	• Map of the resource; • Content map – static, dynamic, functionality, interactivity; • Using quick links and metaphors; • Horizontal content correlation (within one cognitive level); • Vertical content correlation (between different cognitive levels).

It is an undeniable fact that the development of digital technologies requires a qualitatively new type of information interaction, defined as interaction with multimodal text. Discussing its broad semantic

scope, multimodality researchers note that the layout of *multimodal text* is highly dynamic – image, sound, animation often complement the message, but it is quite possible that they apostrophize the message and suggest a contrary meaning (Luchinskaya and al, 2021). Multiple studies (Binder, 2014; Britsch, 2005; Mellgren and Gustafson, 2011; Granly and Maagero, 2012) reveal that multimodal text encourages preschool children to discover and create meaning.

In an operational aspect, digital resources require a multiliterate approach that integrates an expanded set of hybrid literacies and new pedagogies (Mills, 2009). In connection with these conclusions, Lazar Stošić emphasizes that "older teachers during their training did not have the opportunity for training with modern technical devices, did not have access to information technologies, educational technologies... while the younger generation of teachers possess the knowledge necessary for their use" (Stošić, 2015: 113).

In the context of preschool education, the functional suitability of digital resources is subject to the criteria outlined in Table 2.

CRITERIA	Low degree of indication	Medium degree of indication	High degree of indication
1. Relevance of the digital resource to the educational goals and practices in kindergarten.	The multimodal text validates children's experiences and competencies.	The multimodal text adds value beyond conventional analog methods.	The multimodal text contributes to refining meanings, synthesizing ideas, and transforming understanding.
2. Quality of the digital resource in activating „motivated association" between signifier and signified.	The multimodal text mediates the interpretation of images and events in storytelling.	The multimodal text presupposes another emerging behavior of social literacy.	The multimodal text stimulates cognitive activity towards analyzing the relationships between motivated signs (signifier and signified).
3. Effectiveness of the digital resource in promoting cultural responsiveness.	The multimodal text encourages active engagement in the process of seeking meaning.	The multimodal text prompts sharing and collaboration and positions the child as a competent communicator.	The multimodal text motivates the testing of skills for exploration and self-expression through access, analysis, evaluation, and creation of multimodal designs.

Conceptualizing foundational assumptions for designing a multimodal educational environment, operationalized through a triad of aspects of enriching interaction in kindergarten, S. Dermendzhieva elucidates: "1) Conceptual Aspect (what is the meaning) – reflects the significance and value of implementing multimodal practices in pedagogical interaction aimed at the early development of multiliteracy in preschool age; 2) Personal Aspect (what will develop) - reflects the current need to enrich pedagogical interaction in kindergarten with various communicative modes to refine meanings, synthesize ideas, and transform understanding necessary for early development of informational, visual, multicultural, digital, and media literacies, as substantive dimensions of literacy in a contemporary context; 3) Activity Aspect (how it will be shaped) – identifies meaning-centered fields with their basic concepts and indicators, and highlights the approaches through which the implementation of multimodal practices in pedagogical interaction is structured, mediating the objective phenomena for child development: sociocultural context and cognitive activity, children's exposure and interactions in real and online spaces, cultural responsiveness, dialogization, and personalization in the context of early development of multimodal literacy in preschool age (Dermendzhieva, 2021: 163-164).

By problematizing the fields and acknowledging the potential of the multimodal approach, the kindergarten has a chance to become a focal point of educational spaces, sufficiently democratic and inclusive, synergizing both "the stories, identities, languages, and discourses, including those of marginalized subjects, and providing the opportunity for them to become visible, (as) resource carriers, viewing their 'recognition' (of resources) as an important characteristic of multimodal education, especially in the context of social justice" (Archer, 2014: 190). Through the analysis of practical levels in the kindergarten, S. Dermendzhieva highlights an innovative organization of activities based on multimodality, namely: "(1) contextual interaction; (2) reflexivity and cultural responsiveness; (3) conceptualization and sense-making; (4) active engagement; (5) creative transformation; (6) problem-solving" (Dermendzhieva, 2021: 164).

Conclusion

The complete design of digital resources for multimodal environmental composing in kindergarten is an opportunity to create for the child a logical, attractive, living experience, as a synergetic medium of cognitive, affective, sensory cognition in order to engage and stimulate self-knowledge in a multimodal educational environment. This stimulates non-linear, perceptual and creative synergism in producing experiences that reference starting points for enriching pedagogical interaction, through which external social and educational multimodal environmental effectiveness will be transformed into internal child personal effectiveness of knowing the world and the self through a parallel appreciation of the child's personal experience and authenticity as reference points for self-actualization and self-expression, stimulated by synchronizing and synergizing modalities and their environmental composing.

It is through the design of digital resources that the existing contradictions in the initial conditions of pedagogical interaction in the kindergarten will be overcome, which are related "to the imbalance between the sociocultural and individual nature of the participants and to the particularities of the social, normative evaluation of their capabilities" (Dimitrov, 1994: 163).

All of this necessitates specific training for future preschool teachers in the field of multimodal environmental composition and the design of multimodal digital ensembles that synergize various modalities rather than linearly combining them in sequence.

Conflict of interests

The authors declare no conflict of interest.

Author Contributions

Conceptualization, S.D.; methodology, N.T.; writing – original draft preparation, N.T. and S.D.; writing – review and editing, N.T. and S.D.; Analysis, discussion and conclusion, N.T. and S.D.; All authors have read and agreed to the published version of the manuscript.

Acknowledgements

This study is financed by the European Union-NextGenerationEU, in the frames of the National Recovery and Resilience Plan of the Republic of Bulgaria, first pillar "Innovative Bulgaria", through the Bulgarian Ministry of Education and Science (MES), Project № BG-RRP-2.004-0006-C02 "Development of research and innovation at Trakia University in service of health and sustainable well-being", subproject „Digital technologies and artificial intelligence for multimodal learning – a transgressive educational perspective for pedagogical specialists" № H001-2023.47/23.01.2024

Author's Note: The transmedia game resembles gaming models in its material dimensions but differs with increasingly hybrid and social characteristics.

References

Alper, M. & Herr-Stephenson, R. (2013). Transmedia Play: Literacy Across Media. *Journal of Media Literacy Education, 5*(2). https://doi.org/10.23860/jmle-5-2-2

Archer, A. (2014). Power, social justice and multimodal pedagogies. C. Jewitt (ed.) The Routledge Handbook of Multimodal Analysis. London: Routledge, (189-204). https://www.researchgate.net/publication/280154215_Power_social_justice_and_multimodal_pedagogies#fullTextFileContent

Bass, S. (2018). Bridging Home and School: Factors That Contribute To Multiliteracies Development In A Yup'ik Kindergarten Classroom. https://scholarworks.alaska.edu/handle/11122/8576?show=full

Binder, M. (2014). The Storied Lives Children Play: Multimodal Approaches Using Storytelling. *Journal of Childhood Studies, 39*(2), 11-20. https://doi.org/10.18357/jcs.v39i2.15219

Britsch, S. (2005). The multimodal mediation of power in the discourses of preschool story designers. Text - *Interdisciplinary Journal for the Study of Discourse, 25*(3), 305-340. https://doi.org/10.1515/text.2005.25.3.305

Dermendzhieva, S. (2021). Предучилищно образование за мултимодална грамотност [Preschool education for multimodal literacy]. Благоевград: Университетско издателство „Неофит Рилски".

Dimitrov, D. Kr. (1994). Предучилищна педагогика – курс лекции, част 1 [Preschool pedagogy – course lectures, part 1].

Благоевград: Университетско издателство „Неофит Рилски“.

Dyankova, G., & Nikolova, S. (2023). Multicultural competence as a teacher's metacognition to achieve a positive school climate, International Journal of Cognitive Research in Science, Engineering and Education (IJCRSEE), 11(2), 257-265. https://doi.org/10.23947/2334-8496-2023-11-2-257-265

Friedman, A. (2018). To "read" and "write" pictures in early childhood: multimodal visual literacy through Israeli children's digital photography. *Journal of Children and Media, 12*(3), 312–328. https://doi.org/10.1080/17482798.2018.1443147

Hill, S. (2010). The millennium generation: Teacher-researchers exploring new forms of literacy. Journal of Early Childhood Literacy 10(3):314-340. http://dx.doi.org/10.1177/1468798410372820

Crafton, L., P. Silvers, & M. Brennan. (2009). Creating a critical multiliteracies curriculum: repositioning art in the early childhood classroom, 2009, (p. 31-51), Boston, MA: Springer https://www.academia.edu/99132396/Creating_a_Critical_Multiliteracies_Curriculum_Repositioning_Art_in_the_Early_Childhood_Classroom

Gavrilova, M. (2016). Социальная семиотика: теоретические основания и принципы анализа мультимодальных текстов [Social semiotics: theoretical foundations and principles of analysis of multimodal texts]. Political science (RU), №3: 101-117. Российской ассоциации политической науки (РАПН). https://www.politnauka.ru/jour/article/view/491/489

Genova, D. (2019). Мултимодална комуникация: теоретични подходи и приложения [Multimodal Communication: Theoretical Approaches and Applications]. Сб. в чест на чл.-кор. проф. дн Стоян Буров "Aut inveniam viam, aut faciam". Велико Търново: УИ «Св. св. Кирил и Методий», 2019, с. 153-169.

Granly, A., & Maagerø, E. (2012). Multimodal texts in kindergarten rooms. *Education Inquiry,* 3(3), 371–386. https://doi.org/10.3402/edui.v3i3.22041

Kress, G. (2003). Literacy in the new media age. London: Routledge, 2003.

