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Education 5.0 Digital Learning Technologies Self-Efficacy Scale for Pre-Service Teachers: A Validity and Reliability Study[#]

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Research Article

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ABSTRACT

This study aimed to develop a valid and reliable measurement tool that examined pre-service teachers' digital learning technologies self-efficacy based on Education 5.0. Scale development stages were applied in the study. The participants consisted of 1083 pre-service teachers studying in education faculties at three different state universities during the 2022-2023 academic year. To assess the scale's validity and reliability content, face and construct validities were examined. Besides, the dataset was divided into two equal parts (n=541) for Exploratory Factor Analysis (EFA) and (n=542) for Confirmatory Factor Analysis (CFA) to confirm its validity and reliability. The analysis results revealed a 5-point Likert-type measurement tool consisting of 25 items and 5 different factors was obtained and confirmed by CFA. The Cronbach's Alpha internal consistency coefficient was found as (≥.91), indicating strong internal consistency. The model fit indices ($x^2/df = 2.145$; $p < .01$; AGFI = .90, GFI = .92, CFI = .93, IFI = .93, RMSEA = .46, SRMR = .41, RMR = .40) were determined to be accepted with criterion value ranges. In conclusion, the study contributes a valid and reliable scale to the field for evaluating pre-service teachers' digital learning technologies self-efficacy based on Education 5.0.

Keywords: Education 5.0, digital learning technologies, self-efficacy, pre-service teacher, scale development.

Öğretmen Adayları için Eğitim 5.0 Dijital Öğrenme Teknolojileri Öz-Yeterlik Ölçeği: Geçerlik ve Güvenirlik Çalışması

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Bu çalışma ön inceleme sürecinde ve yayımlanmadan önce iThenticate yazılımı ile taranmıştır.

ÖZ

Bu çalışmanın amacı, öğretmen adaylarının dijital öğrenme teknolojileri öz-yeterliklerini Eğitim 5.0 bağlamında inceleyen geçerli ve güvenirli bir ölçme aracı geliştirmektir. Çalışmada ölçek geliştirme aşamaları uygulanmıştır. Katılımcılar, 2022-2023 akademik yılında üç farklı devlet üniversitesinin eğitim fakültelerinde öğrenim gören 1083 öğretmen adayından oluşmaktadır. Ölçeğin geçerlik ve güvenirliği; kapsam, görünüş ve yapı geçerliği analizleriyle gerçekleştirilmiştir. Bununla birlikte, veri seti Açımlayıcı Faktör Analizi (AFA) (n=541) ve Doğrulayıcı Faktör Analizi (DFA) için (n=542) iki eşit parçaya ayrılmıştır. Analiz sonuçları, 25 madde ve 5 farklı faktörden oluşan 5'li Likert-tipi bir ölçme aracı modelinin elde edildiğini ve DFA ile doğrulandığını göstermektedir. Cronbach Alfa iç tutarlık katsayısı ($\geq .91$) olarak bulunmuş ve pozitif bir iç tutarlılık göstermektedir. Model uyum indeksleri ($x^2/df = 2.145$; $p < .01$; AGFI = .90, GFI = .92, CFI = .93, IFI = .93, RMSEA = .46, SRMR = .41, RMR = .40) kabul edilen ölçüt değer aralıklarıyla uyumlu bulunmuştur. Sonuç olarak bu çalışma, öğretmen adaylarının dijital öğrenme teknolojileri öz-yeterliklerini Eğitim 5.0 bağlamında değerlendirmek için geçerli ve güvenirli bir ölçek olarak alana katkı sağlamıştır.

Anahtar Kelimeler: Eğitim 5.0, dijital öğrenme teknolojileri, öz-yeterlik, öğretmen adayı, ölçek geliştirme.

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Introduction

The effective use of digital technologies is increasingly becoming crucial, revolutionizing educational and business environments with innovative approaches across various fields. The rapid progress of digital technologies globally necessitates individuals to have new skills, relying on self-efficacy to stay relevant (Grand-Clement, 2017). This dynamic transformation is observable in diverse human endeavors, leading to influences on relationships, information disseminations, societal perspectives, living conditions (Levano-Francia et al., 2019), etc. To keep up with the age, both individuals and societies must comprehend and embrace the ongoing process (Bozkurt et al., 2021). Given the pivotal role of innovation in the development of 21st century skills, it becomes imperative to adopt lifelong learning, and cultivate creative problem-solving abilities across various domains for coping with demands, uncertainties and, complexities brought about by the contemporary advancements of this age (Charkas, 2018).

As digital natives advancing toward smart societies, it becomes crucial for them to enhance and cultivate a diverse set of skills, such as proficiency in mastering data management, expertise in handling big data, and gaining a comprehensive understanding of Internet of Things (IoT) functionalities (Mehmood et al.,2017; Partnership for 21st Century Skills, 2019). Recognizing the importance entrepreneurship (Kummitha, 2019), embracing critical (Agbo et al., 2021) and creative thinking, cultivating innovative ideas and solutions, addressing routine assessments, and designing potential improvements are becoming increasingly essential. Therefore, self-efficacy should encompass the evaluation of goals, behaviors, conditions, fostering strategic development in smart learning environments (Koper, 2014). The accessibility of information has a huge impact on data validity, serving as a key indicator for accessing the latest and accurate data promptly and effectively to stay relevant in this innovative digital age (Chasse, 2017), enabling informed predictions about future developments (Vista et al., 2018).

