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Validation of The Scale on Pre-Service Teachers' Digital Competence to Assist Students with Functional Diversity

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ABSTRACT

One of the objectives of education is to provide diverse pupils with proper educational opportunities. It is anticipated that the night instructors will have this equipment. In this study, validity, and reliability evaluations of the scale to be used to identify digital competence in prospective instructors to support children with functional diversity were conducted. To conduct the research, education faculty students were selected as the target audience. The data gathered were subjected to exploratory factor analysis. A confirmatory factor analysis was used to validate the obtained results. According to the findings of the investigation, thirty components and five contributing variables were found. It has been proposed that future academics do studies on the validity and reliability of the instruments with a number of different populations.

Keywords: pre-service teachers, digital competence, assist students

INTRODUCTION

Technological developments have consequential changes and effects in the world of education as well as affecting all areas of life. Students can make significant progress with the use of information and communications technology (ICT) and other resources (Alexopoulou et al., 2019; Budnyk & Kotyk, 2020). Regarding education, ICT has assumed a significant role in the processes of teaching and learning and has become a need for numerous social, cultural, and health issues in the majority of civilizations throughout the globe (Sarkar, 2012). The utilization of digital resources by teachers may be viewed as a bridge in the promotion of learning for all types of students, independent of their information access limitations (Adam & Tatnall, 2008; Heiman et al., 2017; Wu et al., 2014).

The industrial digital revolution is occurring rapidly, and the rate of change is accelerating. This indicates that if you do not act promptly, you will fall behind soon. If we are to realize the promise of digital technologies throughout the economy, industry in all sectors and throughout Europe must adopt these technologies as soon as feasible (European Commission, 2015).

It is essential to train future education professionals in digital literacy, a topic that has been extensively covered in the relevant literature (McGarr & McDonagh, 2021; Reisoglu & Cebi, 2020), as has the effect of a number of different factors on ICT acquisition (González García et al., 2019; Grande-De-Prado et al., 2020; Juhaňák et al., 2019). The progression of one's digital competency may be influenced by a number of personal and environmental factors. Learning about its impact provides us with information that might be valuable when formulating future educational policies that use ICT (Cabezas-González et al., 2021).

In the form of international and national conceptual frameworks, efforts have been made to describe the precise abilities that instructors need develop to successfully incorporate digital technology into teaching and learning. The International Society for Technology in Education's (ISTE) 2008 standards for teachers, which are also known as the national education technology standards (NETS), have been acknowledged and accepted in many countries throughout the globe. They are utilized for learning and teaching in the twenty-first century, establishing a standard of excellence by merging technology and methods that are helpful for learning (Aslam et al., 2020). The professional digital competence framework for teachers is a document that was prepared by The Norwegian Centre for ICT in Education for the purpose of serving as a resource for policy developers, department heads, teacher educators, teachers, student teachers, and other individuals. It seeks to increase the overall quality of teacher education as well as the continuous professional development of educators in a structured manner (Kelentrić et al., 2017). The technological pedagogical content knowledge (TPCK) framework that was developed by Mishra and Kohler (2006) to develop technology leadership of administrator of educational institutions, the objectives will be inadequate in many areas including the sharing of institutional technology resources, technology vision, technology managers, and digital citizenship, all of which have an effect on technology leadership (Demir, 2011). The goal of the mentoring technology enhanced pedagogy (MENTEP) project is to provide a tool that is dependable, user-friendly, and sustainable for educators to utilize to evaluate their own level of technology-enhanced teaching (TET) competency. TET competency refers to the ability to effectively use ICT in the classroom, as well as a knowledge of the consequences for student learning. MENTEP will provide assistance for educators as they engage in professional development activities that include learning in complicated, real-world, or 'genuine,' settings in which there are no predefined or 'correct' solutions (Looney, 2015). The level of digital competence possessed by educators is a multifaceted notion that incorporates components of social, cultural, pedagogical, ethical, and mental attitudes respectively (Lucas et al., 2021).

When developing policies and training programs, educational institutions at the higher education level are required to bear these ICT possibilities in mind. ICTs support student-centered teaching models in comparison to teacher-centered models, allowing for a culture shift from one of teaching to another of learning (Cabezas-González et al., 2021). A growing number of students from different backgrounds are enrolling in university classes. Students who come from a variety of cultural and social backgrounds, who are of different ages, who are in a number of different personal and work situations, who are mobile, who have a variety of interests and resources, and who attend university classes highlight the need for the university to articulate new proposals that allow it to respond to the variability of student profiles and situations (Fernández-Batanero et al., 2022).