Kress, G. (2011). 'Partnerships in research': multimodality and ethnography. *Qualitative Research,* 11(3), 239-260. https://doi.org/10.1177/1468794111399836

Luchinskaya, E., R. Volkova, B. Kabanyan, & Y. Luchinsky (2021). Polycode as a multimodality of academic discourse. *XIV International Scientific and Practical Conference "State and Prospects for the Development of Agribusiness - INTERAGROMASH 2021"*. Published online 22 June 2021. E3S Web Conf. Volume 273/12160. https://doi.org/10.1051/e3sconf/202127312160

Madzharov, G. (2018). Детска психология заедно [Child psychology together]. София: Кушовалиев.

Malone, S. (2004). Education for multilingualism and multi-literacy in ethnic minority communities: the situation in Asia. By 1. Asian/Pacific Book Development, 2004, Vol. 34. https://www.sil.org/system/files/reapdata/85/71/30/85713096327433737297738899137315471758/susan_malone_48911.pdf

Mellgren, E., & Gustafsson, K. (2011). Early Childhood Literacy and Children's Multimodal Expressions in Preschool. In: Pramling, N., Pramling Samuelsson, I. (eds) Educational Encounters: Nordic Studies in Early Childhood Didactics. *International perspectives on early childhood education and development*, vol 4. Springer, Dordrecht. https://doi.org/10.1007/978-94-007-1617-9_10

Mills, K. A. (2009). Multiliteracies: interrogating competing discourses. *Language and Education*, 23(2), 103–116. https://doi.org/10.1080/09500780802152762

Morris Ch. W. (1964). *Signification and Significance: A Study of the Relations of Signs and Values*. Cambridge, Mass.: MIT Press.

Stošić, L. (2015). The importance of educational technology in teaching. *International Journal of Cognitive Research in Science, Engineering and Education (IJCRSEE), 3*(1), 111–114. https://doi.org/10.23947/2334-8496-2015-3-1-111-114

Stoun, Al. (2001). Войната между желанието и техниката в края на механичната епоха [The war between desire and technology at the end of the mechanical age]. София: Изток-запад.

Tasevska D. (2023). Роля на видеоигрите върху умствената ротация и краткосрочната памет [Role of video games on mental rotation and short-term memory]. Библиотека „Диоген“, том 31, брой 1 (103-123). https://doi.org/10.54664/BZME3447

Tsankov, N., & Damyanov, I. (2019). Expertise in the Selection of Electronic Educational Resources–Conceptual Vision. International Journal of Emerging Technologies in Learning (Online), 14(7), 216., https://online-journals.org/index.php/i-jet/article/view/9922/5614, https://doi.org/10.3991/ijet.v14i07.9922

Wolfe, S., & R. Flewitt. (2010). New technologies, new multimodal literacy practices and young children's metacognitive development. *By Cambridge Journal of Education,* Vol. 40 - Issue 4, pp. 387-399. https://doi.org/10.1080/0305764X.2010.526589

Original scientific paper

Received: July 09, 2024.
Revised: August 01, 2024.
Accepted: August 09, 2024.

UDC:
316.723
004:316.324.8
78:316.324.8
10.23947/2334-8496-2024-12-2-497-506

Check for updates

Mapping the Trajectory of Popular Culture: From Rock Album Narratives to Video Game Transmediality

Aleksandar M. Filipović[1*] , *Aleksandar S. Janković*[2]

[1] Faculty of Law for Commerce and Judiciary, University Business Academy, Novi Sad, Serbia
e-mail: sasha.filipovic@gmail.com
[2] Faculty of Dramatic Arts, University of Arts in Belgrade, Serbia
e-mail: bonvivan@gmail.com

Abstract: Popular culture is not a coherent concept; it lacks an organic whole and is subject to change. It is neither fixed nor concrete, with its modus operandi rooted in everyday life. It does not possess a definitive meaning, as it is constantly being redefined and reevaluated, and the canon of pop culture works is continually expanding. During its heyday in the 1960s, pop culture evolved, shaping both its passive and active roles. The passive (mass) aspect reflects a tendency to act as a "mirror" of reality, as it is and as it should be, adding a certain degree of glamour within the entertainment industry, major Hollywood productions, and politically correct celebrities. The active aspect relies on the potential for social action within pop culture. Pop culture has become capable of supporting and leading significant cultural changes, such as in music, film, literature, and shifting social attitudes toward war and destruction, family, religion, and other critical issues since the 1960s. In the 21st century, the activity, vitality, and relevance of pop culture are based on technology, AI, and video gaming. Other narratives become allusive and outdated, yet they still define the modes of life of the era. This paper aims to first investigate and define the trajectory of popular culture and, consequently, to project the future directions and modalities we can expect, considering the increasing significance and impact of popular culture juxtaposed with elite culture.

Keywords: *popular culture, society, narratives, consumer habits*

Introduction

Leading thinkers of the Frankfurt School, Theodor Adorno and Max Horkheimer (1947) described the culture industry as an "iron system" in their book *Dialectic of Enlightenment* (Dialektik der Aufklärung). They argued that entertainment is an inseparable part of this system, which aims not only to distract consumers from genuine social and political issues but also to prevent them from doubting that resistance to the system is possible. According to Horkheimer and Adorno, standardized and repetitive entertainment expects the consumer to simply say "yes" and submit, thereby maintaining the social order.

However, in the historical context of the Western world just emerging from a great war and genocide, the Frankfurt School believes that the human subject must rationalize both work time and leisure and free themselves from domination in every respect. Freedom is the key to Western democracy, but the way Adorno and Horkheimer understand and accept it is quite subjective. The culture industry plays a vital role in the cyclical manipulation of freedom; work evokes the need for escapism, and when this form of "escape" is achieved, it implies that the idle worker should return to work.

As human emancipation grew during the subsequent decades of global industrialization, with advancements in racial, gender, national, and cultural freedoms, mass culture evolved into pop culture, becoming dominant in the growing middle and working classes (television, radio, phonograph records). The negative aspects of pop culture remain, however, similar to the views of Adorno and Horkheimer: mass production, profit, lack of creators' talent, emotional inconsistency, virtuality, passivity, and demagoguery, all of which support totalitarianism.

*Corresponding author: sasha.filipovic@gmail.com

Pop culture affirmatively transforms everyday life. People live through pop culture, not alongside it. Therefore, popular culture is a crucial and effective part of the material reality of history, shaping the possibilities of our existence even decades later (see more: Shuker, 1994). Subversive functions emerge in the historical context when pop culture texts become a field for expressing marginalized social identities and functions (anti-globalism, socially conscious films, albums, and songs that criticize the political system, the struggle for minority rights). Pop culture has different histories, for example, The 1960s represent the flourishing of privacy and cultural freedoms, while the 1970s are associated with feminism and the emancipation of Black culture, and as such, it represents a sort of *folie à deux* with the consumer. This means that each consumer of popular culture has the right to their own perception, classification, or periodization of it. They establish an interaction with like-minded individuals, which can create an entirely different system of cultural valuation that is subject to change and enhancement. In other words, the periods are marked by pop culture events rather than generally accepted historical facts, for example, the arrival of the Beatles in America, the release of the album "Sgt. Pepper's Lonely Hearts Club Band," and the beginning of the TV series "Star Trek", etc.

However, it strongly correlates with society, technological revolutions, and emergence and spread of Internet, which enveloped nearly the whole planet and all the people on it (see more: Bjelajac and Filipović, 2020; Bjelajac, Filipović and Stošić, 2022) have brought significant changes in the way the audience consumes the works of popular culture, whether it is music or film or even video games, whose current state is a direct product of ICT development. These changes in the habits of consumers resulted in changes in how the artists conceptualize, create and distribute their works.

This paper aims to determine the everchanging landscape of popular culture, and to detect crucial events that have brought the change both in perception of works of popular culture in consumers, and in conceptual and creative changes the artists have undertook in order to adapt to paradigm and epoch shifts. Additional goal of this paper is to identify the current trajectory of popular culture, and by using the conclusions, make projections of future changes in this important phenomenon. The starting hypothesis are that due to its intrinsic elements and its nature, popular culture took the place that was occupied by elite culture for centuries, but, due to societal and technological changes, the main carriers of narratives of popular culture have also changed.

Methodology

In the research process, we used the following methods: theoretical and interpretative method in researching the relevant phenomena in general; historical method, to research context and identify both mutual and exclusive aspects of various societal ages we have undergone over the last 70 years, the method of media content analysis in researching how cultural artefacts change through time and cultural paradigms, and methods of qualitative and comparative analysis, which helped us to draw conclusions in a broader scope that corresponds with the aims of this paper.

Music as a Catalyst for Shift of Cultural Paradigm

From today's perspective, the sixties do not just appear as a golden age; they truly were, because they were the last decade that "had a heart," which was expressed through a global pop-cultural revolt against selfishness, hypocrisy, bureaucracy, and war. On the other hand, the sixties had a supranational cultural context, initially for Western Europe, and then equally for America and Europe, in a trans-block sense. Especially since this was a time when cultural communication, in a then-divided and media-undeveloped world, led to the erosion of boundaries and began to transcend political ones, laying the foundations for common, primarily pop-cultural and cultural values. Popular culture and rock and roll played a role in bridging the differences between national cultural contexts (not in the sense of annihilation, but in finding elements for mutual understanding, introducing new cultural values, reexamining old ones, etc.), and finding ways to establish communication and a new form of cultural competence and supranational paradigm.

Before 1963, the perception of pop music rested on four factors: the lyrics, the music, the attitude, and the appearance of the performer. The best example of this claim is Elvis Presley, whose presence did

not go beyond these elements. Moreover, it is possible to fully enjoy the appearance and feeling of a pop performer while the songs themselves are a completely secondary sensation. Therefore, the pop music audience was more or less differentiated, and only a minority could enjoy all the listed aspects. After 1963, record companies focused on the feelings and needs of their audience, so it is clear that Bob Dylan's lyrics were the center of attention, while for the Beatles, it was the music. Hence, the contemporary music industry is again more related to an audience with a more defined and sophisticated taste, unlike an audience that likes a bit of everything. Dylan and the Beatles helped the music industry move away from the studio and ideological constraints of the fifties, so it can be said that the most vibrant pop years were between 1965 and 1967, when the transformations of pop performers were most visible.

