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## Digital Competencies in the Context of Preschool Music Education

Blaženka Bačlija Sušić<sup>1\*</sup> , Martina Mičija Palić<sup>2</sup> 

<sup>1</sup>University of Zagreb, Faculty of Teacher Education Zagreb, Croatia, e-mail: [blazenka.baclijasusic@ufzg.hr](mailto:blazenka.baclijasusic@ufzg.hr)

<sup>2</sup>Music College Zlatko Baloković, Zagreb, Croatia, e-mail: [micija.palic@gmail.com](mailto:micija.palic@gmail.com)

**Abstract:** Given the digitalization of modern society and the way a child acquires musical experiences, practitioners are expected to apply various media in everyday educational praxis. The theoretical framework of technological pedagogical content knowledge (TPACK) is an approach that connects the knowledge of educators with Information and Communications Technology (ICT), concurrently developing technology-supported pedagogical knowledge and integration of technology into education. The paper aims to investigate educators' self-assessment of their digital competencies and their implementation in musical activities with preschool children. The respondents are full-time and part-time graduate students of the Early Childhood and Preschool Education study program from faculties of teacher education in Croatia. The obtained results indicate that 91,1 % of respondents didn't have any formal ICT education while 59,5 % didn't have any additional type of music education except during their studies. Nevertheless, the greatest knowledge participants have shown on the competencies for using digital tools (CFUDT) scale succeeded by a technological knowledge (TK) scale of the adapted TPACK-TCCMA survey, thus the respondents rated their digital and ICT competencies exceedingly high unlike music and pedagogical competencies. Considering the results obtained, it can be concluded that additional attention should be given to the development of digital, music, and pedagogical competencies during studies that will be applicable in both music and other areas of education.

**Keywords:** digital competencies, music preschool education, Information and Communications Technology (ICT), Technological pedagogical content knowledge (TPACK).

### Introduction

Due to the contemporary way of life in which modern technology is increasingly prevalent, children from an early age are surrounded by various forms of digital media used independently or with the help of adults (Chaudron, 2015; Common Sense Media, 2017; Ofcom, 2017; Mantilla and Edwards, 2019). Although there are numerous criticisms of their overrepresentation in the lives of children at the expense of free play, it is necessary to accept the new changes and integrate technology into all areas of child-rearing. Several research suggest, for example, that well-designed computer programs facilitate and contribute to the understanding and acquisition of knowledge and child development (Hsu, Tsai and Liang, 2011; Panagiotakou and Pange, 2010; McKinnon, 2005; Ralph and Petrina, 2018; Bullock et al., 2017; Herodotou, 2018). Therefore, given the way new generations grow up, in convergency to the content, children need to be provided with various forms of digital animation in the acquisition of knowledge and skills (Liang et al., 2013). Technology, consequently, needs to be integrated into all areas of a child's upbringing and education, including the context of music education.

As a result of the development of modern technology, the availability of music is immensely represented in everyday life by comparison to previous generations. Nowadays, the child adopts and acquires various musical experiences on a daily basis, not only in educational situations. From a socio-cultural perspective, anything that occurs in the community and practice can be relevant and represent a source of a child's knowledge (Lave and Wenger, 1991). Assuming that children also bring with them "home technological knowledge" (McPake, Plowman and Stephen, 2013), they are likewise active co-creators of their musical culture (Vestad, 2013, 2014). Hence, music streams into children's lives through different media like TV, DVD player, mobile devices, recordings, and other forms of information communication technology (ICT). There are also Disney and DreamWorks productions, the children's music networks that transmit music to children enriching their musical repertoire at homes, community, preschool, and school

