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Attitudes of Students and Teachers' Opinions Towards Robotic Applications in Secondary Schools

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Abstract: The ongoing advancements in technology and their implications for robotics raise questions regarding high school students' attitudes toward robotic applications. The formation of teachers' opinions is identified as a research gap alongside these developments. This research aims to measure the attitudes of students in secondary schools towards robotic applications, in terms of various variables and to evaluate teachers' opinions. This research was designed as mixed methods research. The sample of the research consisted of 469 students and 25 teachers. The quantitative data of the study were collected with the robotics activity attitudes scale-RAAS, which was adapted to the language of the researchers. Qualitative data was collected with the teacher interview form created by the researchers. Parametric tests, t-tests, and ANOVA were applied to the data set, and weighted average, frequency, and percentage calculations were made. The data obtained from the teacher interview form was transformed into findings using the descriptive analysis method. As a result of the research, it was determined that the students had a high degree of robotic attitude. It was determined that students' robotic attitudes showed a significant difference in favor of male students according to the gender variable. There was no difference in students' robotic attitudes depending on the classroom variable, and a majority of teachers have a positive attitude towards the use of robotic applications in education in Kazakh secondary schools. The attitudes and opinions of teachers and students towards robotic applications are positive.

Keywords: *attitude, robotic applications, robotic attitude scale, secondary schools.*

Introduction

The perceived advantages of robotic applications in secondary education have been the subject of numerous research, which have led to favorable attitudes among instructors and students. A substantial amount of research highlights how educational robots increases student engagement and motivation, especially in STEM education. According to Selcuk at el. (2024), integrating robotics into the curriculum increased students' interest in it and created a more dynamic and engaging learning environment. This dedication is essential because increasing academic performance is directly related to intrinsic motivation, especially in subjects that find it difficult to pique students' interest.

Additionally, the development of pupils' computational thinking abilities has been linked to the use of robotics in the classroom. According to Zhang at el. (2021), students' views about STEM areas are reshaped by robotics exposure, which also helps them develop their problem-solving abilities. Given the current emphasis on developing the abilities required for the landscape facilitated by the technology of the future workforce, this transition is essential. Teachers can better prepare students for postsecondary education and careers in STEM fields by utilizing robotics, which helps close the skills gap in a number of industries.

Teachers have also realized how robotic applications can offer experiential learning possibilities tailored to the needs of various students. According to Di Battista, et al. (2020), robots can specifically help kids with special education needs by offering engaging and dynamic learning opportunities that were previ-

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ously challenging to accomplish. Because robotic technologies may bridge learning gaps and establish fair learning environments where all students can thrive, their versatility emphasizes the inclusion they offer.

It has also drawn attention to how enthusiastic teachers are about incorporating robotics into their lesson plans. According to the study, educators are becoming more interested in integrating technology into their lessons as they become aware of the educational benefits of robots (Piedade, 2021). Given that robotics not only enhances student learning but also acts as a catalyst for teacher professional development, this increased interest is indicative of a larger trend towards the modernization of educational processes. Teachers frequently express their desire to employ these cutting-edge tools to enhance their technical proficiency and pedagogical approaches, which will further enhance the teaching and learning environment.

Nevertheless, even while robotic applications are thought to have significant advantages in terms of encouraging student engagement and enhancing teaching methods, it is crucial to investigate the difficulties that accompany their use. A more thorough grasp of the advantages and disadvantages will result in a more complete picture of how robots affects the educational landscape. While there are many benefits to using robotic applications in secondary schools, there are also a number of drawbacks that can have a big impact on instructors' and students' views. The difficulty of learning and utilizing robotic technology is a common issue in the literature. According to Ortega-Ruiperez and Alcalde (2023), some students view programming as a daunting undertaking requiring a certain set of technical skills. This can deter students from participating in robotics-related activities. This sentiment highlights the necessity for educators to address the robotics learning curve because programming anxiety can lead to a lack of interest in STEM (science, technology, engineering, and mathematics) subjects.