The availability of technical potential does not, contrary to what is asserted in many models for the integration of technology, guarantee that the technology will be utilized in an efficient manner (Bingimlas, 2009; Makki et al., 2018; Mishra & Kohler, 2006). As a result, those who teach and those who are considering becoming teachers ought to be aware of this issue. According to research carried out with educators, they do not have a very high level of competence in the application of technology, particularly when it comes to children who have varying characteristics (Cabero-Almenara et al., 2022; Casillas Martín et al., 2020, Colón et al., 2019).

To be effective, a sophisticated procedure that promotes pre-service teachers' abilities for the integrated use of educational technology is required. These competences must involve the use of methodologies (Tondeur et al., 2018). The specific features of pre-service teachers in terms of ICT (attitudes, simplicity of use, innovativeness, belief, and experience) have a significant impact on the ways in which they employ educational technologies (Farjon et al., 2019; McGarr & McDonagh, 2021; Teo & Milutinovic, 2015)

In the field of education, a political commitment has been made to uphold fairness and inclusion of a high quality. This commitment pertains to fundamental and international rights (Romaní et al., 2022). O'Byrne et al. (2019) and Odame et al. (2020) are two examples of recent research that looked at the challenges that students with disabilities face in higher education. In both studies, classroom practices were cited as the most significant barrier to students' ability to succeed over the long term. Another area of focus for the use of ICT to help individuals with disabilities has been "professional development of teachers" which involves educating educators on how to make effective use of ICT to promote educational inclusion (Fernández-Batanero et al., 2022).

It is envisaged that students who will be teachers in the future would have this competency to enhance the learning process of students with difficulties when they become teachers themselves. The purpose of this study is to modify the scale that was established to test the competencies of pre-service teachers in the use of ICT to support children with difficulties so that it can be used in the Russian environment.

METHOD

The study employs both quantitative and qualitative methods in its investigation (Van Klaveren & De Wolf, 2019). Even though the qualitative method is the one that is recommended for use for assessing the linguistic validity of the scale, within the context of the psychometric analysis of the study, the quantitative method was utilized (DeVellis & Thorpe, 2021).

Participants

Participants are undergraduate students studying at universities in Russia. Total 524 students are volunteer to participate to fill online questionnaire. 331 of the participants are female, and 193 of them are male. Age distribution of the participants is 17 years (1%), 18-19 (54%), 20-21 (22%), and 22 years and over (23%).

Data Collection Tool and Process

Teachers' digital competence questionnaire adapted in this study was developed by (Cabero-Almenara et al., 2022). Teachers' digital competence questionnaire, there are six factors: "general aspects", "visual", "hearing", "cognitive", "motor", and "accessibility". In the general aspects dimension, there are questions that measure the competence of teacher candidates in general. The visual dimension includes questions measuring ICT proficiency that can be used specifically for the visually impaired. In the hearing dimension, it is the part where pre-service teachers' competencies on how to help their students with hearing problems are measured. In the cognitive dimension, it is the part where pre-service teachers' competencies regarding which ICT tools they can choose to help their students with cognitive difficulties are determined. The motor dimension was aimed to measure the ICT proficiency that can be used for students with motor limitations. The accessibility dimension measures the ICT use proficiency in reaching different students as a whole.

To carry out the validation of the instruments. Firstly, we determined two translator team who has at least five years of academic translation experience. The original instrument was translated from English into Russian by the first team. Then second team translated the scale from Russian into English. The quality of the translation was considered in relation to the coincidence with the original version. In the second step, we determined the readability and understandability of each item with 15 undergraduate students. In the third step, we applied the instruments to 331 undergraduate students. In the final step, we calculate the psychometric properties of the instrument.