> "Works of mass art possess an industrial character, so they navigate the sphere of production-consumption relations like fish in water. Unlike them, unadulterated works of art, those that bear the stamp of authorial individuality, created most often from purely spiritual impulses, are, by force of circumstances, left to the laws of the market."
>
> (Božilović, 2021, page 17)

As Paul Ricoeur notes: "No culture can withstand and absorb the shock of modern civilization. There is a paradox here: how to become modern and return to sources" (Hačion, 1996, page 115). Pop had to find its own way to survive. Thus, the explosion of creativity of that time has survived as today's nostalgia industry, offering the ideals of the sixties as an eternal adolescent dystopia.

In this sense, pop music can be connected to the definition of music in general, which states that "all music is music of the people." The key demographic group of pop music enthusiasts is the baby boomer generation, followed by Generation X. Their taste in literature, film, and music created an enormous power and industry. This generation of teenagers, consciously or unconsciously, rejected the quasi-official pop culture that emerged during the Depression and war years, creating an idealized and romanticized image of the perfect American (post-war) family. The sudden rise of interest in "black" culture and an alternative view of the American heritage and dream would take teenagers far. The industry created formats, often acting subversively, i.e., industrializing the subversive, as seen in the examples of music albums dealing with activism (moderate or radical, ecological or political) like Marvin Gaye, Curtis Mayfield, or bands like the Sex Pistols, The Clash, Rage Against the Machine, and Public Enemy. With the development of technology, pop culture lost some key narratives such as the format of the conceptual or thematic album. Some important authors were dislocated in consumer confusion and transition (Neil Young, Radiohead...), while escapist entertainment became dominant, common in the digital bits of streaming services. However, the history of pop culture has always moved cyclically. According to RIAA (The Recording Industry Association of America), for two consecutive years, more vinyl records have been sold than compact discs (for example, in 2023, 43 million vinyl editions were sold compared to 37 million CDs). From 1987 to 2022, thirty-five years have passed, so primary rituals with the necessary fetishization of formats have changed significantly. CD players and CDs were much more expensive than balanced vinyl and audio cassettes, which were the absolutely dominant sound carriers for two key decades for popular music. The CD offered unrivaled sound clarity at the expense of the unconvincingness of vinyl records, which were susceptible to damage with crackling and skipping, and storage issues. The CD format carried digital sound, stronger and more pronounced, was more practical, compact, and very quickly cheaper. Hardware for playing this format was more accessible and noticeably cheaper. The peak of global consumerism (the nineties) coincided with some key and all-pervading musical genres (grunge, alternative rock, Britpop, techno, R'n'B, hip hop...), so the democratic perception of the music industry overshadowed the elitist and snobbish approach of previous eras. However, the 21st century marked the end of physical media, i.e., the need for collecting, so the multi-generational transfer was successfully completed at the beginning of the third decade of the new millennium. The transition to streaming services was entirely successful without the need for regression. In this light, the return of vinyl brings back some forgotten narratives such as the ritual of playing records, physical and intellectual activity in a shorter period compared to digital playlists that can last for hours. Consumer psychology has brought back the dramaturgy of enjoyment and pleasure. With some anthropological imperatives such as storage and belonging to a particular consumer culture. This discourse was not present for CD and cassette buyers.

> "From a Lacanian viewpoint there can only be one answer: Music is the pivotal place where the voice exceeds the word so as to transgress and go beyond the Law. This is where the drive meets desire, where excessive jouissance meets logos, excess or "surplus enjoyment" meets satisfaction rather than metonymic deprivation. *Jouis-sense*, or enjoyment-in-meaning, was Lacan's neologism for the moment when meaning is eclipsed, inverting into the excesses of a consuming self-enjoyment. In music, the glimpses and attempts at a pre-symbolic agency unbridled by the Law of castration are opened up for singers, as well as their fans. In the contemporary music scene such transgression against and beyond the Law is staged across a number of registers offering unconscious fantasies that directly cope with the de-Oedipalization of postmodernity with its paedomorphic extension of youth cultures well into their late twenties and early thirties. Some forms, as we shall see, submit to the Law of the signifier. They constitute forms of repetition and serialization in the commodity market, acting as unifying master signifiers—the moulds of identity for youth to mimic. Other affective forms such as Gangsta rap, Punk Rock, Goth, and Heavy Metal have attempted forms of transgressions to introduce a dissonance for youth rebellion and resistance against the Symbolic Order".
>
> (Jagodzinski, 2005, page 33)

As the core demographic of pop music consumers has remained unchanged (13-24) to this day, the music industry, at the turn of the centuries, is dominated by the "silent majority," whose age range extends from the first official "teenagers" (baby boomers), who are now over 75 years old, to Generation X (mid-fifties). Without a doubt, young people will be the first to understand that rock and roll carries a determined message. However, that message is not necessarily related to youth per se. Therefore, the sale of pop albums by profiled teenage performers began to decline sharply at the beginning of the eighties and continues to do so today.

While the market cycles thesis offers an economic explanation for the perplexing historical shifts in popular music tastes, it has faced several criticisms. Methodological challenges arise from its initial focus on commercially successful singles, with the underlying assumption that the diversity of rock music is reflected in the hit parade. This approach neglects the predominance of "album sales over singles since the early 1970s and the generally accepted view that the longer format holds greater aesthetic value. Furthermore, the thesis interprets market diversity as a direct function of the number of individual hit records in a given year. To substantiate this argument, a critical stylistic analysis of the actual hit recordings, based on their musical features rather than the companies that released them, would be necessary. Additionally, it can be argued that independent labels' products are not always characterized by innovation and often replicate styles already popularized by major competitors. Finally, as Peterson and Berger themselves acknowledge, the distinction between major and independent labels has been blurred since around 1970, with the two tiers of the industry historically interconnected through the majors' control of distribution". (Shuker, 1998, page 186)

Digital Transformation of Popular Culture

Popular culture is typically defined as a culture that correlates with the needs of the average person, aligning cultural patterns with the educational and emotional levels of the broadest segments of society (Strinati, 2004), who have, through the natural development of society and social relations, attained complete social power and, accordingly, the right to sovereignly form their semiosphere as a bloc of semiotic units within the cultural value system (Filindash, 2023). The popular culture of that social segment, which Ortega y Gasset once referred to as the "masses" (see more: Ortega and Gaset, 2013), is today propelled by impressive ICT capabilities and represents a powerful industry producing specific products in unlimited quantities, often being used for the control and production of desirable consumer behavior (see more: Horkheimer and Adorno, 1947). Multiple replicated examples of everyday culture spread uncontrollably through ICT means, typically having a hypnotic effect on the audience.

All societies on the planet today live and share the general aspects and consequences of complete digitization, in which ICT becomes the ultimate framework not only for development but also for the existence of popular culture, and its mass distribution becomes unsustainable without mass communications,

and soon we will reach that level of dependence on artificial intelligence (AI). Entering the digital field and remaining in it as a new natural environment, tailored precisely for popular culture and its consumers, popular culture has gained new characteristics. Even routinely exploring visible changes in contemporary popular culture within the global socio-cultural space, we can undeniably state the acquisition of some convergent and participatory characteristics of popular culture. The "old," elite culture, with its inherently closed and inaccessible semiosphere, had a small number of consumers and an even smaller number of adherents. The upcoming masses of new cultural consumers suddenly and irresistibly "pushed to the forefront of social reality determined to take the best seats and undertake the most suitable means, indulging in pleasures that were once the privilege of the few" (Ortega and Gaset, 2013, page 37). The greatly increased number of new consumers led to the erosion of the general threshold of cultural experience. The number of new culture consumers who could provide a coherent answer to Heidegger's question: "what is artistic in a work of art" (more in: Hajdeger, 2000, page 60), or, paraphrased, what is artistic in a cultural artifact and why do we consider it artistic (if it truly is), was negligible. In addition, this "accumulation and fullness" of the first and, as immediately became apparent, privileged social ranks, did not bring a change only in the speed of distribution of cultural artifacts; it also changed the mechanism of their creation, allowing the broadest spectrum of popular culture users, and today ICT and AI culture, to collaborate and create culturally valuable and art-infused projects. Digitally transformed popular culture became capable of creating and utilizing numerous metaspaces in which it easily levitates between phenomenological and higher cognitive spheres of processing perceptions and experiences observed through the consumption of popular culture works (Filipović, 2024). The commercial symbiosis of hardware and software has brought technology to the level that it can be the driving force behind cultural institutions in their intent to modify their industry of popular culture products, not only by creating their content but by creating it together with users, receiving instant feedback from the digital consumer community, which sometimes can act as a factor of correction and adaptation of content to the needs and tastes of the culture. In the new stage of adapting popular culture to the consumer community, the new role of the mass audience, which has been upgraded from a passive receiver of cultural content to a position of not only producer but also an entity that, with its commercial capacity, determines what and in what quantity will be produced, was quickly identified. This led to the mass appearance of undesirable cultural products that were of such low quality that even the lowest segments of new consumers found them substandard, thus receiving the colloquial label of junk and kitsch (see more in: Easthope, 1991), which in several countries had legal and financial repercussions. As the next characteristic, digital popular culture permanently abandons the concept of a homogeneous audience: instead, it transforms cultural content into atomized clusters, where each user becomes an author emitting their own cultural codes and ideas.