According to the teachers, the difficulties go beyond the pupils' participation and encompass feelings of inadequacy over their own robotics skills. According to Papadakis and Kalogiannakis (2020), a lot of teachers are intimidated by their ignorance, which can make them hesitant to include robotic applications in their lessons. The rapid advancement of technology exacerbates this lack of confidence by causing a gap between instructors' present skill levels and the requirements of modern educational tools. As a result, the positive benefits that robotics can have on the classroom may be hampered because children might not receive enough help or direction from teachers who feel unprepared.

Furthermore, Kucuk and Sisman's (2020) study revealed notable differences in students' openness to robotic applications according to variables including gender and prior exposure to related technology. According to their research, male students are more likely than female students to be confident and enthusiastic about participating in robotics, which can help them overcome emotions of intimidation or disinterest. In order to foster a more equitable learning environment, educational interventions should be modified to account for these inequalities and guarantee that all students are included and actively participate (Sahmurova, and Gursesli, 2020).

Teachers' perspectives of the tools and training required for the successful integration of robots in the classroom add another level of complication. According to Negrini (2020), teachers are generally skeptical about the feasibility of incorporating robotic applications in the absence of sufficient institutional support. Teachers frequently voice worries about a lack of resources, such as funding, workshops for training, and necessary access to technology. This concern suggests that while educators acknowledge the potential educational advantages of robotics-such as the ability to foster critical thinking and problem-solving abilities-they also acknowledge the logistical obstacles that may jeopardize these prospects.

The combination of these elements implies that although everyone agrees that robotic applications have the potential to improve educational outcomes, students and teachers should overcome a number of obstacles that may make implementation more difficult. Promoting positive attitudes and optimizing the impact of robotics in high school will require addressing these issues through focused training, resource allocation, and the development of an inclusive learning environment. The use of robotics in secondary education has generated a lot of discussion and exposed a variety of attitudes in both instructors and students. The efficacy and sustainability of robotics in the educational environment are largely determined by these attitudes, which are influenced by both individual experiences and institutional environments. Students' increased devotion to robotics applications is a common benefit, as seen by their enthusiastic engagement in robotics camps and project-based learning activities. Such stimulating activities can significantly boost pupils in STEM subjects, fostering a generation of people who want to pursue careers in science, technology, engineering, and mathematics, according to research by Üçgül, and Altıok, (2022) and Tiryaki and Adigüzel (2021). When robotics is included into the curriculum, students frequently report

feeling more motivated and interested in learning. This shows that robotics applications act as both instructional tools and catalysts to ignite a passion for technical materials.

On the other side of the spectrum, students' excitement is contrasted with educators' worries about the long-term viability of robotic projects. Without a specific framework to guarantee their integration into the larger study program, Diken (2022) contends that the mere deployment of robotic technology is inadequate and emphasizes the necessity of ongoing support and resources. In order to use robotic applications effectively, teachers raise concerns about the resources' accessibility, which necessitates the availability of current professional development opportunities. This demonstrates the differences in preparation and resource availability, which affect teachers' willingness to use robots in their lessons generally.

Furthermore, a significant body of literature offers a nuanced viewpoint on the overall effects of robotic applications in the classroom. Although numerous research point to observable benefits including enhanced teamwork and innovative problem-solving abilities (Zadok, 2020), these benefits need to be considered in the context of implementation difficulties. The potential benefits of robotics in education can be hampered by a number of issues, according to educators, including varying levels of institutional support, insufficient training, and financial limitations. Understanding these difficulties is crucial because it draws attention to the intricate realities that instructors must deal with while implementing new technologies.