The rapid advancement of technology prompted Japan to introduce "Society 5.0," a concept focused on addressing present and potential challenges in today's world (Bundu & Patta, 2019). This human-centered society initiative aims to create a society adept at efficiently tackling a variety of issues in time with digital solutions for all humanity (Japan Prime Ministry Office, 2017). Technologies such as the Internet of Things, big data, robotics, and other AI-supported technologies have important roles in addressing social, ecological, and economic problems, as many countries are expected to face diverse challenges due to data-driven innovation and emerging new technological applications in the near future (Fukuda, 2020). In this regard, educational transformation is becoming essential for the progression of Society 5.0. Such transformation leads to an understanding and appreciation of evolving processes and tackle challenges. Therefore, this transformation should be realized through curricula revisions aligned with the digital demands of the age. Consequently, the objectives of Education 5.0 include development of innovation skills, knowledge skills, media and technology skills, as well as life and career skills (Dwiningrum, 2021). The focal point is on educating individuals who are knowledgeable and skilled, an approach increasingly common in universities facilitating innovations and productivity (Chirume, 2020).

Referred as the "talent tsunami," driven by digitalization and the need to develop new skills in response to demands of today's business world, highlights the importance of enhancing professional competencies and basic skills through education (Auricchio, 2017). It is about how data is generated, managed, stored and applied for long-term competitive advantages in global world (Manesh et al., 2020). The basic aspects of the digital age rely significantly on digital self-efficacy. Therefore, students, teachers, and staff in educational environments need to develop high-level skills to actively participate in digitized and networked environments (Punie, 2007). As Reisoğlu and Çebi (2022) state, these skills are crucial for accessing and managing information, creating and sharing content, facilitating communication, fostering collaborative work, and developing problem-solving skills. These can be achieved through competent use of digital technologies, taking into account both national and international developments (Bozkurt et al., 2021). For this reason, it is necessary to move learning beyond the traditional constraints of time and space (Roll & Wylie, 2016). AI-powered technologies provided aspects for improvements that provide significant opportunities to overcome complex challenges (Bekeš & Galzina, 2022). This has led to the development of smarter lesson plans, enriched resources, access to information, secure campuses, and more in various domains (Abdel-Basset et al., 2018). Moreover, it promotes the development of competencies such as data literacy, communication and collaboration, intellectual property, problem solving, critical thinking, digital well-being and security in educational settings (Ardıç & Altun, 2017; European Commission, 2019; Ferrari, 2012; Janssen et al., 2013; Suwanroj et al., 2019). Consequently, recognizing the risk of pre-service teachers' lacking competence in 21st century skills to educate future generations, such as global connectivity skills in digital environments (Bozkurt et al., 2021), requires a comprehensive assessment of how they use technology (Aydın, 2019; Murat, 2018) and how they develop these skills (Çiftçi & Bakar, 2020).

Effective digital transformation projects are essential to ensure Turkey's education system needs in demands of digital age (Karabacak & Sezgin, 2019). These initiatives should focus on individuals' development of digital competencies and high-level cognitive skills in the long term (Demirci-Celep, 2020). Given the rapid progress of Technology 5.0 in various fields, there's a need to conduct new research (Dewi et al., 2020). For instance, the Scientific and Technological Research Counsil of Türkiye

emphasizes research on innovative technologies within scope of R&D and innovation (TÜBİTAK, 2021). However, to achieve Türkiye's goal of being among the most developed countries in the world, individuals should training with cultural progress of the characteristics of Society 5.0 (Öztürk & Ateş, 2021). Therefore, to conduct new studies on Society 5.0 and its variables in Türkiye is important (Akın et al., 2021). In this regard, competence of today's teachers and learners in using digital technologies is a crucial factor (Sa & Serpa, 2020) because, today's generation exhibits self-directed learning tendencies and finds traditional courses boring (Shatto & Erwin, 2016). Indeed, even their perspectives on school autonomy reflect a self-directed approach (Çankaya et al., 2020). Their expectations to integrate digital real-life experiences into school settings indicate a positive connection with the digital world. It's important to see this expectation as an attitude rather than a negative perception (Howell, 2012) because, this generation is significantly affected by digital transformation. They are equipped with smart devices, social media, internet-based technologies, and exhibit strong self-control mechanisms to deal with uncertainties (Bağcı & İçöz, 2019). As a result, it is important to maintain independence, critical thinking skills, experience with new technologies, the ability to collaborate, exchange information and opinions, demonstrate creativity, and to adapt new conditions (Akramova, 2017). Since, the unique characteristics of each generation inevitably affect education, it is crucial for teachers to gain a comprehensive understanding of the generation that they educate (Ömür, 2021). Generation Z teachers should be competent in implementing student-centered educational approaches that aim to develop skills related to the technological platforms and apply innovative technology-supported strategies and methods, (Karadoğan, 2019). The teaching profession is increasingly valued for the perceived self-efficacy and competence. Therefore, it is crucial for educational stakeholders to understand and address their needs (Cortino, 2019). With the emergence of Marketing 5.0, driven by innovative technologies, the future consumer market will be shaped and this respect it is essential to examine characteristics and preferences of Generation Z and Alpha (Koç, 2021).