\*Corresponding author: [blazenka.baclijasusic@ufzg.hr](mailto:blazenka.baclijasusic@ufzg.hr)



environments (Lum and Shehan Campbell, 2007; Shehan Campbell and Lum, 2007). The emergence of the World Wide Web (www) and the Internet, which provides new, easily accessible ways to gain musical experiences, also contribute to the vast presence of music in children's everyday life (Parra-Damborenea, 2014). Children are therefore surrounded daily by both video and audio media (radio, CD player) through which they listen to and receive music. Based on such incentives as well as using digital, mobile, and software applications, preschool children furthermore have the opportunity to create music (McPake, Plowman and Stephen, 2013; Paule-Ruiz et al., 2017). Certain research confirm that the methodology of music education has numerous benefits from the use of new educational technologies – ICT (Bauer, Reese and McAllister, 2003; Savage, 2007; Wise, Greenwood and Davis, 2011; Riley, 2013). Mobile learning and game-based learning are new approaches characterized by the utilization of mobile devices that enable learning anywhere and at any time (Paule-Ruiz et al., 2017). In addition, touch-based interaction can also be employed to practice motor skills and spatial abilities (spatial learning) (Parra-Damborenea, 2014).

Regardless of the contemporary context in which children are nowadays constantly surrounded by different media and different forms of digital technology through which they gain musical experiences, music education is under-represented in early and preschool education (Ilari and Gluschankof, 2009). In line with the present digital age and changes in the image of the young music learner, O'Neill (2012) points to the importance of a developed awareness for the need to provide different opportunities and forms of involving children in music activities. In this context, the musical and digital competencies of teachers and educators are immensely important. For technology integration into the upbringing and education of children, it is primarily necessary to develop the competencies of educators in this field. Various documents and research point out that it is essential to integrate this way of acquiring musical skills and knowledge into the curriculum at all levels and for each child or student (Rose and Meyer, 2002; National Council for Accreditation of Teacher Education, 2008; Shillady and Parikh, 2012; International Society for Technology in Education [ISTE], 2014; Ministry of Science and Education of the Republic of Croatia [MSE], 2011; MSE, 2014). Also, the conducted research confirm that the competencies of educators are one of the most influential factors in the integration of technology into education (Belland, 2009; Bingimlas, 2009; Brinkerhoff, 2006; Chen, Looi, and Chen, 2009; Hew and Brush, 2007; Inan and Lowther, 2010; Karaca, Can and Yildirim, 2013; Scherer, Siddiq and Tondeur, 2019; Dogan, Dogan and Celik, 2021; Lee and Tsai, 2010).

Accordingly, in order to further improve this field, special attention should be paid to further research into the competencies of educators. Specific technological knowledge and skills are not enough to integrate these values into education. Taking into consideration that digital competencies include pedagogical knowledge in addition to technological, a combination of these proficiencies is a prerequisite for implementation of technology in educational process (Kabakçi Yurdakul and Çoklar, 2014). Unlike the so-called techno-centric integration approach, attention should be focused on the techno-pedagogical approach (Kabakçi Yurdakul et al., 2012), because the former is focused on technology and teachers acquisition of technological knowledge and skills, while the techno-pedagogical integration approach is focused on pedagogical aspect of technological integration into educational situations. From the stated angle, in this research is represented one of the approaches that is applied in the field of early and preschool education – the TPACK model (Kabakçi Yurdakul et al., 2012).

TPACK model for teacher education was shaped by joining assistive technology to existing theoretical framework (Marino, Sameshima and Beecher, 2009). By means of the same theoretical framework the ICT-TPCK model was also developed (Angeli and Valanides, 2009). Moreover, from this pedagogical approach was formed the ICT-TPCK that combines intersection of content, learners, context, and ICT components while in other study the pedagogical content knowledge with the web knowledge were combined with the aim to create the framework of Technological Pedagogical Content Knowledge-Web (Lee and Tsai, 2010). For the purpose of professional development of science teachers' competencies, TPACK model represents the base for the specific integrated model Technological Pedagogical Science Knowledge (TPASK) (Jimoyiannis, 2010). Several research further indicate the need for further development of this theoretical framework in order to apply it in different areas of education and specific subject areas. Despite the numerous papers and research related to the theoretical framework of TPACK, there are few papers focused on the application of this theoretical framework in the context of preschool education (Chai, Koh and Tsai, 2013; Liang et al., 2013; Voogt et al., 2012; Hsu et al., 2014; Santos and Castro, 2021; Valtonen et al., 2017). Insufficient representation of this theoretical framework in the context of early and preschool education (ECE) can be attributed to the low level of ICT competencies of educators or the lack of resources and technical support in the milieu of early and preschool education (Li, 2006). Also, it is precisely because of these factors that are attributed to the underrepresentation of this theoretical framework in the context of ECE in later research (Liang et al., 2013). Namely, until the