In their research, Zhong and Xia (2020) conducted a systematic review to explore the potential of educational robotics in mathematics education. In their research, Zviel-Girshin and Shaham (2020) evaluated robotic applications as a tool to develop technological thinking in early childhood. Di Battista, et al. (2020) consulted teachers' opinions on the effectiveness of robotic applications in education, and as a result of the research, teachers stated that robotic applications were effective for students with special needs. Lebrasseur at el. (2021) used various robotic arms in their studies and revealed that children showed significant improvements in performing their daily activities. Boyarinov and Samarina (2020) organized an educational robotics course for teacher candidates as a research subject. MägiMägi, at el. (2021), discussed the effectiveness of using robotic toys in early childhood education to support children's social and emotional competence. In their research, Boada Maestre and Genís (2021) evaluated ethical issues in the use and integration of educational robots in special education. In their research, Kanbul and Uzunboylu (2017) evaluated the effectiveness of coding training and robotic applications in acquiring 21st-century.

Despite teachers' concerns, research shows that there is a general sense of cautious optimism regarding the use of robotics in the classroom. Concepts gathered from numerous studies indicate that the use of robotic applications can result in a rich, multifaceted educational experience when schools offer the required skills and infrastructure. The next generation of well-documented issues and the assurance that educators and students feel prepared to interact with robotic technologies are prerequisites for this hopeful outlook.

Today, the work done in the 21st century for students, teachers and educational programs, which are expressed as the three basic elements of education, are more valuable than in previous periods. Research in the field evaluates the application of robotics in education at different levels and in different areas of education. However, with the technological developments that are developing every day, with their reflections on the field of robotics, there is still a question about the attitude of high school students towards robotic applications. In parallel with these developments, we wonder how teachers' opinions are formed. It is very important that these issues are presented as a research gap.

Purpose of the Research

The purpose of this research is to measure the attitudes of students in secondary schools toward robotic applications in terms of various variables and to evaluate teachers' opinions. Following the research purpose, the following hypotheses and research questions were developed.

H_1: Students in secondary schools have high attitudes towards robotic applications.

H_2: The attitudes of students in secondary schools towards robotic applications differ according to gender.

H_3: The attitudes of students in secondary schools towards robotic applications vary depending on the class they study in.

1. What are the teachers' opinions about the use of robotic applications in education in secondary schools?
2. What are teachers' opinions about the advantages of using robotic applications in education?
3. What are teachers' opinions about the disadvantages of using robotic applications in education?

4. What are teachers' suggestions for increasing the use of robotic applications in education?

Materials and Methods

This section contains information about the research method, study group, development of the data collection tool, collection and evaluation of data, and the ethical process of the research.

Research method

This research was designed as mixed methods research. Mixed method research design is a design in which qualitative and quantitative data are collected and both designs are considered together. The aim of this design, where two designs are used in a single study, is to allow a more detailed and comprehensive understanding of a phenomenon by using the advantages of qualitative and quantitative data (Sahmurova, at el. 2010; Sandelowski, 2000; Sezgin, at el. 2019). In this study, a mixed method design was preferred to measure the attitudes of students in Kazakh secondary schools towards robotic applications in terms of various variables and to evaluate teachers' opinions.

Participants

In this research, simple sampling technique is used. Simple random sampling is a technique in which each element in the population has equal chance and probability of being selected. Here, the selection of elements depends entirely on chance or probability; therefore, this sampling technique is sometimes known as chance method. Simple random sampling is a basic sampling method and can easily be a component of a more complex sampling method. The main feature of this sampling method is that each sample has the same probability of being selected.

The quantitative sample group of the research consists of 469 students studying in various secondary schools in Kazakhstan in the 2024-2025 academic year. Likewise, simple sampling technique was used to determine the sample group in collecting qualitative data. The qualitative sample group includes 25 teachers working in various secondary schools in Kazakhstan in the 2024-2025 academic year. Demographic information about students and teachers is given in Table 1.

Table 1. *Demographic information of students and teachers.*

Student		
Gender	F	%
Female	211	44.9
Male	258	55.1
Class	F	%
9th grade	138	29.4
10th grade	142	30.3
11th grade	189	40.3
Total	469	100
Teacher		
Gender	F	%
Woman	11	44
Male	14	56
Total	25	100

Table 1 shows the demographic distribution of the students and teachers who participated in the research. 44.9% of the students are female and 55.1% are male. 29.4% of the students participating in the research are studying in the 10th grade, 30.3% are in the 11th grade and 40.3% are in the 12th grade. 44% of the teachers participating in the research are women and 56% are men.