In summary, the effective use of digital technologies in education is crucial not only for the today's generation but also for future students and the development of the country. This study emphasizes the importance of developing a scale to evaluate pre-service teachers' self-efficacy in digital learning technologies in the context of Education 5.0. Considering the dynamic nature of today's digital environment and the role of Generation Z pre-service teachers in education of Generation Alpha, the study contributes to the field as a valide and reliable data collection tool to address new approaches in this context and for ever-changing educational environments.

Method

The Stage of Structuring the Item Pool

To increase the explanatory and predictive power of the scale, measures of personal efficacies should be organized according to their functional domain and be representative of the task demands in the relevant domain. This includes providing a clear definition of activities and a conceptual analysis of the various aspects, types of abilities required and contexts in which they are applicable (Bandura, 1997). First, the characteristics to be measured were determined (İlhan et al., 2020). In this context, considering the roles of Education 5.0 (Bigirimana, 2021), principles determining the basic structures of Society 5.0 (Keidanren, 2020), new technologies (Güzeloğlu-Yörük & Erat, 2021; Yamano et al., 2020), competencies and innovative ecosystem (Keidanren, 2019; Kellevezir, 2022), the characteristics included in the scale are creative thinking and entrepreneurship, critical thinking, data skills, Internet of Things and safety competencies. These are named as competencies because of their function in measuring personal efficacy (Bandura, 1997). Second, a comprehensive review of the literature and theoretical knowledge (Ala-Mutka, 2011; UNESCO, 2022; Vuorikari et al., 2022), as well as a previous studies on digital competence scales was conducted to develop valid and reliable scale's items. Some contributions of specific references were identified (e.g., Akkoyunlu et al., 2010; Bayrakçı, 2020; Karakuş et al., 2022; Nordén et al., 2017; Ocak & Karakuş, 2018; Olur & Ocak, 2021; Şimşek & Yazar, 2016; Toker et al., 2021; Ulfert-Blank & Schmidt, 2022; Wang et al., 2021; Yazar & Keskin, 2016; Yılmaz et al., 2021). Despite the abundance of literature, there was a significant gap in related scale development study, and to address this gap, behavioral characteristics of the scale were developed in demensions based on previous studies. These studies include the European Union-funded project "Dedalus/Developing Data Literacy Courses for University Students," by Walker et al. (2019) provided indicators of data items. "Internet of Things Skills" (Van Deursen et al., 2021) was used fort he competency items of the Internet of Things. Critical thinking competency indicators (Faciona, 1990), creative thinking competency indicators (Treffinger et al., 2002), entrepreneurship competency indicators (European Commission, 2018) and the safety competency indicators are based on the DigComp 2.2 (Vuorikari vd., 2022). Consequently, a pool of 40 items was developed for the Education 5.0 digital learning technologies self-efficacy scale for pre-service teachers.

The Stage of Receiving Expert Opinions

Experts opinions were carefully evaluated to ensure content and face validity. Content validity is concerned with whether the sample of items represent the characteristics to be measured in quantity and quality, while faace validity is used to evaluate the name of the scale, its descriptions, the organization of the items (Büyüköztürk, 2020; DeVellis, 2017). Experts' opinions include clarity, brevity, grammar, reading level, face validity, plurality, addition of new items, and suggestions (Worthington & Whittaker, 2006). The

scale, comprising 40 items, was evaluated using an expert evaluation form and graded as “Must stay”, “Must be corrected “, and “Must be removed.” In this context, each item was analyzed by a total eight experts: three from the Instructional Technologies Department, three from the Curriculum & Instruction Department, one from Assessment & Evaluation Department, and one from Primary Education Department. The content validity was calculated using "Modified Lawshe Technique," a widely used method in the literature, and originally developed by Lawshe (1975) and later revised by Wilson et al. (2012); Ayre and Scally (2014). The formula for this technique is as follows:

$$\mathrm{CVR}_{\mathrm{critical}} = \frac{\mathrm{n}_{\mathrm{critical}} - (\mathrm{N}/2)}{(\mathrm{N}/2)} \text{ or } \mathrm{CVR} = \frac{\mathrm{Ng}}{\mathrm{N}/2} - 1$$

The Content Validity Ratio (CVR) is significant with a minimum and critical value of α=.05, determined based on the number of experts involved. The evaluation is linked to the scale items, which are rated on a 3-point scale (Ayre & Scally, 2014; Lawshe, 1975; Wilson et al., 2012). Since there were 8 experts, the CVR criterion value of the scale was .750. After analyzing the opinions of experts, the scale’s content validity index and critical content validity ratio were optained as CVI = .85, CVR = α=.05 at significance level. Additionally, during the expert review process, 3rd, 4th, 8th, 18th and 31st items received a value of .500. Since the expert opinions were in favor of revising these items, they were revised and aligned with experts’ feedback given. After determining participant information and rating items on a 5-point Likert-type scale, includes "Every time (5)", "Often (4)", "Sometimes (3)", "Rarely (2)", and "Never (1)" by an assessment and evaluation expert, the scale was applied.