The digital transformation of society necessarily changes the role and significance of media channels, which have in the meantime become a "conditio sine qua non" for the existence of popular culture. The altered role of media channels, which emerged as a commercial response to the demands of a new type of consumer, has led to the convergence of ICT technologies with the affirmation of visual capabilities at the expense of print, resulting in the disappearance of what was once the dominant semantic-verbal interaction among people, and the establishment of a new screen-based, visual culture.

Given that the collection of cultural practices known as popular culture itself represents the greatest transformation of culture to date (Williams, 1976), digital transformation represents a new stage and a necessary continuation of the transformation and adaptation of cultural content to new users. Building on previous transformations, digitally transformed popular culture maintains itself as the "leading means of universal conformation of mass consciousness" (Filindash, 2023). As a result of digital transformation, the archetype of the elite creative personality of the author is replaced by the archetype of the mass personality, which simultaneously possesses the characteristics of a consumer. The mechanism of incorporating the results of creative activity into the realm of mass culture is carried out by shifting the emphasis from creative value to consumer value. This explains the high rate of trend changes in popular culture. The mass individual has emerged as an expression of the changes that have occurred in contemporary society and its culture. The rapid development of technology has made culture accessible and omnipresent in the life of society; the new culture has become a highly desirable element of people's lives, a daily and invaluable backdrop. However, the widespread availability of popular culture and, in principle, the low feedback from consumers have negatively impacted its overall quality. The elite cultural semiosphere has retained all its arrogance and independence from the commercial character of the popular culture

semiosphere. To ensure bare existence and profitable success in the market, producers of popular culture content constantly listen to the desires of the masses and, in accordance with those desires, identify and update their "range of demand" (ibid).

Although not the primary focus of this paper, it is worth mentioning the significant application of immersive technologies as one of the postulates of the digital transformation of popular culture. Immersion is often encountered in art and entertainment when authors use various interactive performances and exhibitions to create immersive experiences for their consumers. Immersion is frequently used in video games (VR games) and the film industry (3D movies). Immersive activities in the context of virtual reality and similar technologies allow users to fully immerse themselves in a virtual world and, in a way, "forget" the real world while in the virtual one. In general, augmented or extended reality technologies are used to provide presence in artificial, alternative environments and are becoming increasingly widespread in museum and exhibition practices. Digital technologies offer an attractive way of engaging with any artistic objects, notable contemporary figures, including paintings (ibid).

Immersive technologies, no matter how attractive to the audience, provoke certain objections that could be categorized as attempts to control mass opinion and produce the desired consciousness of consumers, which should be a subject of deeper analysis from the standpoint of the ethics of using immersive technologies. Replicating originals using immersive techniques creates a world of secondary reality for the person of digital culture. The high cost of replicas in the everyday mind equates their consumer and artistic value, neutralizing the value of the original and the copy. For example, in 2021, the starting price of NFT tokens of works belonging to the State Hermitage Museum at an online auction was ten thousand US dollars (ibid). The use of high artistic level samples in mass culture through digital technologies is of a dual nature: positively—as a means of education, entertainment, and inclusion into the interactive language, and negatively—as a cause of intellectual impoverishment. When it turns to works of elite art in the format of secondary pseudoreality, mass culture increases the content field and expands the social sphere of influence.

Video Games and the Evolution of the Narrative Landscape of Popular Culture

The process of digitalization and technological development has been the catalyst for one of the most significant transformations in human history, altering lifestyles, social relations, and modes of production while simultaneously introducing new products and ways of utilizing and perceiving existing products. Culture, including popular culture, could not remain immune to such drastic and pervasive changes. Certain branches of popular culture, at least in terms of their consumption methods, have undergone less dramatic changes, such as comic books and, to some extent, film. Despite the introduction of digital visual effects that were previously unattainable, watching films in cinemas has remained the most desirable and optimal way to consume film content. Naturally, the cinema industry has not remained stagnant; it has embraced new technologies to create more immersive film-watching experiences, notably through the development of significantly larger screens, such as IMAX.

The film industry experienced a brief crisis caused by the COVID-19 pandemic, during which streaming services bypassed theatrical premieres and life cycles, instead showcasing films on their online platforms. However, once the pandemic subsided, theatrical premieres and screenings resumed their traditional prominence. Music, perhaps, has undergone the most significant changes. This assertion does not merely include the use of digital tools in music production but pertains to the conceptualization and methods of music consumption. This evolution began with the development of the digital .mp3 format and the subsequent changes it introduced (see: Hinduja, 2006) and continued with the advent of music streaming services like Spotify and Deezer, which have come to dominate how music is consumed. When music, which has had a narrative unity since the classical era—whether called an opera, symphony, concerto, or, in popular music, an album—serves as the foundation, the partitioning of music into individual tracks causes profound changes with at least a twofold impact: consumers no longer perceive individual tracks as part of a broader, thoughtfully conceived whole, and musicians increasingly abandon the concept of the album as a cohesive narrative entity, especially in popular music. Although some artists defy this trend, the fact remains that what was once the norm has become the exception, and these artists do not represent a substantial niche within the overall spectrum of musical creation. The narrative landscape of popular culture is now defined and shaped by the artifacts of another medium, or rather an inherently

digital art form and, thanks to digitalization, has become the most lucrative product of the cultural industry: video games.

For the sake of complete scientific accuracy, it must be noted that the first experimental products considered proto-video games were analog, such as the patent "The Cathode Tube Amusement Device" by Thomas T. Goldsmith and Estle Ray Mann, which describes the concept of controlling the position of a dot on the screen from 1947, or the game "Tennis for Two" by Willy Higinbotham from 1958 (Filipović, 2022, pages 239-240). However, the first proto-video game that was distributed in any form was digital: "SpaceWar," created in 1961 by a group of enthusiasts at MIT, which functioned solely on the PDP-1 computer and was distributed by the computer's manufacturer as software for its testing. From that point onward, video games have grown and evolved, becoming increasingly complex, in tandem with the development and capabilities of hardware, often initiating hardware development through symbiotic relationships with the computer hardware industry. Symbiotic relationships characterize the entire history of video games, and here we emphasize another such relationship, this time with film, which introduced video games to popular culture as early as the 1970s, and revolutionized cinematic possibilities, particularly in the domain of computer-generated effects and animation. It is noteworthy that one of the first significant films, "Tron" (1982), which featured a video game developer as its protagonist and had a narrative directly related to video games—where the developer is trapped inside interactive software and attempts to escape by performing actions reflective of video game gameplay elements—was not even nominated for an Academy Award for Special Effects, despite being revolutionary in that domain, because Academy members considered that the filmmakers cheated by using computers (see: Filipović, 2013; Filipović, 2016). Of course, over the past forty years, things have changed so drastically that it is now newsworthy when a director uses practical visual effects or shoots films in an analog format on film stock. On the other hand, video games quickly achieved immense popularity and a significant position both in popular culture and the entertainment industry, with the first video game protagonist whose popularity and recognizability transcended the medium and became a cultural artifact being Pac-Man from the 1980 game of the same name. The video game industry grew so rapidly, largely reflecting the growth of Atari, that by 1983 it suffered such a crash in the North American market that recovery forecasts were bleak. However, thanks to a series of correlating factors not detailed here, the video game industry not only recovered but, again due to a series of correlating factors not elaborated upon, has become the most profitable segment of the cultural industry and one of the most significant carriers of popular culture in the digital age. What is drastically different and new compared to most of the history of video games is their primacy and role in shaping important narratives of popular culture.

For a significant portion of their history, primarily due to technical limitations (notably hardware performance and data storage capacities), video games featured very simple narratives. The computing hardware of the time did not provide the conditions necessary for developing more complex narratives comparable to those found in other elements of popular culture. It was not until the advent of CDs as data storage media that video game developers began to address broader themes. In this context, the 1990s marked the beginning of a more substantial integration of video game narratives into the overall narrative landscape of popular culture.

The success of the 1996 video game "Tomb Raider" and its subsequent franchising, symbolized by the character Lara Croft, marked a turning point in recognizing the importance of video game narratives and their elements, such as character development. Lara Croft herself became an iconic figure in popular culture, in a manner that characters like Pac-Man or Super Mario could not. Her recognition and popularity were among the first transmedial artifacts of video games, a phenomenon that would later become far more commonplace. Besides the transmedial success of the franchise's heroine, the overall narrative of the franchise was also adapted into other media and arts, resulting in three blockbuster films, the first of which was released in 2001—just five years after the launch of the original "Tomb Raider" game. This occurred during a time when films, particularly those of such high expense and marketing, were not typically based on video games.

After nearly twenty years and numerous unsuccessful attempts (notably the work of Uwe Boll, who adapted video games into some of the most critically panned films in cinematic history), recent times have seen several well-received films and streaming series adapted from video games. These adaptations have been well received by both critics and audiences, particularly the gaming audience, which is a crucial factor in determining the success of such cross-media adaptations (notable examples include "The Last of

Us" and "Fallout"). It appears that filmmakers have finally grasped how to successfully translate gameplay into screenplay. Consequently, we can expect further continuation of this trend, as video games have, in the meantime, produced a large number of innovative and excellent narratives, suggesting that filmmakers and creators of TV and streaming series have only scratched the surface of available material.

While the relatively sparse narratives in video games prior to the mid-1990s can be attributed to underdeveloped hardware rather than a lack of creative ingenuity on the part of video game creators, the latter half of the 1990s witnessed a significant surge in culturally significant narratives within video games. Examples include "Tomb Raider," as well as "Grand Theft Auto," "Fallout," and "Silent Hill," among others. Alongside narratives crucial to the lore of popular culture, new hardware capabilities provided a platform for artistic expression in video games, transforming the medium into a legitimate form of art.

Noteworthy creators in this context include Hideo Kojima, known for the "Metal Gear Solid" series and later "Death Stranding," and Fumito Ueda, creator of "Ico," "Shadow of the Colossus," and "The Last Guardian." These games are often cited as pivotal evidence in discussions about whether video games should be considered art.