appearance of the mentioned theoretical framework of TPACK (Mishra and Koehler, 2006), there was no theoretical framework that would direct the professional development of educators in this field.

Aware of the possible problems that technology can cause in a child's development, Liang et al., (2013) point out that regardless of them, it is more important that educators create the necessary form of TPACK that will best suit their unique educational context. Also, they further believe that given the many advantages of the application of technology in the context of education, it is important that its adequate application is supported by appropriate knowledge of the theoretical model by educators. This method of application is deemed a considerably better choice compared to its avoidance in working with children (Liang et al., 2013). The authors of the research related to the application of TPACK in the context of ECE point out that it is necessary to test this theoretical model in different contexts given its many potentials and application (Voogt et al., 2012; Chai et al., 2013; Voogt and McKenney, 2016; Valtonen et al., 2020). In addition, since Chai et al. (2013) further emphasize, that it is essential for the theoretical framework to be contextualized for specific content, technology and pedagogy, the aim of this paper is to apply this theoretical model in the context of preschool music education.

## Materials and methods

### *The objective of the study, research questions, and instrument of data collection*

The purpose of this study is to conduct reliability and validity analysis of instrument – TPACK-deep: a technological pedagogical content knowledge scale (Kabakçi Yurdakul et al., 2012; Liang et al., 2013) by using Exploratory Factor Analysis (EFA), in order to show adjusted TPACK-deep scale's application in the context of preschool music education. Also, the paper seeks to measure preservice teachers' self-assessment of their knowledge, skills, and competencies regarding technology integration in preschool music education.

In order to accomplish the objective, the following research questions were defined:

1. Is the reliability and validity of the adopted instrument adequate?
2. How do preschool teachers assess their technological pedagogical content knowledge (TPACK) in the context of preschool music education?
3. Is there a correlation between the preschool teachers' years of service and TPACK scales?

As an instrument of data collection in this research, a TPACK survey was used (Kabakçi Yurdakul et al., 2012; Liang et al., 2013) which was altered to include digital competencies in the context of preschool music education and contains the following subscales: music content knowledge (MCK), pedagogical music content knowledge (PMCK), technological knowledge (TK), competencies for using digital tools (CFUDT) and technological competencies in the context of music activities (TCCMA), respectively. The exploratory factor analyses indicated adequate reliability and validity of the adjusted TPACK-TCCMA survey.

### *The respondents*

A total of 190 preschool teachers and educators participated in this research. The majority of the respondents (N=179; 94,2%) were currently attending graduate study of Preschool teacher education. Thereby 69,8% (N=125) were in the first year of graduate study while 30,2% (N=54) attended the second year of graduate study. Most of the participants (60,5%; N=115) were currently employed in a preschool facility with the average work experience of 11 years. In addition, 35,8% (N=68) of them were not working in practice while 3,7% (N=7) had part-time jobs in preschools. The largest number of the participants (45,3%; N=86) was in the age group of 18-25 years, 21,1% (N=40) 40-50 years, 17,4% (N=33) 25-30 years, 15,8% (N=30) 30-40 years and 0,5% (N=1) 50-65 years. The participants were predominantly female (N=188; 98,9%) while only 1,1% (N=2) were male, which is in line with the percentage of preschool teachers in Croatia. Furthermore, 59,5% (N=113) of the respondents didn't attend any form of music education before joining the faculty, while 40,5% (N=77) acquired some kind of music education before attending the faculty of preschool education. Additionally, 46,8% (N=89) attended some form of music education for less than a year, 20,5% (N=39) in the duration of 1-3 years, 13,5% (N=25) for less than a year, 11,6% (N=22) for 3-6 years, 4,7% (N=9) for more than 10 years and 3,2% (N=6) for 6-10 years. The vast majority of participants (N=173; 91,1%) didn't attend additional forms of ICT courses before gaining knowledge in this area on faculty, while 8,9% (N=70) of them participated in some type of ICT education.