The Participants and the Stage of Application

Considering planning of research design, one of the most critical factors is determining the appropriate sample size. It should be large enough to represent the entire research population, ensuring high reliability, and facilitating the application of complex statistical methods (Cohen et al., 2007). However, there is not a consensus in the existing literature regarding on adequacy of sample size for factor analysis (Aksu et al., 2017). One perspective suggests that a sample size of 300 participants would be sufficient to minimize potentail influence of participant variance on the items (Nunnally, 1978). Furthermore, various thresholds have been proposed to assess the adequacy of sample size: 50 is considered very low, 100 is considered low, 200 is categorized as medium, 300 is regarded as good, 500 is viewed as very good, and 1000 is considered ideal (Comrey & Lee, 1992; Tavşancıl, 2010). On the other hand, studies involving scales with numerous items and factors require a larger participant pool. It is recommended that the number of participants should be more than 5 times the numbers of items (variables), and the optimal ratio is 10 times the number of participants (Ho, 2006; Cohen et al., 2007) as applied in this study. Considering 40 items of the scale, the adequacy of sample size was determined as 10 times the number of items and above, resulting in 541 for exploratory factor analysis and 542 for confirmatory factor analysis, N=1083 in total. Pre-service teachers studying at the education faculties of three different state universities participated in the study in Türkiye during 2022-2023 academic year. Demographic information of participants is given in Table 1.

As seen in Table 1, 73.5% of the participants were female, while 26.5% were male.

Table 1. The Descriptive Qualities of Participants

Gender	**N**	**%**	**Branch**	**N**	**%**
Female	796	73.5	Mathematics	143	13.2
Male	287	26.5	Geography	12	1.1
Total	1083	100.0	Turkish Language	92	8.5
			Classroom Teach.	73	6.7
			Science Teaching	105	9.7
			German Teaching	84	7.8
			Art Teaching	60	5.5
			English Teaching	151	13.9
			Turkish Literature	39	3.6
			Social Sciences	67	6.2
Grade	**N**	**%**	Preschool Teaching	94	8.7
Freshman	293	27.1	History Teaching	39	3.6
Sophomore	369	34.1	Music Teaching	3	.3
Junior	306	28.3	Chemistry Teaching	20	1.8
Senior	115	10.6	PGC	101	9.3
Total	1083	100.0	**Total**	1083	100.0

Considering participation levels by grades, 34.1% were sophomores, 28.3% were juniors, 27.1% were freshmen, and 10.6% were seniors. Regarding branch distribution, the highest percentage was in English with 13.9%, followed by Mathematics with 13.2%, and Psychological Guidance and Counseling (PGC) with 9.3%. On the other hand, the lowest distribution is seen in Music with 0.3%, Geography with 1.1%, and Chemistry with 1.8%.

Results

The study aimed to develop the validity and reliability of the Education 5.0 digital learning technologies self-efficacy scale for pre-service teachers. The scale was conducted to a total of 1083 participants in the 2022-2023 academic year. This section presents the outcomes of various analyses, including adequacy of sample size, normality test, inter-item correlation, factor definition, exploratory factor analysis, reliability assessment, and confirmatory factor analysis.

The Stage of Sample Adequacy, Normality, Inter-Item Correlation and Cattell's Scree Plot Analyses

Before analyzing the construct validity of the scale, the adequacy of sample size was controlled. It was calculated by using the Kaiser-Meyer-Olkin (KMO) sampling adequacy and Barlett Sphericity tests. The KMO test provides insights into the variance ratio of variables/items within the dataset (Kaiser, 1974), whereas the Barlett Sphericity test examines the hypothesis of relationships in the correlation matrix (Tabachnick & Fidell, 2013). According to the results, Kaiser-Meyer-Olkin (KMO) value is 0.95, and the significance of Barlett's Test of Sphericity is p<.05 provided suitable indicators ($X^2(780) = 9186.729; p = .00$) for the factor analysis (Field, 2018; Kaiser, 1974; Kaiser & Rice, 1974; Karagöz & Bardakçı, 2020; Pallant, 2016; Worthington & Whittaker, 2006).

Following the sample size adequacy analysis, it is crucial to determine normal distribution of the dataset. Normality assumes that all variables selected from the population follow a normal distribution (Tavşancıl, 2010). This helps establish relationships of correlation for factor analysis (Can, 2019). Since, the skewness and kurtosis coefficient values were between -1.5 and +1.5, it is reasonable to assert that the dataset exhibits a normal distribution (Tabachnick & Fidell, 2013).

It is crucial to explore the inter-item correlation matrix to facilitate factor analysis as well. Generally, an inter-item correlation matrix is considered acceptable when the correlation coefficient is r >.30 or exceed; otherwise, the dataset becomes questionable (Yaşlıoğlu, 2017). In this analysis, it was observed that items exhibited an inter-item relationship with values r >.30 and above with the correlation matrix value of Determinant>.01. This result indicates the dataset's suitability for factor analysis (Can, 2019). Upon examining the inter-item correlation analysis, Cattell's scree plot test, a widely accepted method, was employed to determine the number of factors of the scale. The unrotated scree plot test results are presented in Figure 1.

The figure shows a steep downward trend, beginning with the first factor and continuing through the second factor. It then transitions to a horizontal plane after the fifth factor, but according to scree plote, there are seven potential factors to be considered. Cattell (1966) states that determination of factors is associated with specific conditions and the total variance is obtained from the rotation of true and error-related factors. Essentially, when a significant variable is omitted, the total variance remains fixed as a percentage covering the majority of duplicating variance. Furthermore, when error variance is included into common error factors through rotation, the true factors become apparent.