Data collection tools

The quantitative data of the study were collected with the robotics activity attitudes scale-RAAS (Cross, et al. 2016), which was adapted to the language of the researchers. In the qualitative part of the research, a teacher semi-structured interview form was developed by the researchers to evaluate teachers' opinions. The translated items were arranged in line with the opinions of experts and a temporary scale form was created.

Robotics attitude scale

The original form of the scale was developed by Cross et al. (2016) The scale has a structure of 45 items and consists of 4 factors. The factors of the scale were determined as curiosity, interest, expectation, trust, and identity. The Cronbach Alpha internal consistency coefficient of the scale was found to be 0.972.

Language Equivalence Study: The Robotic Attitude Scale form, which will be adapted into Kazakh, was translated into Kazakh by 4 experts working in the field of linguistics who know both languages very well. These translations were examined, taking into account expert suggestions, and a temporary Kazakh form was created. It is intended that there will be no difference in meaning between the translation and the original form. For this reason, the created Kazakh form was translated back into the original language by experts using the back-translation method after 3 weeks. The Kazakh translation was compared with the original scale, and the final version of the scale in Kazakh was created with the closest translations.

Pilot application: At this stage, the pilot application sample group of the scale was created and the draft scale was applied to the sample group. 453 secondary school students participated in this part of the research. 204 of the students are girls and 249 are boys. The students who participated in this part of the research were not included in the main sample group of the research. 453 students met the sample size criterion of 5 times the number of items required in factor analysis studies (Child, 2006).

Exploratory Factor Analysis: At this stage, the SPSS 25.0 statistical program was used. In the first stage, it was checked whether the adapted scale had a normal distribution. Kolmogorov-Smirnov was preferred as the normal distribution test. As a result of the application, the analysis made on the data set ($p=.052>.050$) indicates a normal distribution. All items in the scale were used for exploratory factor analysis. In this analysis, it was first aimed to test whether the sample size was sufficient. The value of $0.76 > 0.70$ obtained from the Kaiser-Meyer-Olkin (KMO) test revealed that exploratory factor analysis could be performed on the data. Then, Bartlett's Sphericity test was applied and the results were evaluated. Bartlett's Sphericity test ($\chi^2 =559.677$, $p=.000$) showed that it was appropriate to perform exploratory factor analysis on the data. At this stage, the eigenvalue was determined as 1, and principal component analysis was performed. As a result of the analysis, a structure with 4 factors with an eigenvalue greater than 1 emerged. 13 items that could not be combined under factor structures and pointed to a different factor on their own were removed from the scale. Then the analyses were repeated. As a result of repeated analyses, similar stages were passed and the 24-item structure of the final form emerged. When the scree plot was examined in the exploratory factor analysis, it was determined that the lowest load value was 0.575.

Confirmatory Factor Analysis: At this stage, the SPSS Amos 25.0 statistical program was used. Goodness-of-fit indices were examined for confirmatory factor analysis. χ^2 /df (Chi-Square/Degree of Freedom), NNFI (Non-Normed Fit Index), and RMSEA (Root Mean Square Error of Approximation) values were taken as criteria for the fit of the model. In the analysis, these values are χ^2 /df= 1.354 ($p=.000$), NNFI=.88, and RMSEA=.058, respectively. Hooper et al. (2013) set the value below 5 for χ^2 /df; They recommended above .80 for NNFI and below .080 for RMSEA. Based on this view, it has been revealed that the scale maintains its original structure in Kazakh culture.

The item factor loadings and Cronbach's Alpha coefficients of the scale, which were finalized as a result of confirmatory factor analysis, are given in Table 2.