## Results

The results of the Exploratory Factor Analysis (EFA) revealed that preschool teachers' responses on the instrument TPACK-deep: A technological pedagogical content knowledge scale (Kabakçi Yurdakul et al., 2012; Liang et al., 2013) adapted to research digital competencies in the context of preschool music education could be grouped into five factors. The factors contained are music content knowledge (MCK); pedagogical music content knowledge (PMCK); technological knowledge (TK); competencies for using digital tools (CFUDT) and technological competencies in the context of music activities (TCCMA). Thereby, principal component analysis as an extraction method with oblimin rotation was used. Items with factor loading less than 0,5 were deleted. KMO and Bartlett's Test show that sample size is appropriate with a number of variables taken for the study (KMO=,923; Chi square=3809,820, df=453,  $p<,05$ ). The scales accounted for 75,977% of the total variances (Table 2). The Eigenvalues of the five scales listed were all greater than one. The reliability (alpha) of the overall scale was 0,96 and the reliability coefficients for the scales were from 0,86 to 0,95. This suggests that adapted five scale TPACK-TCCMA for preschool music education can be considered adequate for measuring preschool teachers' digital competencies in the context of preschool music education.

The TPACK-TCCMA survey initially included 33 items, divided in six scales:

1. content knowledge (CK) was equaled to music content knowledge (MCK) – the scale was assessing the preschool teachers' knowledge about music in general.
2. pedagogical knowledge (PK) – the scale evaluated pedagogical competencies and methods for implementation of music activities in preschool education process.
3. pedagogical content knowledge was adjusted as pedagogical music knowledge (PMK) – the scale was measuring the ability of preschool teachers to implement the various pedagogical strategies for acquiring musical content in preschool situations.
4. technological knowledge (TK) – the scale was used to evaluate the level of preschool educators' digital competencies in the context of general user digital competencies framework.
5. technological pedagogical and technological content knowledge combined as technological music knowledge (TMK) – the scale was assessing the preschool teachers' competencies necessary to use technology in music activities with children.
6. technological pedagogical content knowledge (TPACK) became technological pedagogical music content knowledge (TPACMK) – the scale was evaluating the implementation of information communication technology in order to conduct music activities with children by integrating musical content, ICT and the fundamental postulates of music pedagogy.

Particles from the existing questionnaire which were deleted because of the factor loading less than 0,5 were mostly connected with the creation of digital content, thus the respondents were not able to create web pages, to regularly follow the advance in new information communication technologies and didn't have a possibility to facilitate children with the appropriate use of ICT for communication during the group music activities. The probable reasons for these results lie in the accessibility of ICT in preschool facilities as well as in the insufficient preschool teachers' level of competencies for creating digital content, a factor that acquires sustainable level of technological knowledge.

The results of exploratory factor analysis (EFA), according to Keiser Guttman and Scree plot test criterium, with oblimin rotation displayed in Table 1 revealed that responses can be grouped in five scales: music content knowledge (MCK); pedagogical content knowledge (PCK), technological knowledge (TK), competencies for using digital tools (CFUDT) and technological competencies in the context of music activities (TCCMA). The first factor of music content knowledge (MCK) partially merged content knowledge (CK) and pedagogical knowledge (PK) from the original survey, consequently consisting of seven items used to assess the knowledge about music content and the implementation of music activities in working with children. The second factor was pedagogical music content knowledge (PMCK) consisted of six items related with the various aspects of implementing music activities (solving problems, understanding the content, encouraging the children to express themselves, involve children in practical activities and manage the acquisition of knowledge). The third factor was technological knowledge (TK) with three items regarding the use of computers, acquiring new digital skills and solving technical problems. The fourth factor was competencies for using digital tools (CFUDT) with six items related to the use of social media and communication tools (messaging and video calls) in everyday life and supporting children in use of technology in the context of music. This factor emerged from the initial technological knowledge (TK) scale, while the fifth factor was technological competencies in the context of music activities (TCCMA) with eight items initially amalgamated from technological music knowledge (TMK) and technological

pedagogical music content knowledge (TPMCK).