The rapid pace of technological development has led to the democratization of video game production tools, meaning that virtually anyone with an idea and the skills to implement it could create an independent video game. This increased the number of significant games, and at the same time, significant narratives, but market hypersaturation somewhat reduced visibility. Paradoxically, the increase in the market practically led to its contraction, but this in turn brought progress in other aspects related to the video game business, such as marketing, promotion, and sales.

Looking forward, the future appears exceptionally promising, as the crucial element of hardware development is advancing faster than ever. This development is now closely linked with the evolution of artificial intelligence, which has always been an integral part of video games, even in their most rudimentary functions (see: Filipović, 2023). This synergy presents new possibilities for narrative creation in the medium of video games, reinforcing its position as a central element in both the narrative landscape of popular culture and the broader context of digital culture and the digital age.

Discussion

Listeners of traditional rock music (The Beatles, Stones, Eagles, Led Zeppelin) undoubtedly belonged to the excessive and rebellious youth of the 1960s, who constructed their identity on what might be a revolt against the older generation, aspiring for autonomy (primarily from working-class families) due to the improved living conditions following World War II. According to the "more money – more music" principle, the increased spending power of the youth created new values and ideals (expressed through musical and film tastes and, certainly, fashion). This led to the emergence of teenage culture, which was based on the contradiction between authentic and manufactured, i.e., market-imposed values versus what truly spoke for and about the youth. In attempting to understand pop music and its ambivalent impact, we arrive at the audience as the most crucial determinant of cultural significance. The audience is what imparts multifaceted meaning to the musical message, conditioned by the dynamics of the music industry (technology, production, artist's intention, and the social location of listeners). The importance of historically situating the type of meaning in pop music rests on: industry professionals, musicians, critics, fans, and, ultimately, the mythology stemming from the fact that a significant portion of pop music and pop culture, in general, is rooted in Anglo-American hegemony, cultural imperialism, and globalization. Although original pop culture belongs to the 1960s, it is clear that generations born between 1955 and 1975 have a better grasp of the mythology of pop culture than of national history or tradition. While for the generation born before World War II pop culture represents an incomprehensible dystopia, for all others it is a form of escapism, pleasure, and identity formation. However, popular culture also belongs to those born later, the Millennials and Generation Z, and their life and, consequently, cultural habits and needs correspond to the spirit of the times and the era in which we live. This mixture of different generations with varying values and habits determines the prevailing forms of popular culture. To paraphrase Karl Marx, how we secure our existence defines all other aspects of life, including the cultural aspect, and in these differences between various generations that currently coexist lie the reasons for the shift in the cultural paradigm towards popular culture and the way cultural content is consumed, which, in turn, determines how that cultural content is, so to speak, presented. The fragmentation of music into individual tracks

as the basis for a new dominant mode of listening, through algorithmically generated playlists based on similarity, has somewhat diminished the significance of musical albums as artistic wholes, as fewer consumers listen to albums in their entirety. Of course, as previously noted, purchasing music on physical media somewhat maintains the narrative nature of musical albums as important. However, if we compare this to the distribution of video games, we can conclude that consumers who continue to purchase physical media of popular culture products predominantly belong to collectors, and the mass nature of popular culture, by its nature, places collectors and other niche or fringe groups low on the significance scale. On the other hand, the profits from digital distribution allow for the release of a limited number of physical collectible copies, which are typically very expensive, several times more so than the purely digital version. This further reduces the mass appeal and accessibility of physical copies, especially for those generations who have consumed cultural and entertainment content digitally throughout their lives.

As popular culture has taken the pedestal from elite culture because the quality and originality of their narratives were initially comparable, and in some cases even more impressive, we cannot discuss popular culture without addressing the significance and quality of its narratives. The moment popular culture loses its narrative nature, we can begin to discuss its end. However, popular culture has not lost its narrative nature, although it may seem so to certain groups of people, as serious narratives have disappeared from one form of popular culture and migrated to another. Here, we discuss the central theme of our work, music and video games, as carriers of innovative narrative functions in popular culture. The democratization of production tools has multiplied the number of performers and creators across the entire spectrum of popular culture. The fact that the audience of popular culture has altered its way of consuming pop cultural content does not mean that the overall audience has diminished. On the contrary, the audience continues to grow, enabling market success for content that would have been rejected as financially risky ten or twenty years ago. Video games like “Stray,” where the player’s avatar is a cat and the gameplay and mechanics correspond to the perspective and physics of a cat’s movement, would not have fared well in the past market, but today, the game has achieved cult status. Games produced by FromSoftware (the Dark Souls series, Bloodborne, Elden Ring), which convey narrative and guidance solely through introductory cutscenes, flavor text, and dialogues with scattered NPCs, essentially requiring players to access community meta-knowledge of the game, have shown that rich narratives can be conveyed to audiences through extremely fragmented, if not hidden, information that provides only a fragment of the overall context. Through the gaming experience combined with such narrative techniques, the consumer perceives the narrative and its place within it. A different example is the game “Hellblade: Senua’s Sacrifice” and its sequel, “Hellblade II: Senua’s Saga,” where the narrative significance lies in the choice of game theme and the innovation in depicting psychosis, from which the protagonist suffers throughout her life. The way the internal experience of psychosis is integrated into both the narrative and gameplay of these games contributes to a powerful emotional charge that defines the gaming experience in a manner similar to the best works of literature, film, or music. Out of plethora of great video games , we have mentioned only a few which are enough to confirm our thesis that the focus of narrative function in popular culture has shifted to video games, which, along with the increasingly rapid technological growth, will likely bring the most impressive forms that will define the time to come.

Conclusions

The digital era and its socio-cultural principles have undeniably altered the method of consuming media content. The reduction in attention span, a consequence of the oversaturation of the media and cultural space, has led to the fragmentation and parceling of media content. When examining the media content observable in contemporary digital platforms, we see confirmation of this assertion. Books have been condensed into quotes, films into clips and gifs, musical albums into individual tracks or into background music accompanying photographs or short videos in social media posts. On the other hand, the audience has increased exponentially and is now gathered in practically one place, making it easy to access and deliver personalized marketing messages. This, in practical terms, represents an enormous space for creativity across the entire spectrum of popular culture, and provides creators with creative freedom, offering optimism for the future. This very space enables more frequent adaptation of works from one medium and art form to another. While film as a form of popular culture has historically been based on cinematic interpretations of literary sources and even musical albums, which is nothing new, here we

are discussing another possibility—one where increased frequency of such adaptations diminishes the visible difference between the two media or art forms. The shared audience creating this new space will, in the future, establish conditions for full transmediality, where narratives will be canonically told through, primarily, visual media. For example, a narrative begun in a film might continue through a video game and conclude in a streaming series, or any other combination of media. The future trajectory of popular culture thus appears contradictory—on one hand, forms are becoming shorter, while on the other, conditions are being created for the development of very long narratives spread across several different media and art forms. However, in this case, it is not a paradox but rather an additional proof of the assertion about market oversaturation, where it seems there is still space for both existing and emerging forms.

Conflict of interests

The authors declare no conflict of interest.

Author Contributions

Conceptualization, A.M.F. and A.S.J.; methodology, A.M.F.; resources: A.M.F. and A.S.J.: supervision: A.M.F.; writing—original draft preparation, A.M.F. and A.S.J.; writing—review and editing, A.M.F. and A.S.J. All authors have read and agreed to the published version of the manuscript.

References

Bjelajac, Ž., & Filipović, A. (2020). Internet Addiction Disorder (IAD) as a Paradigm of Lack of Security Culture. *Kultura polisa, 17*(43), 239-258, Retrieved from http://kpolisa.com/index.php/kp/article/view/244

Bjelajac, Ž., Filipović, A. M., & Stošić, L. V. (2022). Internet Addiction Disorder (IAD) as a Consequence of the Expansion of Information Technologies. *International Journal of Cognitive Research in Science, Engineering and Education (IJCRSEE)*, *10*(3), 155–165. https://doi.org/10.23947/2334-8496-2022-10-3-155-165

Božilović, N. (2021). *Popkulturalni fenomeni XX veka* [Pop-cultural Phenomena of the 20th Century). SKC.

Easthope, A. (1991). *Literary into Cultural Studies.* Routledge.

Filindash, L. V. (2023). The specifics of mass culture in the era of digitalization. *Vestnik Universiteta*, *4*, 199–206. https://doi.org/10.26425/1816-4277-2023-4-199-206.

Filipović, A. (2013). Odrastanje Nintendo generacije: Kako je video igra postala važan element popularne kulture [Coming-of- Age of the Nintendo Generation: How Video Games Became an Important Element of Popular Culture]. *Medijski dijalozi,* 6(17), 511-525.

Filipović, A. (2016). *Paradigma kulturološkog pozicioniranja video igre* [The paradigm of cultural positioning of video games]. [*Doctoral dissertation*, Univerzitet umetnosti u Beogradu: Fakultet dramskih umetnosti]

Filipović, A. (2022). *Bića i svetovi video igre: Teorijska i kulturološka paradigma* [Beings and Worlds of Video Games: Theoretical and Cultural Paradigm]. Pravni fakultet za privredu i pravosuđe. https://doi.org/10.51738/afbsvg22

Filipović, A. (2023). The Role of Artificial Intelligence in Video Game Development. *Kultura polisa*, 20(3), 50-67, https://doi.org/10.51738/Kpolisa2023.20.3r.50f

Filipović, A. (2024). Phenomenological Aspects of Video Game. *Kultura polisa*, 21(2), 98–123. https://doi.org/10.51738/Kpolisa2024.21.2r.98f

Hačion, L. (1996). *Poetika postmodernizma* [Poetics of Post-Modernism]. Svetovi.