Table 1. KMO and Bartlett's test for each factor

Factor	KMO	Bartlett's test
General aspects	0.729	X^2=795, df= 3, p<0.001
Hearing	0.669	X^2=799, df= 3, p<0.001
Motor	0.727	X^2=1043, df= 3, p<0.001
Visual	0.741	X^2=898, df= 3, p<0.001
Cognitive	0.764	X^2=1641, df= 3, p<0.001
Accessibility	0.759	X^2=1331, df= 3, p<0.001

Data Analysis

To assess the validity and reliability of the instrument, it was subjected to some testing. The first thing that was done was to examine whether or not the data followed a normal distribution. According to Kim (2013), for a measurement to have a normal distribution, the skewness should be between -2 and +2, and the kurtosis should not be more than seven if the sample size is greater than 300. In the second step, an exploratory factor analysis (EFA), was carried out. There are five processes involved in factor analysis: checking the appropriateness of the data, extracting the factors, using criteria to determine which factors should be extracted, choosing a rotational technique, and interpreting the results (Williams et al., 2010). The first thing that we do is examine the size of the sample. The number of people in the sample is above 300, and it is adequate. The Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity were the next tests that we looked at. In the second stage of the process, the primary axis factoring extraction approach was selected as the best option. The numbers of the factors can be determined using parallel analysis. In addition to that, the loading factor was higher than 0.4. The rotation procedure was carried out using maximum likelihood with varimax rotation for the fourth phase of the process. Because of the nature of the scale, classification is made according to disability types, so EFA is made separately for each dimension.

After that, a confirmatory factor analysis (CFA), often known as a CFA, was carried out to investigate the factor structure. In addition, descriptive statistical analyses, and an internal consistency study (using Cronbach's alpha) were carried out in order to determine the instrument's degree of reliability. X2/df, the comparative fit index (CFI), the incremental fit index (IFI), the root means square error of approximation (RMSEA) and its 95% confidence interval (CI), and the standardized root mean square residual were the adjustment indices that were utilized to validate or invalidate the tested model (SRMR). It was believed that a model had an adequate fit to the data if it had values of RMSEA and SRMR that were less than or very close to the thresholds of 0.06 and 0.08, as well as values of RMSEA and SRMR that were less than or very close to the thresholds of 0.06 and 0.08 for the incremental fit index (CFI and IFI) (Hair et al., 2014; Kline, 2005). JASP 0.16 (JASP, 2021) is the program that was utilized for all analysis.

FINDINGS

To begin, an EFA will be carried out, and this will be followed by a CFA so that the results can be verified. The discussion of the results will conclude this section, and it will focus on reliability.

Factor Analysis

KMO and Bartlett's test results were analyzed for sample suitability for each dimension. According to **Table 1**, KMO value over 0.6 also in Bartlett's test p is smaller than 0.01 for each factor. As a result, the sample is suitable for factor analysis. Then we check each dimension has unique structure or not. To calculate factor number, the parallel analysis was applied.

While the lowest factor load was 0.672 within the six factors structure, the highest was 0.978. Since there is a single structure factor in each dimension, the factor names have remained the same as in the original scale. In addition, none of the items require removal (**Table 2**).

When the total factor loads and the explained variances are examined, it is seen that the single factor structure is preserved in each dimension (**Table 3**). The lowest declared variance was calculated as 68.5% and the highest as 87.2%. These results show that each dimension has a singular structure in itself.

Table 2. Factor loading for each factor

Items	GA	H	M	V	C	A
1-I have knowledge of the possibilities that ICT offers to people with disabilities	0.896					
2-I am able to select specific ICT resources based on the physical, sensory and cognitive capabilities of different students	0.827					
3-In general, I feel prepared to help students with certain disabilities with the use of technical aids and the use of ICT	0.775					
4-I am able to adjust the curriculum with the support of ICT for students with hearing disabilities		0.805				
5-I know how sign language works		0.672				
6-I am able to apply teaching strategies supported by ICT to facilitate the integration of students with hearing disabilities		0.978				
7-I know different types of keyboards for people with different types of mobility limitations			0.794			
8-In general, I know the possibilities that ICT offers to students with motor disabilities			0.949			
9-I am capable of making curricular adaptations supported by ICT for students with motor limitations			0.866			
10-I am aware of different computer software programs that are targeted at people with visual disabilities				0.820		
11-I know how to create a document on a word processor and eliminate those aspects that may make it difficult to view for people with visual disabilities				0.837		
12-In general, I know possibilities offered by ICT to students with visual deficits				0.902		
13-I am able to apply didactic strategies supported by ICT to facilitate the inclusion of students with cognitive disabilities					0.967	
14-In general, I am aware of the possibilities that ICT offers to students with cognitive disabilities					0.913	
15-I am able to adjust the curriculum with the support of ICT for students with cognitive disabilities					0.921	
16-I am able to create web pages with high accessibility parameters						0.945
17-I can point out different institutions, national and international, that are related to the study and research of the accessibility of the sites						0.904
18-I am able to explain principles that the Center for Design for All recommends are followed, in order to create websites that serve to achieve a 'design for all'						0.877