The results of the exploratory factor analysis suggest that adapted five scale TPACK-TCCMA for preschool music education can be considered reliable for measuring preschool teachers' digital competencies in the context of preschool music education, thus answering positively to the first research question.

**Table 1**  
*Rotated Factor Scores from Pattern Matrix (Oblimin Rotation) for the scales of the adapted TPACK-TCCMA survey for preschool teachers*

| Item  | Measure                                                                                                                                                                                                  | Factor loading |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| MCK   | I have sufficient knowledge about music necessary to work with children.                                                                                                                                 | -0,81          |
| MCK   | I can think about music content on a professional level.                                                                                                                                                 | -0,83          |
| MCK   | Independently, without help, I can understand the musical content that I need to carry out musical activities in working with children.                                                                  | -0,74          |
| MCK   | I believe that I can sovereignly and safely carry out musical activities in working with children.                                                                                                       | -0,82          |
| MCK   | I am able to carry out various forms of musical activities in working with preschool children (singing a song, performing singing games, counting, playing Orff instruments, creative activities, etc.). | -0,62          |
| MCK   | I am able to approach the implementation of musical activities in working with children in an integrated way.                                                                                            | -0,60          |
| MCK   | I can plan and implement group music activities in working with children.                                                                                                                                | -0,63          |
| PMCK  | Without the use of information and communication technology (ICT), I can solve the usual doubts related to the implementation of musical activities in working with children.                            | 0,71           |
| PMCK  | Without the use of ICT, I can help children in various ways to understand music content and acquire musical skills and knowledge.                                                                        | 0,87           |
| PMCK  | Without the use of ICT, I can deal with the common difficulties that children face in music activities.                                                                                                  | 0,88           |
| PMCK  | Without the use of ICT, I can encourage children to express their own musical experience and experiences, emotions, imagination, etc.                                                                    | 0,90           |
| PMCK  | Without the use of ICT, I can actively involve children in practical music content and activities.                                                                                                       | 0,88           |
| PMCK  | Without the use of ICT, I can encourage children to express their own musical experience and experiences, emotions, imagination, etc.                                                                    | 0,90           |
| PMCK  | Without the use of ICT, I can actively involve children in practical music content and activities.                                                                                                       | 0,88           |
| PMCK  | Without the use of ICT, I can direct children to manage the acquisition of music content.                                                                                                                | 0,86           |
| TK    | I believe that I possess the digital competencies necessary for the effective use of computers.                                                                                                          | -0,76          |
| TK    | I think I can easily acquire new computer/digital skills.                                                                                                                                                | -0,74          |
| TK    | I know how to solve my own technical problems when using computers and information and communication technology.                                                                                         | -0,84          |
| CFUDT | I can independently use social media such as Facebook, Instagram, Twitter, etc.                                                                                                                          | 0,74           |
| CFUDT | I can independently use digital communication tools to send messages (email, Viber, WhatsApp, Messenger, etc.).                                                                                          | 0,78           |
| CFUDT | I can independently use digital communication tools for video calls (Skype, Zoom, Google Meet, Webex, etc.).                                                                                             | 0,74           |
| CFUDT | I am able to facilitate children to use technology to find information about music on their own or with the support of educators, parents or adults.                                                     | 0,56           |
| CFUDT | I am able to support children to use technology to construct different forms of knowledge presentation (e.g., music-didactic games).                                                                     | 0,62           |
| CFUDT | I have a capacity to make it easier for children to collaborate with each other using technology (in pairs or in small groups).                                                                          | 0,55           |