Hajdeger, M. (2000). *Šumski putevi* [Off the Beaten Track]. Plato.

Hinduja, S. (2006). A Critical Examination of the Digital Music Phenomenon. *Critical Criminology*, *14*(4), 387–409. https://doi.org/10.1007/s10612-006-9006-0

Horkheimer, M., & Adorno, T. W. (1947). *Dialektik der Aufklärung* [Dialectic of enlightenment]. Querido.

Jagodzinski, J. (2015) *Music in Youth Culture: A Lacanian Approach.* Palgrave Macmillan.

Ortega & Gaset, H. (2013). *Pobuna masa* [The Revolt of the Masses]. Gradac.

Shuker, R. (1994). *Understanding Popular Music.* Routledge

Shuker, R. (1998). *Popular Music: The Key Concepts.* Roultledge.

Strinati, D. (2004). *An Introduction to Theories of Popular Culture*. Routledge.

Williams, R. (1976). *Keywords: A Vocabulary of Culture and Society*. Routledge.

AUTHORS` GUIDELINES

Types of contributions

Original Research, Review Articles, Studies and articles, Book Reviews, Case Studies and Monographic studies.

BEFORE YOU BEGIN

Authorship of the Paper

Authorship should be limited to those who have made a significant contribution to the conception, design, execution, or interpretation of the reported study. All those who have made significant contributions should be listed as co-authors. Where there are others who have participated in certain substantive aspects of the research project, they should be acknowledged or listed as contributors. The corresponding author should ensure that all appropriate co-authors and no inappropriate co-authors are included on the paper and that all co-authors have seen and approved the final version of the paper and have agreed to its submission for publication.

Authors of work

The author of the paper should be the person who made the greatest contribution to the creation of the work. All those who contributed to the making of the work should be listed in the paper and as co-authors. If there are other contributors who took part in the preparation of making the same work should be listed or admitted as associates.

Before accepting a final version of the paper for publication is necessary that the author and all co-authors approved the final version.

Changes in authorship

Privacy change in authorship relates to the addition, deletion, or rearrangement of author names in accepted version of the paper. An amendment to the data on the authors or co-authors is not possible after acceptance and publication in the online version.

If there is a need to amend the information on the authors, it is necessary to state the following:

1. The reason for the addition or deletion of author,
2. A written confirmation (send it scanned by e-mail) where all the authors agree that the notified operation is a named person is added or removed from the list of authors.
3. The editor will notify the author that needs to be added or removed from the list and will ask for his consent.

Requirements that are not sent by the respective author (corresponding author) will not be considered.

Originality and plagiarism

Authors are required to submit original written article. If other work necessary to work properly quote according to the instructions on the citation of work. If you use ideas of other authors require their written consent and using the same.

Plagiarism in all its forms constitutes unethical behavior and will be severely punished, and as such is unacceptable. The author or authors are required before reporting to work in the journal checking their work through some of the programs for testing against plagiarism. The Editorial Board reserves the right to verify each work through the test of plagiarism and if the same occurs to notify the author.

Disclosure and conflicts of interest

Disclosure and conflicts of interest can be multiple. If the author or institution where the author has a financial assistance in project design or research is needed to adequately cover letter to inform the editorial and the public. Publication in journal person or institution that is financially supported by the making of the work or project is the best way to protect against conflicts of interest.

At the end of the text, under a subheading “Conflicts of interest”, all authors must disclose any actual or potential conflict of interest including any financial (direct of indirect), personal or other relationships with other people or organizations within three years from the commencement of any work.

Fundamental errors in published work

If the author detects an error in the published paper is obliged to instantly inform journal editors or publishers and that as soon as possible the same document. The author shall, in the event of an error, to cooperate with the editorial board to remove the same.

Copyright Notice

The Author(s) warrant that their manuscript is their original work that has not been published before; that it is not under consideration for publication elsewhere; and that its publication has been approved by all co-authors, if any, as well as tacitly or explicitly by the responsible authorities at the institution where the work was carried out. The Author(s) affirm that the article contains no unfounded or unlawful statements and does not violate the rights of others. If copyrighted works are included, the Author(s) bear responsibility to obtain written permission from the copyright owners. The Corresponding author, as the signing author, warrants that he/she has full power to make this grant on behalf of the Author(s).

By signing this agreement, the Corresponding author grants to the Publisher the following rights to the Manuscript, including any supplemental material, and any parts, extracts or elements thereof:

- the right to reproduce and distribute the Manuscript in printed form, including print-on-demand;
- the right to produce prepublications, reprints, and special editions of the Manuscript;
- the right to translate the Manuscript into other languages;
- the right to reproduce the Manuscript using photomechanical or similar means including, but not limited to photocopy, and the right to distribute these reproductions;
- the right to reproduce and distribute the Manuscript electronically or optically on any and all data carriers or storage media – especially in machine readable/digitalized form on data carriers such as hard drive, CD-Rom, DVD, Blu-ray Disc (BD), Mini-Disk, data tape – and the right to reproduce and distribute the Article via these data carriers;
- the right to store the Manuscript in databases, including online databases, and the right of transmission of the Manuscript in all technical systems and modes;
- the right to make the Manuscript available to the public or to closed user groups on individual demand, for use on monitors or other readers (including e-books), and in printable form for the user, either via the internet, other online services, or via internal or external networks.

Articles published in the Journal are Open-Access articles distributed under a Creative Commons Attribution 4.0 International (CC BY)

The Journal allows Author(s) to deposit all versions of their paper in an institutional repository and non-commercial subject-based repositories, such as PubMed Central, Europe PMC, arXiv and other repositories, or to publish it on Author's personal website and departmental website (including social networking sites, such as ResearchGate, Academia.edu, etc.).Publisher copyright and source must be acknowledged and a link must be made to the article's DOI.

Upon receiving the proofs, the Author(s) agree to promptly check the proofs carefully, correct any typographical errors, and authorize the publication of the corrected proofs.

The Corresponding author agrees to inform his/her co-authors, of any of the above terms.

The journal allows readers to read, download, copy, distribute, print, search, or link to the full texts of its articles and allow readers to use them for any other lawful purpose.

Copyright Agreement

For open access articles, permitted third party (re)use is defined by the following Creative Commons user licenses:

Creative Commons Attribution (CC-BY)

Lets others distribute and copy the article, create extracts, abstracts, and other revised versions, adaptations or derivative works of or from an article (such as a translation), include in a collective work (such as an anthology), text or data mine the article, even for commercial purposes, as long as they credit the author(s), do not represent the author as endorsing their adaptation of the article, and do not modify the article in such a way as to damage the author's honor or reputation.

Language (usage and editing services)

Please write in good English (American or British usage is accepted, but not a mixture of these). For non-native English speakers, and perhaps even for some native English speakers, the grammar, spelling, usage, and punctuation of the text are very important for an effective presentation. Hence, manuscripts are expected to be written in a clear, cogent, and readily understandable by an international readership. To avoid unnecessary errors, you are strongly advised to use the 'spell-check' and 'grammar-check' functions of your word processor.

Authors who feel their English language manuscript may require editing to eliminate possible grammatical or spelling errors and to conform to correct scientific English may wish to use the English Language Editing service available from EDANZ -

http://www.edanzediting.com/services/english_editing

NEW SUBMISSIONS

Manuscripts must submit only online, proceeds are totally online and you will be guided stepwise through the creation and uploading of your files. Electronic submission reduces the editorial processing and reviewing times and reduces the time of submission to publication.

You have to use IJCRSEE template to prepare your article and this version upload via

http://ijcrsee.com/index.php/ijcrsee/about/submissions#onlineSubmissions

Formatting requirements

The prepared article should be formatted with IJCRSEE template. There are some parameters for authors.

If your article includes any Videos and/or other Supplementary material, this should be included in your initial submission for peer review purposes.

Divide the article into clearly defined sections.

Structure of Manuscripts

Title Page

The title page should include:

The name(s) of the author(s)

A concise and informative title

The affiliation(s) and address(es) of the author(s)

The e-mail address of the corresponding author.

Abstract

The abstract should contain a maximum of 250 words. The abstracts should avoid any abbreviations and mathematical formulas.

Keywords should include 4-6 keywords.

Text Formatting

Manuscripts should be submitted in Word, A4, Arial Narrow, 10-point for abstract and keywords and 12-points for text.

A complete manuscript falls need to be maximum 8,000 words excluding references, tables, and figures. Depending on the research and work purposes, the editor decides the acceptance of a larger number of pages.

For numerations of pages use the automatic page numbering function.

In the text for emphasis use italics.

The use of abbreviations should be avoided. If using the first Abbreviations should be used throughout the text the same.

For headings use maximum three levels.

Footnotes should be avoided. If used, footnotes should only contain additional text (comment), and not information about sources used.

Acknowledgments should be placed in a separate section before the reference list.

Introduction – State the objectives of the work and provide an adequate background, avoiding a detailed literature survey or a summary of the results.

Materials and Methods – Provide sufficient detail to allow the work to be reproduced. Methods already published should be indicated by a reference: only relevant modifications should be described.

Results – Results should be clear and concise.

Discussions – This should explore the significance of the results of the work, not repeat them. A combined Results and Discussion section is often appropriate. Avoid extensive citations and discussion

of published literature.

Conclusions - The main conclusions of the study may be presented in a short Conclusions section, which may stand alone or form a subsection of a Discussion or Results and Discussion section.

Appendices - If there is more than one appendix, they should be identified as A, B, etc. Formulae and equations in appendices should be given separate numbering: Eq. (A.1), Eq. (A.2), etc.; in a subsequent appendix, Eq. (B.1) and so on. Similarly for tables and figures: Table A.1; Fig. A.1, etc.

Acknowledgments - Collate acknowledgments in a separate section at the end of the article before the references and do not, therefore, include them on the title page, as a footnote to the title or otherwise. List here those individuals who provided help during the research (e.g., providing language help, writing assistance or proofreading the article, etc.).