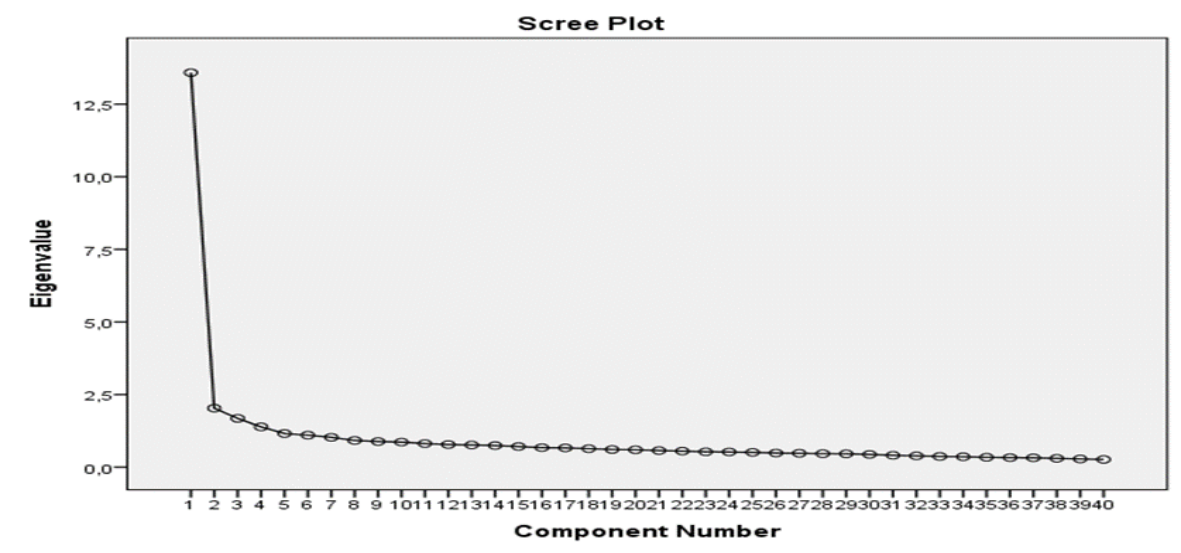

Figure 1. Distribution of the items of the scale according to the scree plot test

The Stage of Exploratory Factor Analysis

Exploratory Factor Analysis is a statistical procedure used to reduce a large number of variables into certain number of facors and transform them into a maximum number of new variables within each factor while minimizing the relationship between different factors (Karagöz & Bardakçı, 2020). In this study, the Principal Axis Factoring method was used, which assumes perfect self-correlation for each variable in itself, generates common variance and sets all diagonal factors to one (Aksu et al., 2017; Field, 2018; Greenacre et al., 2022; Ringnér, 2008). Additionally, varimax, one of the orthogonal rotation techniques that generalizes the results and provides the best solution was used to obtain rotation (Kaiser, 1959; Büyüköztürk, 2020). This technique provides interpreting the solution without altering the mathematical properties of dataset, ensuring the effects of uncorrelated factors are summed in a simple way, and independent, while the relationship between a factor and any item remains direct in this technique (DeVellis, 2017). Furthermore, when omitting items, various criteria were considered to ensure they do not measure the same structure. Initially, the focus of this study was on retaining items with high loading values (Büyüköztürk, 2020). Then, items with loading values under .01, indicating both low contribution to the factor and high measurement error were omitted (Fabrigar & Wegener, 2011; Kaiser, 1958). Within this scope, items with loading values i30: .050, i1: .017, i6: .012, i8: .001, i9: .099, i11: .015, i15: .046, i27: .032, i39: .092, i28: .021, i29: .019, i24: .035, i26: .039 were omitted from the scale. Lastly, items i40 and i10 were removed due to overlapping that they were theoretically related to each other. Finnaly, it was considered to be included items values with .001 and above in the scale (Kaiser, 1958). The results of this analysis are given in Table 2.

As seen in Table 2, the total variance ratio of the scale is 43.815%. This ratio percentage is considered adequate in multifactor scale development studies within the field of social sciences when the total variance ratio exceeds 40% (Büyüköztürk, 2020; Tavşancıl, 2010) as in this study. The creative thinking & entrepreneurship competency dimension accounts for 12.245% of the variance and includes 8 items. The critical thinking competency dimension explains 10.907% of the variance with 6 items, and the data competency dimension explains 7.509% of the variance with 4 items. Furthermore, Internet of Things competency dimension, consisting of 4 items explains 6.733%, and the safety competency dimension with 3 items explains 6.421% of the variance. Consequently, the analysis revealed 5 different factors ranging from 3.061 to 1.605, whose eigenvalues exceeded the .01 threshold and were considered suitable of factor analysis (Kaiser, 1991). As for naming the factors, all items obtained within the scope of 5-factors structure were named by considering the competence indicators determined by literature research. Accordingly, Factor-I consisting of 8 items, named as “Creative Thinking & Entrepreneurship Competency”, includes indicators such as examining ideas in depth, being open and courageous in exploring ideas, recognizing opportunities, creativity, predicting and valuing ideas. Factor-II, called “Critical Thinking Competency” and consisting of 6 items, includes indicators of interpretion, analysis, evaluation, inference, explanation and self-regulation. Factor-III, called “Data Competency” and consisting of 4 items, has indicators of data protection and security, and data selection and critical evaluation. Factor-IV, called “Internet of Things Competency” and consisting of 4 items, refers to data processing and communication skills. Finally, Factor-V consisting of 3 items and called “Safety Competence”, has indicators related to safety competency. Table 3 presents the factor loadings, item distribution among factors, and Cronbach's Alpha values.