|       |                                                                                                                                                                                                          |      |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| TCCMA | I am able to use various computer programs created to acquire musical knowledge.                                                                                                                         | 0,74 |
| TCCMA | I know information and communication technologies that I can use to facilitate the adoption of music content.                                                                                            | 0,69 |
| TCCMA | I can use appropriate information and communication technologies to present music content (e.g., multimedia sources, music picture books in multimedia format, animated music content, etc.              | 0,70 |
| TCCMA | I can use some specialized computer games to check the acquired musical skills and knowledge of children (e.g., sound memory, games for recognizing sounds, instruments, etc.)                           | 0,65 |
| TCCMA | I can choose the information and communication technologies that I will use to improve and enhance the way of conducting activities in working with children.                                            | 0,77 |
| TCCMA | I can use strategies that combine content, technologies and methods and implement them in the process of conducting musical activities in working with children.                                         | 0,81 |
| TCCMA | I can provide guidance in helping others to coordinate the use of content and information and communication technologies in their preschool.                                                             | 0,71 |
| TCCMA | I can design music activities that appropriately integrate music content, information and communication technology and the basic laws of music pedagogy for learning appropriate for preschool children. | 0,77 |

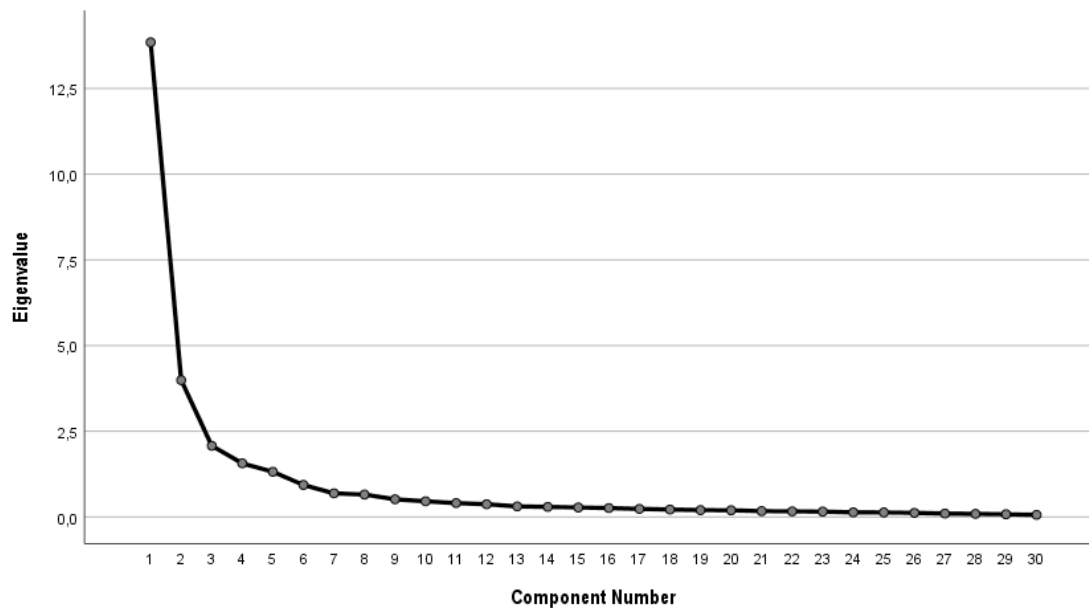


Figure 1. Scree plot

**Table 2**  
*Total Variance Explained*

| Component | Initial Eigenvalues |               |              | Extraction Sums of Squared Loadings |               |              |
|-----------|---------------------|---------------|--------------|-------------------------------------|---------------|--------------|
|           | Total               | % of Variance | Cumulative % | Total                               | % of Variance | Cumulative % |
| 1         | 13.85               | 46.15         | 46.15        | 13.85                               | 46.15         | 46.15        |
| 2         | 3.99                | 13.30         | 59.45        | 3.99                                | 13.30         | 59.45        |
| 3         | 2.08                | 6.92          | 66.38        | 2.08                                | 6.92          | 66.38        |
| 4         | 1.56                | 5.21          | 71.59        | 1.56                                | 5.21          | 71.59        |
| 5         | 1.32                | 4.39          | 75.98        | 1.32                                | 4.39          | 75.98        |