Reference Style – All manuscripts should be formatted using the American Psychological Association (APA) citation style, which is used primarily in the social sciences. For additional examples, consult the most recent edition of the Publication Manual of the American Psychological Association. Use of DOI is highly encouraged.

CITING REFERENCES IN TEXT

Please ensure that every reference cited in the text is also present in the reference list (and vice versa). Any references cited in the abstract must be given in full. Citation of a reference as 'in press' implies that the item has been accepted for publication.

• If an one author is sufficient to cite only the year, but not the page if you do not quote the text directly, or do not mention the fact that needs to be linked to the page.

Busk (2014) compared reaction times ...

In a recent study of reaction times (Busk, 2014) ... (ibid, str.105).

When citing in plain text, the author's name and year of release of work separated by commas.

If we are in the plain text provide the name and year of the author, there is no need to give the same information again in parentheses.

In 2012 Stosic compared reaction times ... (ibid, page 102).

• When a work has two authors, always indicate both names and year and between surnames of the authors specify the conjunction &.

Nightlinger and Littlewood (2003) demonstrated ...

As has been shown (Busk & Serlin, 1993) ...

• When in plain text quoting the names of three, four or five authors, first make sure to include all the names, and text enough to write only the first and add '' and associates".

First time: Yan, G., Tian, H., Bai, X. & Rayner, K. (2006). found ...

Second time: Yan, G.et al. (2006) found ... (ibid, p. 12)

• When a work has no author's name, whether it's because it is issued by the agency, organization, or governmental institutions, rather than the names of authors mention the name of the institution or organization that has signed the paper, and if a name is long, just so many words or abbreviation as needed to locate the source in the list of references.

First time: (National Institute of Mental Health [NIMH], 1999) ...
Second time: (NIMH, 1999) ...

• When you do not have the names of institutions or authors, when the work is anonymous, then mention only the first few words of the title, and we quote them in parentheses under the quotation marks

in plain text in italics.

These result present (‘’ Study Finds, ‘’ 2002) ...

The book College Bound Seniors (2003) ...

When work in the header nominated as anonymous, then it in the text under the anonymous quote and cite year, in English (Anonymous, 2011).

• If there are two references to the same author’s last name, then be sure to mention when citing the initials to avoid unnecessary search in a list of references.

JM Goldberg and Neff (1961) and ME Goldberg and Wurtz (1972) studied ...

• If the same author or the same authors cite two or more references, then in brackets do not repeat names but just add a year for the next release.

Past research (Edeline & Weinberger, 1991, 1993) ...

Past research (Gogel, 1984, 1990) ...

• When the same author we have more work during one year, then these sources labeled the letters of the alphabet a, b, c and so on.

Several studies (Gogel, 1984, 1990a, 1990b) ...

• When several authors cite in the same bracket, or when we point to the consent of the author, references detach semicolon and listed them in alphabetical order.

Several studies (Balda 1980, Kamil 1988, Pepperberg & Funk, 1990) ...

• If with some of the references cite a source that confirms what is specific to this reference, then the source listed below see also, but that goes with the source of reference, but not alphabetically.

Several studies (Minor 2001; see also Adams, 1999; Storandt, 1997) ...

• When quoting hearsay, cite the author’s name and year of the original work, followed by a semicolon and then cited code, then last name, year and foreign labor from which he quoted original work.
The first definition of intrinsic motivation gave Decy (1975; see Suzić 2005, p. 108) ...

• If we know the year of the first publication of the work, then it is to be connected age translation by first listed year of first publication, a slash and then year translation.

(James, 1890/1983)

• For an Internet source that does not have a bookmarked Web page, use a pair of ¶ and paragraph number on the page where it was published.

(Myers, 2000, ¶ 5)

• Personal communication or publicly spoken words in a lecture to quote only in plain text, but not in the list of references, but does mention the date of actual communication.

Decy (personal communication, April 18, 2001) ...

REFERENCES

• Form Guidance papers in the journal is as follows:

The author's name [comma], initial / names [point], [open small brackets] year of publication [close little brackets] [point] title of the paper [point], the name of the magazine - in italics [comma] the number or volume - in italics [comma] page starting work [line] Page completing work [point].

Dennis, TA, Cole, PM, Wiggins, CN, Cohen, LH & Zalewsky, M. (2009). The functional organization of preschool-age children's emotion expressions and actions in challenging situations. *Emotion, 9,* 520-530.

• Form quoting the works of authors of books is as follows:

The author's name [comma], initial / names [point], [open small brackets] year of publication [close little brackets] [point] title deeds - in italics [point], the city (and state) [two counts], the publisher [Point].

Hirsch, Jr., E. D. (1996). *The schools we need and why we do not have them*. New York: Doubleday.

• When you mention a paper published in a journal or as part of a book as a chapter, then applies the following form:

The author's name [comma], initial / names [point], [open small brackets] year of publication [close little brackets] [point] title of the paper [point], In Proceedings ... (note that the work was published in a journal or book ...) The name of the publisher [open small brackets] Issue. (Note that this is a publisher) [Close little brackets] [comma] title of the collection - in italics [open small brackets] page starting work [line] Page completing work [point], the city (and state) [two counts], publisher [point].

Barrett, KC, & Campos, JJ (1987). Perspectives on emotional development: II. A functionalist approaches to emotions. In Osofsky JD (Ed.), *Handbook of Infant Development* (2nd ed., Pp. 555-578). Oxford, England: Wiley.

• If seven or more authors, then we will list the names of the six authors, and the seventh and the rest fall into the category of '' and associates ''.

Adam, JJ, Paas, F. Teeken, JC van Loon, EM, Van Boxtel, MPJ, Houx, PJ, et al. (1998). Effects of age on performance and a finger-precuing task. *Journal of Experimental Psychology: Human Perception and Performance, 24*, pp. 870-883.

Second and last author in a list of references are always stating afterward conjunctions & English.

• In magazines published articles cite the following form:

the author's name [comma], initial / names [point], [open small brackets] day, month and year of publication [close little brackets] and the title [point], the name of the magazine or newspaper - italics [comma], number of journals or Newspapers - italics [comma], page beginning of the text [line] Page completing the text [point].

Henry, W. A., III. (1990, April 9). Beyond the Melting Pot. Time, 135, 28-31.

• When we need to with the title of the article mention what kind of material it is then enclosed in square brackets after the title of the paper is printed by it is a brochure, video recording and the like.

Research and Training Center on Independent Living. (1993). Guidelines for reporting and writing about people with disabilities (4th ed.) [Brochure]. Lawrence, KS: Author.

• The work of famous authors downloaded electronically applies the following form:

The author's name [comma], initial / names [point], [open small brackets] year of publication [close little brackets] [point] title of the paper [point], an indication of what kind of material is in square brackets,

taken (note that work will take) the day, month and year, with (internet address).

Schwarzer, R. (1989). Statistics software for meta-analysis [Computer software and manual]. Retrieved March 23, 2001, http://www.yorku.ca/faculty/academic/schwarze/meta_e.htm

• When the list reference is made to the work that is being prepared for the press, after the authors' names, in parentheses, listed in the press in English.

Zuckerman, M. Kieffer, SC (in press). Race differences in faceism: Does facial prominence imply dominance? Journal of Personality and Social Psychology.

• When the list of references cites a newspaper article without the author prints the name of the article, then the time of publication, then the title and number - in italics, and at the end of the page on which the article was published. If the title is long, we can shorten the optimum number of words by taking the first few words.

The new health-care lexicon. (1983, August / September). Copy Editor, 4, 1-2.

• If within the journal as publisher publishes a special issue as a monograph, it is necessary after heading indicate that it is a monograph.

Ganster, DC, Schaubroeck, J. Sime, WE, & Myers, BT (1991). The nomological validity of the Type A personality among employed adults [Monograph]. *Journal of Applied Psychology, 76,* 143-168.

• When an abstract or summary of the quote as the original source, after the title should be in parentheses to indicate that it is abstract.

Woolf, NJ, Young, SL, Famselow, MS, & Butcher, LL (1991). Map-2 expression in cholinoceptive pyramidal cells of rodent cortex and hippocampus is altered by Pavlovian conditioning [Abstract]. *Society for Neuroscience Abstracts, 17*, 480 harvesters.

• Titles that are not in English, and we want them to be published in the journal in English, listed in their native language, and then in the square brackets give the title translation into English. In addition to the title, everything else remains the mother tongue.

Ising, M. (2000). Intensitätsabhängigkeit evozierter Potenzial their EEG: Sindh impulsive persons Augmenter stage Reducer? [Intensuty dependence and event related EEG potentials: Are impulsive individuals augmenters or reducers?]. *Zeitschrift für Différentiel und diagnostisch Psychology, 21*, 208-217.

• In the list of literature translated work following a text that we have a year of the original edition listed in parentheses at the end behind the publisher. When we quote in plain text, year of first publication and translation writing along with a slash between (eg. Laplace, 1814/1951).

Laplace, P. S. (1951). A philosophical essay on probabilities (FW Troscott & FL Emory, Trans.). New York: Dover. (Original work published 1814)

• When the list of references cites a paper published in the Proceedings of the translated, italics will print the name of the collection at the end to add when it published the original.

Freud, S. (1961). The ego and the id. In J. Strachey (Ed. & Trans.), The standard edition of the complete psychological works of Sigmund Freud (Vol. 19, pp. 3-66). London: Hogarth Press. (Original work published 1923).

• When you cite articles published on the university or one of the official institutions, universities, publishers listed as the first name of the university and then university.

Broadhurst, RG, & Maller, RA (1991). Sex offending and recidivism (Tech. Rep. No. 3). Nedlands: University of Western Australia, Crime Research Center.