Table 2. Ratios of Variance Explained by Factor and Total Variance of the Scale

		Rotated Load Values	
Factors	**Eigenvalue**	**Percentage Variance %**	**Total Percentage %**
Creative Thinking & Entrepreneurship Competency	3.061	12.245	12.245
Critical Thinking Competency	2.727	10.907	23.152
Data Competency	1.877	7.509	30.661
Internet of Things Competency	1.683	6.733	37.394
Safety Competency	1.605	6.421	**43.815**

Table 3. Distribution of Items in Factors, Factors Loadings and Cronbach's Alpha Values

		Factors Loadings Values					Cronbach's Alpha
Factors	Item No	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	
Creative Thinking & Entrepreneurship Competency	31	.482					.818
	32	.537					
	33	.467					
	34	.315					
	35	.617					
	36	.596					
	37	.621					
	38	.504					
Critical Thinking Competency	19		.592				.820
	20		.634				
	21		.517				
	22		.496				
	23		.552				
	25		.448				
Data Competency	2			.407			.703
	3			.675			
	4			.584			
	5			.510			
Internet of Things Competency	7				.394		.694
	12				.514		
	13				.683		
	14				.445		
Safety Competency	16					.490	.735
	17					.749	
	18					.587	

* Extraction Method: Principal Axis Factoring
* Rotation Method: Varimax with Kaiser
* Total Varyans: 43.815
* Cronbach's Alpha Total: .91
* Total: 25 items

As seen in Table 3, the Education 5.0 digital learning technologies self-efficacy scale for pre-service teachers consists of 5 different factors. It is worth noting that the loading values of the items within their factors are mostly .45, which is accepted as an indicator good performance, and the threshold value for the criterion is determined as .30 (Büyüköztürk, 2020). Thus, it can be said that item loading values are within acceptable range. The result supports DeVellis's (2017) poin of view, emphasizing that multidimensional scales should include multiple items that exhibit a strong correlation with each another. In addition, the scale's reliability was evaluated using Cronbach's Alpha coefficient as an indicator of internal consistency measurement (Can, 2019). Cronbach's Alpha analysis is an accepted method for evaluating the reliability of measurement tools, especially a five-point Likert-type scale of self-efficacies (DeVellis, 2017; Sönmez & Alacapınar, 2016). Cronbasch (1951) suggests that a minimum reliability score of .70 or higher is acceptable, while the maximum recommended score's realibility is .95, and ideally, scores around .90 is good. However, especially in the context of multidimensional factor analysis a realibility value .60 is also acceptable (Hair et al., 2017; Hair et al., 2019; Kaiser, 1991; Tavşancıl, 2010) as is .69 in Internet of Things Competency. Another method used for item analysis is to divide participants the highest 27% and the lowest 27% groups based on total scores. The difference between item scores of these was evaluated using Independent Sample T-test (Büyüköztürk, 2020) along with Levene's test to evaluate equality of variances between the highest and lowest goups for each item (Can, 2019).

As seen in Table 4, the item-total-score correlation values vary between .33 and .63. The results of the independent sample T-test and the Levene's equality of variances test show that 25 items exhibit a significant relationship $p<.05$ with the total score (Aksu et al., 2017), equal variances of the groups assumed (Can, 2019). In addition, the Pearson correlation coefficient score 25 items shows a significant relationship $p<.01$ with the item total-score correlation (Büyüköztürk, 2020). In this case, it can be said that the 25 items measure the same characteristics and therefore, reliability and validity were ensured.

Table 4. Item Discrimination Indices Values of the Scale

Items	Item Total-Score Correlation	Arithmetic Mean	Standard Deviation	Significance Value (p)
31	.576	3.91	.879	.00
32	.523	3.72	1.026	.00
33	.604	3.89	.954	.00
34	.388	3.42	1.702	.00
35	.608	3.60	.991	.00
36	.618	3.65	.989	.00
37	.632	3.68	1.009	.00
38	.574	3.62	1.027	.00
19	.612	3.79	.966	.00
20	.569	3.86	.937	.00
21	.510	3.95	.862	.00
22	.540	3.99	.881	.00
23	.572	4.07	.836	.00
25	.570	3.94	.927	.00
2	.338	4.07	.941	.00
3	.520	4.02	.787	.00
4	.513	3.79	.876	.00
5	.478	4.01	.887	.00
7	.382	3.55	1.114	.00
12	.518	3.74	1.087	.00
13	.497	4.12	.935	.00
14	.517	3.69	1.155	.00
16	.544	3.58	1.021	.00
17	.485	3.06	1.228	.00
18	.488	3.40	1.160	.00