Table 2. *Robotics attitude scale item factor loadings*

Factor	Item	Expression on Scale	Item Total Correlation	Cronbach's Alpha
Desire to Learn	1	I would like to learn more about robotics	.681	.792
	2	I enjoy learning new information about robots.	.622	
	3	I enjoy doing robotics activities	.615	
	4	I know I can learn a lot about robots.	.641	
	5	I research as much information about robots as I can.	.639	
	6	Learning about robots is important to me.	.674	
	7	I like watching TV shows and/or reading books about robots.	.621	
	8	I'm interested in discovering things about robots.	.655	
	9	Even if it's complicated, I'd love to learn everything about robotics.	.626	
	10	I enjoy exploring new ideas about robotics.	.664	
	11	Robotics interests me.	.648	
	12	I'm curious about how robots work	.645	
Confidence	13	I am a person who can be an expert in the field of robotics.	.588	.866
	14	I can write a computer program.	.592	
	15	I can program a robot.	.603	
	16	I am confident in my ability to build robots.	.583	
	17	I'm good at making robots.	.575	
	18	I can build a robot.	.579	
Computational Thinking	19	I'm good at thinking logically	.720	.812
	20	I like solving complex problems.	.718	
	21	I solve problems logically.	.733	
Team work	22	I can convey my ideas to my group.	.786	.823
	23	I am a good group member	.815	
	24	I enjoy working in groups.	.792	
		Cronbach's Alpha for the Whole Scale		.816

In Table 2, the item totals and Cronbach's Alpha of the robotic attitude view are given as a basis to disseminate the language for the collection of research. In the reliability analysis of the 4-factor structure of the scale, the Cronbach's Alpha value of the desire to learn sub-dimension was found to be 0.792, the Cronbach's Alpha value of the self-confidence sub-dimension was 0.866, the Cronbach's Alpha value of the computational thinking sub-dimension was 0.812 and the Cronbach's Alpha value of the teamwork sub-dimension was 0.823. Cronbach's Alpha value for the overall robotic attitude scale was found to be 0.816. The scale is a 5-point Likert type. In this rating scale, score ranges are considered equal. According to this; the Range from 1.00 to 1.80 Strongly Disagree; 1.81 to 2.60 range Disagree; 2.61 to 3.40 range Partially Agree; The range of 3.41 to 4.20 is rated Agree and the range 4.21 to 5.00 is rated as Strongly agree.

Teacher interview form

A literature review was conducted during the preparation of the teacher interview form. Then, the questions created for the interviews with the teachers were presented to the opinions of 3 field experts. The questions were rearranged in line with expert opinions and asked to 2 secondary school teachers. At this stage, it was evaluated whether there were any unclear points in the questions. The questions, which were stated to have semantic validity by the teachers, were arranged in a semi-structured interview form format and made ready for application. The questions in the teacher interview form are given below.

1. What are your views on the use of robotic applications in education in Kazakh secondary schools? Evaluate by choosing one of the Positive, Undecided, or Negative categories.
2. What are your views on the advantages of using robotic applications in education?
3. What are your views on the disadvantages of using robotic applications in education?
4. What are your suggestions for increasing the use of robotic applications in education?

Data collection process

The quantitative data of the research were collected by applying the robotics attitude scale to teachers via Google Forms. Teacher interview form data was collected through face-to-face interviews with teachers. The robotic attitude scale application time was determined as approximately 20-25 minutes. The average duration of the teacher interview form application was determined as 20 minutes. The language adaptation phase implementation phase of the scale and the implementation phases of the interview forms were completed in approximately 2 months.

Ethics

At each stage of the research, a signed declaration form was received from the teachers and students who participated in the research, declaring their voluntary participation. To researchers; A form was prepared and delivered regarding the method, purpose of application of the research, process, and ethical principles regarding the use of data. Teachers and students who voluntarily agreed to participate in the research by reading the information in the consent form were included in the research. In addition, the principles of research and publication ethics were followed in all processes during which the research was conducted.