Note. GA: General aspects, H: Hearing, M: Motor, V: Visual, C: Cognitive, & A: Accessibility

Table 3. KMO and Bartlett's test for each factor

Factor	SS loadings	Variance (%)
General aspects	2.087	69.6
Hearing	2.056	68.5
Motor	2.282	76.1
Visual	2.187	72.9
Cognitive	2.616	87.2
Accessibility	2.479	82.6

Table 4. Fit indices for the first model and last model

								RMSEA 90% CI	
	χ^2/df	CFI	TLI	IFI	NFI	SRMR	RMSEA	Low	High
Cut-off criteria	≤3	>0.90	>0.90	>0.90	>0.90	<0.08	<0.08		
Initial model	605/120=5.05	0.953	0.941	0.940	0.943	0.034	0.088	0.081	0.095
Last model	298/107=2.79	0.982	0.974	0.982	0.972	0.028	0.058	0.051	0.066

Note: df: Degree of freedom, CFI: Comparative fit index, TLI: Tucker-Lewis index, IFI: Incremental fit index, NFI: Normed fit index, SRMR: Standardized root mean square residual, RMSEA: Root mean squared error of approximation

Confirmatory Factor Analysis

A study of the CFA test model revealed that the latent variable is real, suggesting that it is possible to continue processing it to verify the structural model.

The initial model fit indices are satisfactory, but they are not excellent due to the fact that χ^2/df is bigger than three (**Table 4**).