**Table 3**  
*Correlations for five factors*

|   | 1 | 2    | 3    | 4     | 5     |
|---|---|------|------|-------|-------|
| 1 |   | 0,27 | 0,36 | -0,32 | -0,30 |
| 2 |   |      | 0,23 | -0,52 | -0,21 |
| 3 |   |      |      | -0,31 | -0,36 |
| 4 |   |      |      |       | 0,35  |
| 5 |   |      |      |       |       |

The second research question led us to explore the self-assessment of preschool teachers' regarding the technological pedagogical content knowledge (TPACK-TCCMA) in the context of preschool music education. The respondents' mean scores on the five scales of the adjusted TPACK-TCCMA survey (presented in Table 4) for the factors obtained were all over the mid theoretical range. The preschool teachers attained the highest scores on the competencies for using digital tools (CFUDT) scale with an average of 4,46 per item following a technological knowledge (TK) scale with an average of 4,17 per item on a 1 – 5 Likert scale. The lowest scores of the adjusted TPACK-TCCMA scale preschool teachers attained on the pedagogical music content knowledge scale (PMCK) with an average of 3,70 per item, and technological competencies in the context of music activities scale (TCCMA) with an average of 3,66 per item. These results indicate that most of the preschool teachers tend to demonstrate high agreement with items implying their high digital tools competencies as well as their technological knowledge. Nevertheless, these results suggest that a number of preschool teachers distinguished the use of proper instruction to teach the premeditated music content knowledge (PMCK) and possessed the capacity to adjust technological competencies in performing music activities with preschool children.

**Table 4**  
*Descriptive data on the five scales of adjusted TPACK-TCCMA survey*

|       | Mean | Std. Deviation | Skewness  |            | Kurtosis  |            |
|-------|------|----------------|-----------|------------|-----------|------------|
|       |      |                | Statistic | Std. Error | Statistic | Std. Error |
| MCK   | 3,87 | 0,79           | -0,77     | 0,18       | 1,01      | 0,35       |
| PMCK  | 3,70 | 0,87           | -0,40     | 0,18       | -0,04     | 0,35       |
| TK    | 4,17 | 0,86           | -1,15     | 0,18       | 0,96      | 0,35       |
| CFUDT | 4,46 | 0,62           | -2,05     | 0,18       | 6,63      | 0,35       |
| TCCMA | 3,66 | 0,89           | -0,47     | 0,18       | -0,35     | 0,35       |

The last part of this research examined the role of preschool teachers' experiences and praxis in their responses to the adjusted TPACK-TCCMA survey. For this purpose, participants were divided into two independent groups: those with working experience in a preschool facility and participants without such experience. An independent sample t-test is used to identify these differences. The mean score of



participants with experience in praxis was ,64 with a standard deviation of ,06 while participants without praxis scored a mean value of ,59 with a deviation of ,07 (Table 5). Equality of variance was confirmed with Levene's Test (Table 6) whose significance value was higher than ,05 ( $F=,016$ ,  $p=,90$ ). Results of the t-test for independent samples showed that, on the population level, participants with experience in preschool practice scored significantly higher results on adjusted TPACK-TCCMA survey ( $t= -2,143$ ,  $df = 181$ ,  $p<,05$ ).