Data analysis

In the scale adaptation phase of the research, SPSS 25.0 was used for exploratory factor analysis and SPSS Amos 25.0 was used for confirmatory factor analysis. SPSS 25.0 statistical program was used to analyze the research data. To evaluate normal distribution, Kolmogorow-Smirnov test results were examined and ($p < 0.05$) it was seen that the data set was normally distributed. Parametric tests were performed on the data set obtained from the robotics attitude scale. Independent samples t-test was used in the analysis of bivariate data, and ANOVA, weighted average, frequency, and percentage calculations were used in the analysis of more than two variable data. Descriptive analysis technique was used in the analysis of qualitative data. The purpose of descriptive analysis is to present the data collected as a result of interviews or observations to the reader in an organized and interpreted way (Marshall, 1996). The data obtained from the teacher interview form were categorized by frequency and percentage calculations and presented in tables.

Results

Findings from the Robotics Attitude Scale

Table 3 shows the sub-dimensions of the robotics attitude scale and the weighted averages and standard deviations of the students participating in the research for the overall scale.

Table 3. *Robotics attitude scale*

	M	SS
Desire to learn	3.87	0.679
Confidence	3.91	0.651
Computational thinking	3.65	0.610
Teamwork	3.80	0.688
Robotics attitude scale	3.81	0.654

In Table 3, sub-dimensions of the robotic attitude scale and information regarding the overall scale are presented. Weighted averages and standard deviations were calculated. Willingness to learn sub-dimension (M=3.87, SD=0.679), self-confidence sub-dimension (M=3.91, SD=0.651), computational

thinking sub-dimension (M=3.65, SD=0.610), teamwork the weighted average and standard deviations of the sub-dimension (M=3.80, SD=0.688) were calculated. For the overall robotic attitude scale (M=3.81, SD=0.654), weighted means and standard deviations were determined. These findings reveal that students have high attitudes in the sub-dimensions of the robotics attitude scale and the overall scale.

In Table 4, the t-test results of the students participating in the research according to gender variable are given within the scope of the robotic attitude scale.

Table 4. *T-test results of independent variables according to gender variable*

Gender	N	M	SD	F	p
Female	211	3.51	0.815	14.533	.000
Male	258	4.05	0.644		

Table 4 shows the robotic attitudes of the students participating in the research according to gender variable. T-test results of independent variables were evaluated. As a result of the independent variables T-test, it was determined that the students' robotic attitudes showed a significant difference according to the gender variable ($F = 14.533$, $p < 0.5$). The significant difference was found to be in favor of male students.

In Table 5, one-way analysis of variance (ANOVA) results is given within the scope of the robotic attitude scale, according to the class variable of the students participating in the research.

Table 5. *One-way analysis of variance (ANOVA) results according to the class variable*

Class	N	M	SD	F	P
9th grade	138	3.78	0.649	4,503	.205
10th grade	142	3.75	0.625		
11th grade	189	3.86	0.685		

In Table 5, one-way analysis of variance (ANOVA) results of the robotic attitudes of the students participating in the research were evaluated according to the variable of the class they were studying in. As a result of a one-way analysis of variance (ANOVA), it was determined that the robotic attitudes of the students did not show a significant difference according to the variable of the class they were studying in ($F = 4.503$, $p > 0.5$).

Findings from the teacher interview form

In Table 6, the questions of the teachers who participated in the research were asked: " What are your opinions about the use of robotic applications in education in Kazakh secondary schools?" Their answers to the question were evaluated.

Table 6. *Views on the use of robotic applications in education in Kazakh secondary schools*

Category	F	%
Positive	18	72
Indecisive	4	16
Negative	3	12
Total	25	100

In Table 6, the questions of the teachers who participated in the research were asked: " What are your opinions about the use of robotic applications in education in Kazakh secondary schools?" Their answers to the question were categorized. 72% of the teachers who participated in the study stated that they had a positive attitude toward the effectiveness of using mobile applications to teach robotics to students. While 16% of the teachers stated that they were undecided, 12% stated that they had a negative attitude.