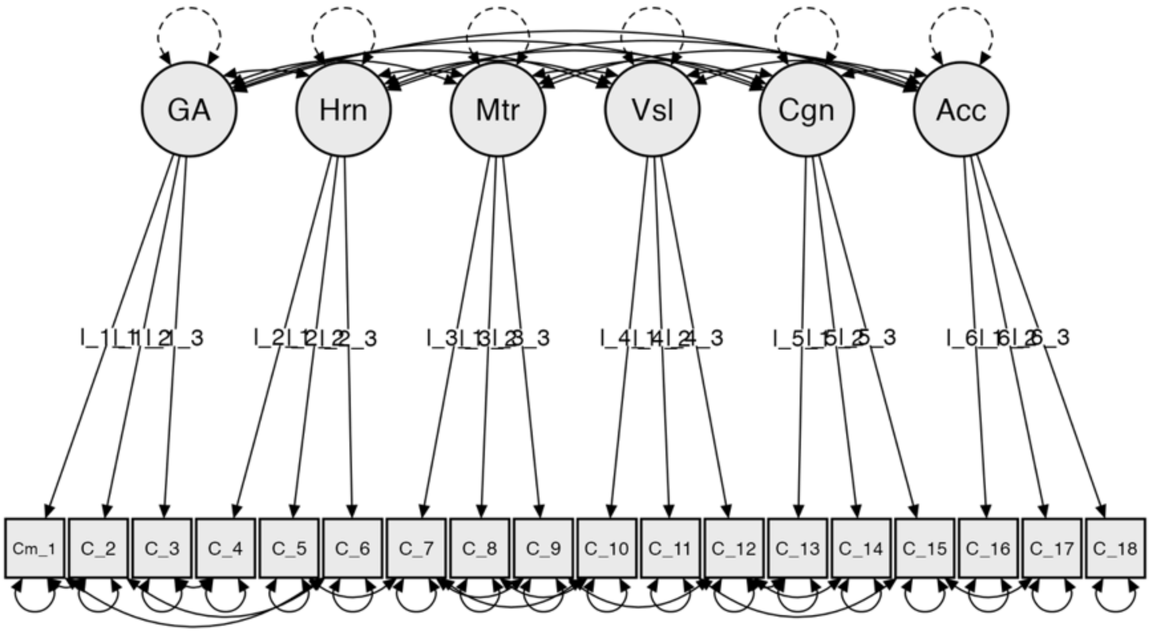

Figure 1. CFA model

Table 5. Factor loading values, z and p values

Factor	Indicator	Estimate	Standard error	z-value	p-value
General aspects	Com_1	1.028	0.053	19.272	<.001
	Com_2	1.050	0.048	21.766	<.001
	Com_3	1.025	0.048	21.481	<.001
Hearing	Com_4	1.039	0.044	23.570	<.001
	Com_5	0.872	0.049	17.617	<.001
	Com_6	1.176	0.042	28.037	<.001
Motor	Com_7	1.043	0.047	22.163	<.001
	Com_8	1.144	0.043	26.834	<.001
	Com_9	1.153	0.043	26.838	<.001
Visual	Com_10	1.019	0.046	22.071	<.001
	Com_11	1.086	0.046	23.446	<.001
	Com_12	1.144	0.043	26.554	<.001
Cognitive	Com_13	1.210	0.041	29.812	<.001
	Com_14	1.168	0.043	27.292	<.001
	Com_15	1.183	0.043	27.838	<.001
Accessibility	Com_16	1.181	0.042	28.326	<.001
	Com_17	1.145	0.042	27.158	<.001
	Com_18	1.126	0.045	24.929	<.001

The development of the new model was accomplished by implementing the covariance connections that were suggested by the software (**Figure 1**). When we take a look at the last model fit indices, we find that the values of the CFI, TLI, IFI, and NFI are all greater than 0.95, however the values of the SRMR and RMSEA are both less than 0.08 (Hair et al., 2014). The CFA has determined that the instruments have reached a level of performance that is adequate.

At the p=0.001 level of statistical significance, the association between each item and the relevant variables can be considered statistically significant for all items. Min z value is 17.617 and the max z value is 29.812. The results of the CFA indicate that there is not a single thing that should be removed (**Table 5**).

Reliability Analysis

Both reliability measures use a threshold of 0.7 as their cutoff value (Hair et al., 2014). According to **Table 6**, each component of Cronbach's alpha and McDonald's value is more than 0.8. Additionally, it was found that the overall scale of the Cronbach's alpha value is 0.971, and that McDonald's likewise has a value of 0.971.

Table 6. KMO and Bartlett's test for each factor

Factors	Items	McDonald's ω	Cronbach's alpha
General aspects	3	0.871	0.870
Hearing	3	0.863	0.854
Motor	3	0.903	0.902
Visual	3	0.889	0.889
Cognitive	3	0.953	0.953
Accessibility	3	0.934	0.934
Total	30	0.971	0.971

DISCUSSION AND CONCLUSION

This research aims to analyze the psychometric features of the competencies of pre-service teachers in the use of ICT to help children who are in difficulties, with the end objective of adapting the findings for application in the Russian setting. The investigation was place at Russia University throughout the spring of the year 2022.

On a total of 524 students, an EFA and a CFA were utilized in order to validate the competence instruments. According to Edwards and Bagozzi (2000) and Watkins (2018), the EFA approach is a multivariate statistical tool. To evaluate the appropriateness of the data, both Barlett's test and KMO were computer-generated for each dimension. The results are quite high across the board for both aspects (Yong & Pearce, 2013). It was determined to use the maximum probability using the varimax rotation extraction approach. Parallel analysis was employed so that we could determine the total number of components. In a separate but simultaneous investigation, we contrasted the actual eigenvalues with the random order eigenvalues. When the real eigenvalues are higher than the arbitrarily ordered eigenvalues, the original factors are kept (Williams et al., 2010). The parallel analysis indicates that each dimension possesses its own distinct component.

The factor load that was the smallest inside the six-factor structure was 0.672, while the factor load that was the most was 0.978. Because there is only one structural component associated with each dimension, the names of the factors have been kept the same as they were in the first scale. Furthermore, none of the things need to be removed in any way.

An examination of the CFA test model was carried out to ascertain whether or not the structure contained within the competency instrument is accurate and whether or not the structural model can be further verified. The values for CFI, IFI, NFI, and TLI are all more than 0.95; on the other hand, the values for SRMR and RMSEA are all lower than 0.08 (Hair et al., 2014). The findings of the instrument agree with those of the CFA. The Cronbach's alpha value of the instrument is 0.971, whereas that of McDonald's is also 0.971.

As a direct result of this, research was carried out to determine the validity and reliability of the competence instruments when applied in the Russian context. According to the findings of the investigation, there were a total of 18 items and six factors. It is recommended that future researchers do studies to determine the validity and reliability of the instrument with a number of different groups. The fact that there was no use of quotas in terms of gender and departments in the selection of the sample is the most significant limitation of the study. In addition to this, the selection of colleges to include in the sample is restricted to those that can be approached. It is important to keep in mind that the data from the study do not adequately reflect the entirety of Russia.

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