**Table 5**  
*Descriptive data regarding the working experience*

|                             | ME (SD)        | MNE (SD)       | t      | df  | p     |
|-----------------------------|----------------|----------------|--------|-----|-------|
| Adjusted TPACK total result | 3,84<br>(0,64) | 4,04<br>(0,60) | -2,143 | 181 | 0,033 |

Legend: ME= Mean score for preschool teachers with experience in praxis, MNE= Mean score for preschool teachers with no experience in praxis, SD= standard deviation, t=t-test value, df=degrees of freedom, p= level of significance

**Table 6**  
*The results of the Levene's test for equality of variances*

|             |                         | Levene's Test for |      |        |     |                 |            |
|-------------|-------------------------|-------------------|------|--------|-----|-----------------|------------|
|             |                         | F                 | Sig. | t      | df  | Sig. (2-tailed) | Difference |
| total score | Equal variances assumed | ,016              | ,899 | -2,143 | 181 | ,033            | -,204      |

## Discussion

In this research, we have explored the self-assessment of preschool teachers' digital competencies and their implementation in the context of preschool music education by using the modified TPACK-TCCMA survey initially created on the basis of the combined questionnaires TPACK (Kabakçi Yurdakul et al., 2012) and TPACK-deep: a technological pedagogical content knowledge scale (Liang et al., 2013). Primary, the reliability and validity analysis of instrument combined from different factors was confirmed like in previous studies (Liang et al., 2013; Hsu et al., 2014; Kabakçi Yurdakul et al., 2012; Lee and Tsai, 2010; Jimoyiannis, 2010) while finding similarities in merging factors (Liang et al., 2013; Lee and Tsai, 2010), thus creating a five scale TPACK model (Lee and Tsai, 2010; Valtonen et al., 2017) adequate for measuring preschool teachers' digital competencies in the context of preschool music education (Kabakçi Yurdakul et al., 2012).

Upon the validation of the instrument, the respondent sample was analyzed in order to present the fact that 59,5% of the participants didn't have any form of music education and 91,1% were without the additional ICT education. These are the reasons why the results obtained for the factors of pedagogical music content knowledge scale (PMCK) and technological competencies in the context of music activities scale (TCCMA), were the lowest among the mean scores which differ from particular research (Hsu et al., 2014) being in the meantime in line with the other research (Liang et al., 2013). Furthermore, the greatest knowledge is shown on the competencies for using digital tools (CFUDT) scale with an average of 4,46 per item, succeeded with an average of 4,17 per item on a technological knowledge (TK) scale, which is in line with the constatation that the so-called Z-generation predominant in this research possessed the highest level of general digital competencies and were consequently familiar with the use of ICT at the substantial point, although Hsu and Chen (2018) specified that "results differ from the perception that younger teacher will tend to have more technological knowledge". This is also in correlation with several studies regarding the necessary level of digital competencies as a prerequisite to implementation of technology in educational process (Panagiotakou and Pange, 2010; Hsu, Tsai and Liang, 2011; Ralph



and Petrina, 2018).

In the final part of this research the role of preschool teachers' experiences and praxis in their responses to the adjusted TPACK-TCCMA survey were examined. The results showed that participants with experience in preschool practice obtained significantly higher results on adjusted TPACK-TCCMA survey ( $t = -2,143$ ,  $df = 181$ ,  $p < .05$ ), indicating the praxis experience as an important factor of implementing technology in performing music activities with children in preschool education context (Liang et al., 2013).

## Conclusion

The contribution of this paper is reflected in the application of the theoretical model TPACK-TCCMA in the context of ECE and its adaptation in music education. Although the obtained results indicate that the work experience of educators is a significant factor that contributes to better self-assessment of educators' competencies in using digital tools (CFUDT) ( $M = 4,46$ ), it is necessary to further develop both musical and pedagogical competencies of educators so that competencies for using digital tools (CFUDT) could be applied in the context of preschool music education. Also, it is necessary to further develop the technological, pedagogical and musical competencies of educators in the field of technological and pedagogical knowledge both during their studies and within their lifelong education. The modern way of life requires adaptation to new generations, the so-called Generation Alpha growing up using technology. Therefore, it is necessary to bring musical knowledge and skills closer to children. In this way, it will considerably contribute to the further development of both the child's musical and creative abilities. In addition, such an approach to music education will also contribute to the development of the digital competencies of children.

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### Conflict of interests

The authors declare no conflict of interest.

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