Table 7 shows the questions of the teachers who participated in the research: " What are your opinions about the advantages of using robotic applications in education?" Their answers to the question were evaluated.

Table 7. *Opinions about the advantages of using robotic applications in education*

Teacher Opinions	F	%
Supports the use of technology in education	18	72
Improves students' learning skills	13	52
Improves the learning process	11	44
Provides permanence in learning	7	28
Increases interest in robotic applications	5	20
Increases students' motivation	2	8

Table 7 shows the questions of the teachers who participated in the research: " What are your opinions about the advantages of using robotic applications in education?" Their answers to the question were categorized. 72% of teachers support the use of technology in education, 52% say it improves students' learning skills, and 44% say it improves the learning process. 28% of the teachers answered that it provides permanence in learning, 20% said it increases interest in robotic applications, and 8% said it increases students' motivation.

Table 8 shows the questions of the teachers who participated in the research: "What are your opinions about the disadvantages of using robotic applications in education?" Their answers to the question were evaluated.

Table 8. *Views on the disadvantages of using robotic applications in education*

Teacher Opinions	F	%
There is a shortage of experienced teachers	16	64
It is a costly application	10	40
Causes overexposure to technology	6	24
In-service training programs for teachers are insufficient	4	16
Preparing for an event takes a lot of time	1	4

In Table 8, the questions of the teachers who participated in the research were asked, "What are your opinions about the disadvantages of using robotic applications in education?" Their answers to the question were categorized. 64% of the teachers responded that there is a lack of experienced teachers, 40% responded that it is a costly practice, and 24% responded that it causes too much exposure to technology. Additionally, 16% of teachers responded that in-service training programs for teachers are inadequate and 4% responded that preparing activities takes too much time.

In Table 9, the teachers who participated in the research asked "What are your suggestions for increasing the use of robotic applications in education?" Their answers to the question were evaluated.

Table 9. *Suggestions for increasing the use of robotic applications in education*

Teacher Opinions	F	%
A curriculum should be created in teacher training programs regarding robotic applications	20	80
Teachers should be given in-service training on robotic applications	19	76
Robotics application opportunities in schools should be increased	8	32
Students should be informed about the effectiveness of robotic applications	7	28
Seminars on robotic applications should be organized for teachers and students in schools	4	16

In Table 9, the teachers who participated in the research asked "What are your suggestions for increasing the use of robotic applications in education?" Their answers to the question were categorized. 80% of the teachers stated that a curriculum should be created in teacher training programs regarding robotic applications. 76% of the teachers responded that teachers should be given in-service training regarding robotic applications. 32% of the teachers stated that robotic application opportunities in schools should be increased, 28% stated that students should be informed about the effectiveness of robotic applications, and 16% stated that seminars on robotic applications should be organized for teachers and students in schools.

Discussions

It was determined that the students participating in the research had highly positive attitudes in the sub-dimensions of the robotics attitude scale and the overall scale. Graffin et al. (2022) also examined the effect of the robotics competition organized in their research on students' attitudes toward science courses. The findings obtained from the research reveal that students' robotic attitudes are high and that their high robotic attitudes also positively affect their attitudes toward science courses. Muniandy et al. (2022) similarly stated in their research that the robotics program had a positive and significant effect on students' attitudes toward science.

It was determined that students' robotic attitudes showed a significant difference according to the gender variable. The significant difference was in favor of male students, and it was observed that the robotic attitudes of male students were higher than female students. In their study, Van Wassenaer et al. (2023) revealed that there were differences between male and female students in the context of robotics education. It was stated in the research that this difference was in favor of male students.

The students participating in the research did not show a significant difference according to the class variable in which they studied. Findings reveal that students exhibit similar robotic attitudes. Gezgin et al. (2022) similarly revealed in their research that secondary school students' attitudes towards robotics and coding education were generally positive.