Table 5. Confirmatory Factor Analysis Fit Index Criteria

Fit Index	Good Fit Value	Acceptable Fit Value
x^2/df	$0 \leq x^2/df \leq 2$	$2 < x^2/df \leq 3$
AGFI	$.90 \leq AGFI \leq 1.00$	$.85 \leq AGFI < .90$
GFI	$.95 \leq GFI \leq 1.00$	$.90 \leq GFI < .95$
CFI	$.97 \leq CFI \leq 1.00$	$.95 \leq CFI < .97$
NFI	$.95 \leq NFI \leq 1.00$	$.90 \leq NFI < .95$
RMSEA	$0 \leq RMSEA \leq .05$	$.05 < RMSEA \leq .08$
SRMR	$0 \leq SRMR \leq .05$	$.05 < SRMR \leq .10$
RMR	$0 \leq RMR \leq .05$	$.05 \leq RMR \leq .10$

The Stage of Confirmatory Factor Analysis

Confirmatory Factor Analysis (CFA) provides theoretically valuable information on latent relationship patterns, the structure of a scale and the validity of its relevant factors. The information is typically derived from analytical findings obtained through exploratory factor analysis (EFA) of the scale. CFA serves the purpose of comparing a limited number of models to assess how well the hypothesized latent variable model fits the data observed and which model the best fits the data obtained (DeVellis, 2017; Finch, 2020). The analysis was conducted using the AMOS package program, which serves as an interface of SPSS. In the literature, there are numerous fit indices to evaluate the validity of the structure/model of a scale within the scope of CFA. However, the most widely used and significant fit indices in research were adopted as criteria for evaluating CFA results (Schermelleh-Engel et al., 2003). The fit index criteria of the CFA are presented in Table 5.

Table 6. Results of CFA Fit Indices Criteria of the Scale

x^2/df	AGFI	GFI	CFI	IFI	RMSEA	SRMR	RMR
2.145	.90	.92	.93	.93	.046	.041	.040

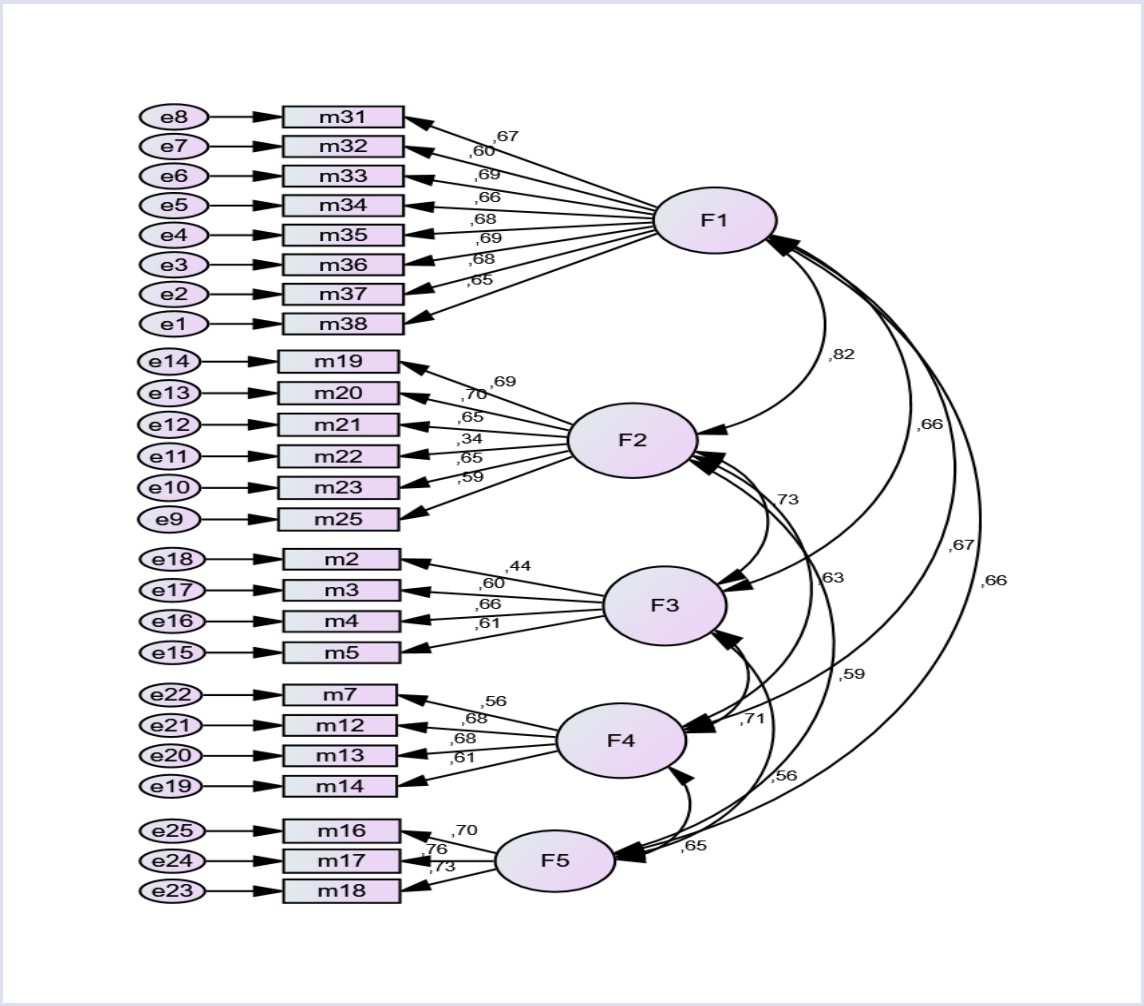

Figure 2. CFA diagram of education 5.0 digital learning technologies self-efficacy scale for pre-service teachers