• When the list of sources cites a report of an organization or institution that has no author, it is best to nominate as the author of this organization, which is also the publisher.

Employee Benefit Research Institute. (1992, February). Sources of health insurance and characteristics of the uninsured (Issue Brief No. 123). Washington, DC: Author.

• When the work was published on the Internet as a photocopy, it should cite the original source noting that this is the electronic version.

Vandenbos, G. Knapp, S., & Doe, J. (2001). The role of reference elements in the selection of resources by psychology undergraduates [Electronic version]. Journal of Bibliographic Research, 5, 117-123.

• If you download from the Internet work that you believe is different from the original, do not copy or no numbered pages, then at the end indicate the date of downloads and web address.

Vandenbos, G. Knapp, S., & Doe, J. (2001). The role of reference elements in the selection of resources by psychology undergraduates [Electronic version]. Journal of Bibliographic Research, 5, 117-123. Retrieved October 13, 2001, from http://jbr.org/articles.html

• When you download from the Internet a document which has no date or author, then the document name takes the place of the author or the first place.

8th GVU's WWW User Survey. (Od). Retrieved August 8, 2000, from http://www.cc.gatech.edu/gvu/user_surveys/survey-1997-10/

• Material from the symposium or a scientific paper which was only exposed, but not published, listed with the note on which the scientific or professional meeting is material exposed. If the author has presented on the site, it is desirable to name and web page.

Cuter, LD, Frölich, B., & Hanrahan, P. (1997, January 16). Twohanded direct manipulation on the responsive workbench. Paper presented at the 1997 Symposium on Interactive 3D Graphics. Abstract retrieved June 12, 2000, from http://www.graphics.standard.edu/papers/twohanded/

• Computer software listed noting computer software. Name of the software we write italics.

Miller, M. E. (1993). The Interactive Tester (Version 4.0) [Computer software]. Weastminster, CA: Psytek Sesvice.

• Data downloaded from the website of the government or other official organization listed noting data file. The filename of the data listed in italics.

Department of Health and Human Services, National Center for Health Statistics. (1991). National Health Provider Inventory: Home health agencies and hospices, 1991. [Data file]. Available from the National Technical Information Service Web site, http://www.ntis.gov

Standards take according to Suzic, N. (2010). *Pravila pisanja naučnog rada APA i drugi standardi* [Rules scientific APA work and other standards]. XBS Banja Luka.

Reference management software

The journal has a standard template – IJCRSEE template. To cite reference, it is the easiest way to use some management software like:

Mendeley (http://www.mendeley.com/features/reference-manager)
EndNote (http://www.endnote.com/support/enstyles.asp) and
Reference Manager (http://refman.com/support/rmstyles.asp).

Above management software have plug-ins to word processing where authors only need to select the appropriate journal template when preparing their article and the list of references and citations to these will be formatted according to the journal style as described in this Guide. If you cannot find an available template, see the list of sample references and citations provided in this Guide to help you format these according to the journal style.

After acceptance

Online proof correction

Corresponding authors will receive an e-mail with a link to our online proofing system, where have to make prof own article. The final version is created in PDF and authors have to accept final version or to immediately report the error. We will do everything possible to get your article published quickly and accurately. Please check carefully before replying, as the inclusion of any subsequent corrections cannot be guaranteed. Proofreading is solely your responsibility.

https://pubpeer.com/Check the comments on published and withdrawn works.

All the articles in this journal have been peer reviewed. Nonetheless, editors and organizers are not responsible for the content shown in this publication.

Submission Preparation Checklist

As part of the submission process, authors are required to check off their submission's compliance with all of the following items, and submissions may be returned to authors that do not adhere to these guidelines.

The submission has not been previously published, nor is it before another journal for consideration (or an explanation has been provided in Comments to the Editor).

The submission file is in OpenOffice, Microsoft Word, RTF, or WordPerfect document file format.

Where available, URLs for the references have been provided.

The text is single-spaced; uses a 12-point font; employs italics, rather than underlining (except with URL addresses); and all illustrations, figures, and tables are placed within the text at the appropriate points, rather than at the end.

The text adheres to the stylistic and bibliographic requirements outlined in the Author Guidelines, which is found in About the Journal.

If submitting to a peer-reviewed section of the journal, the instructions in Ensuring a Blind Review have been followed.

Have checked paper for possible accidental plagiarism. Some plagiarism checker websites includes: http://www.ithenticate.com, www.grammarly.com,www.plagtracker.com, or www.duplichecker.com

To verify originality, your article may be checked by the originality detection service CrossCheck.

International Journal of Cognitive Research in Science, Engineering and Education (IJCRSEE), 12(2), 517-518.

LIST OF REVIEWERS FOR YEAR 2023

International Journal of Cognitive Research in Science, Engineering and Education (IJCRSEE) would like to acknowledge the following reviewers for their assistance with peer review of manuscripts for issues in 2023. Their comments and suggestions were of great help to the authors in improving the quality of their papers. Each of the reviewers listed below returned at least one review for these issues.

Thank you Reviewers!

List of International Journal of Cognitive Research in Science, Engineering and Education (IJCRSEE) reviewers in 2023:

- Aleksandra Janić, University of Niš, Faculty of Philosophy, Department of Serbian
- Language and Literature, Serbia
- Audy Salcedo, Central University of Venezuela, Maule Catholic University, Venezuela
- Bhavana Arya, Manipal University Jaipur, India
- Boro Merdović, Ministry of Interior, Serbia
- Branka Radulović, University of Novi Sad, Faculty of Sciences, Department of Physics, Serbia
- Denis Katakara Kagyera, African Centre of Excellence for Innovative Teaching and Learning Mathematics & Science, University of Rwanda-College of education, New Zealand
- Ekaterina Denisova, Don state technical university, Russia
- Elena A. Makarova, Don State Technical University, Rostov-on-Don, Russia
- Elena Romanova, Altai State University, Barnaul, Russia
- Emil Buzov, St Cyril and St. Methodius University of Veliko Tarnovo, College of pedagogy, Bulgaria
- Faiz Hasyim, STKIP Al Hikmah, , Indonesia
- Gergana Dyankova, SWU “NEOFIT RILSKI” Blagoevgrad, Bulgaria
- Irina Kibalchenko, Department of psychology and life safety, Federal State-Owned Educational Autonomy Establishment of Higher Education «Southern Federal University», Taganrog, Russia
- Irina A. Novikova, Peoples’ Friendship University of Russia (RUDN University), Russia
- Irina Alexandrovna Bakaeva, Academy of Psychology and Education, Southern Federal University, Russia
- İsmail DÖNMEZ, University of Helsinki, Finland
- Janet K. Brewer, JD, PsyD, Governors State University, University Park, Illinois USA
- Jelena Stamatović, Faculty of Education in Užice, University of Kragujevac, Serbia
- Jeremić Biljana, University of Novi Sad, Faculty of Education Sombor, Serbia
- Laura Tsraevna Kagermazova, Chechen State Pedagogical University, Russia
- Ljiljana Gomerčić, University of Primorska, Koper, Slovenia
- Marina Vyacheslavovna Sokolskaya, Russian National Research Medical University. N.I. Pirogov”, Russia
- Marinela Mihova, University of Veliko Tarnovo “St. Cyril and St. Methodius”, Bulgaria
- Marja Nesterova, National Pedagogical Dragomanov University, Kyiv, Ukraine
- Martin Kursch, Charles University Prague, Czechia
- Maulana Rezi Ramadhana, Telkom University, Indonesia
- Milena Vidosavljević, Institute for Serbian Culture Priština, Leposavić
- Miljana Mladenović, University of Nis, Faculty of Pedagogy, Serbia
- Mira Tzvetkova-Arsova, Sofia University Saint Kliment Ohridski, Bulgaria
- Mohammad Hamad Al-khresheh, Northern Border University, Saudi Arabia
- Mr. K. Eswara Rao, Aditya Institute of Technology and Management, Tekkali, Aditya Institute of Technology and Management, Tekkali, India
- Muh. Asriadi AM, S.Pd., M.Pd, Yogyakarta State University, Indonesia
- Nurcan Tekin, Aksaray University, Turkey
- Olga Zvereva, Moscow Pedagogical State University, MPGU Moscow, Russia
- P. Raghu Vamsi, Jaypee Institute of Information Technology, NOIDA, India

- Payame Noor Universitydisabled, Tehran, Iran
- Rizky Amelia, S.Pd., M.Pd., Universitas Lambung Mangkurat, Indonesia
- Tatyana A. Vorontsova, Southern Federal University, Rostov on Don, Russia
- Tijana Pribićević, Faculty of Science, University of Novi Sad, Serbia
- Viktor Voynov, Institute of Developmental Physiology of the Russian Academy of Education, Russia
- Vladan Pelemiš, University of Belgrade, Faculty of Teacher Education, Serbia
- Yuri Bushov, National Research Tomsk State University, Russia
- Yury Nikolaevich Slepko, Yaroslavl State Pedagogical University. K.D. Ushinsky, Russia
- Zehra Özçınar, Ataturk Teacher Training Academy, North Cyprus

CIP - Каталогизација у публикацији
Народна библиотека Србије, Београд

37

INTERNATIONAL Journal of Cognitive Research in Science, Engineering and Education / editor in chief Lazar Stošić. - [Štampano izd.]. - Vol. 1, issue 1 (June 2013)- . - Vranje : The Association for the Development of Science, Engineering and Education ; Rostov-on-Don : Don State Technical University, 2013- (Vranje : Aurora). - 30 cm

Tri puta godišnje. - Drugo izdanje na drugom medijumu: International Journal of Cognitive Research in Science, Engineering and Education (Online) = ISSN 2334-8496
ISSN 2334-847X = International Journal of Cognitive Research in Science, Engineering and Education
COBISS.SR-ID 199383052