The majority of teachers participating in the research stated that they had positive attitudes toward the use of robotic applications in education in Kazakh secondary schools. Gezgin et al. (2022) stated in his research that teachers' attitudes towards educational robotics were positive, which is consistent with the findings of this research.

Teachers participating in the research were asked about their opinions on the advantages of using robotic applications in education. Teachers listed these advantages as supporting the use of technology in education, improving students' learning skills, improving the learning process, ensuring permanence in learning, increasing interest in robotic applications, and increasing students' motivation. Tzagaraki et al. (2022) evaluated teachers' attitudes towards robotic applications in education in their research. Research findings revealed that teachers are of the opinion that robotic applications improve the learning process, improve students' skills, and increase participation in robotic activities.

Teachers were asked about their opinions on the disadvantages of using robotic applications in education. Teachers listed these disadvantages as a lack of experienced teachers, high cost of implementation, excessive exposure to technology, the inadequacy of in-service training programs for teachers, and the fact that preparing activities takes a lot of time. According to Negrini (2020), some of the factors limiting robotic applications are costs, the time required to prepare the activities, and the fact that technologies are extensively present in our daily lives therefore some teachers do not want to bring them to school.

Teachers participating in the research were asked for their suggestions on increasing the use of robotic applications in education. The majority of teachers stated that a curriculum should be created in teacher training programs regarding robotic applications and in-service training should be provided to teachers regarding robotic applications. In addition, teachers suggested that schools should increase robotic application opportunities, inform students about the effectiveness of robotic applications, and organize seminars on robotic applications for teachers and students in schools. In their study, zagaraki et al. (2022) emphasized the difficulties of teachers learning and applying robotic applications and revealed the necessity of education in this field.

Conclusions

In the age of technology, we live in, an approach to education independent of technology is almost unthinkable. As technology develops in every aspect of life, it opens the door to innovations in education. The integration of robots, one of the developing technologies in recent years, into education has created a new understanding of education. Therefore, this study aimed to measure the attitudes of students in Kazakh secondary schools towards robotic applications in terms of various variables and to evaluate teachers' opinions. As a result of the research, it was determined that students' attitudes towards robotic applications in education were high. It is an expected result that male students have higher robotic at-

titudes than female students. In information technologies, male students always have higher attitudes or perceptions than female students. However, it is also an expected result that there are no differences in students' attitudes according to the classes they study. Because, attitudes towards information technologies are formed at a young age. While children play games in electronic environments, their information attitudes are also formed. The majority of teachers participating in the research have positive attitudes towards the use of robotic applications in education in Kazakh secondary schools.

There are advantages of robotic applications in education by teachers; It is expressed as supporting the use of technology in education, improving students' learning skills, improving the learning process, ensuring permanence in learning, increasing interest in robotic applications, and increasing students' motivation. The disadvantages expressed by teachers are; lack of experienced teachers, high cost of implementation, excessive exposure to technology, inadequacy of in-service training programs for teachers, and the fact that preparing activities takes a lot of time. Teachers' suggestions for increasing the use of robotic applications in education are; Creating curricula in teacher training programs on robotic applications, providing in-service training to teachers on robotic applications, increasing robotic application opportunities in schools, informing students about the effectiveness of robotic applications, and organizing seminars on robotic applications for teachers and students in schools.

Recommendations

The following suggestions were developed in line with the findings obtained from the research and teachers' opinions;

1. Although there is a need for practices to increase the robotic attitudes of all students, activities should be organized within the school to improve the robotic attitudes of especially female students.
2. The content regarding robotic applications in teacher training programs should be expanded, and teachers should be given in-service training on robotic applications.
3. Robotic application opportunities in schools should be increased and students and teachers should be informed.
4. Inclusive training seminars for teachers and students regarding robotic applications should be organized in schools.
5. This research can be repeated on a larger scale. It can be done more comprehensively, especially by including the subject of STEM. Similarly, it is recommended that experimental studies be conducted on this subject.

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Author Contributions

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Conflict of interests

The authors declare no conflict of interest.

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