As seen in Table 6, the fit index values showing the relationship between the observed variables and the factors of the model are appropriate as found in previous studies (Aksu et al., 2017; Brown, 2015; Harrington, 2009; Kline, 2011; Schermelleh-Engel et al., 2003). The findings show the structure/model derived from the exploratory factor analysis aligns harmoniously with the results of the confirmatory factor analysis, therefore, confirming the integrity of five-dimensional structure of the scale without modification. Figure 2 illustrates the diagram produced as a result of the CFA analysis.

According to the standardized results of CFA, the items exhibited loading values ranging from .34 to .76. This range indicates that the scale items fit the relevant model Adequately. In this regard, the CFA fit indices (as presented in Table 6) reveal that the model's fit indices values meet satisfactory criteria. As a result, it shows that both the overall and factors' scores of the scale can be used for future studies. In the study, "Education 5.0 Digital Learning Technologies Self-Efficacy Scale for Pre-service Teachers," wit 25 items and 5 different dimensions was successfully developed.

Education 5.0 Digital Learning Technologies Self-Efficacy Scale (E5DLTSES) for Pre-service Teachers Model

The scale was developed as a result of the exploratory and confirmatory factor analyses, provides essential indicators of validity, reliability, suitability, and applicability criteria as a model for scale development studies. The developed The Education 5.0 Digital Learning Technologies Self-Efficacy Scale Model for Pre-service Teachers is presented in Figure 3.

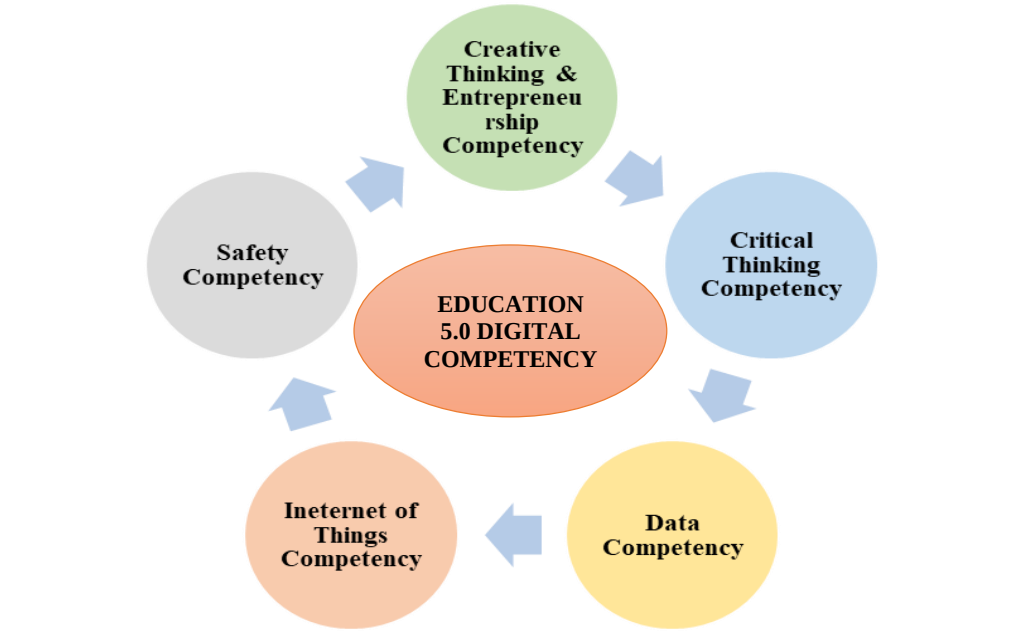

Figure 3. Model of Education 5.0 Digital Learning Technologies Self-Efficacy Scale for Pre-service Teachers (E5DLTSES)

Conclusion, Discussion and Recommendations

In this study, the validity and reliability of statistical studies were conducted to develop the Education 5.0 digital learning technologies self-efficacy for pre-service teachers. Pre-service teachers studying at the education faculties of three different state universities participated in the study, in Türkiye during 2022-2023 academic year. The scale includes 5 factors, 25 positively framed items, and no reverse-scored items. Participants rated these items on a 5-point Likert-type scale, ranging from "Every time (5)", “Often (4)”, “Sometimes (3)”, “Rarely (2)” to "Never (1)." The first factor is Creative Thinking & Entrepreneurship Competency (items 1, 2, 3, 4, 5, 6, 7, 8); the second factor is Critical Thinking Competency (items 9, 10, 11, 12, 13, 14). The third factor is Data Competency (items 15, 16, 17, 18), while the fourth factor is the Internet of Things Competency (items 19, 20, 21, 22). Finally the fifth factor is Safety Competency (items 23, 24, 25) as shown in appendix. The confirmatory factor analysis results confirmed the structure identified by exploratory factor analysis. Moreover, the Cronbach’s Alpha internal consistency coefficients of the scale were ≤.91. The model fit indices, including (x^2/df = 2.145; p<.01; AGFI = .90, GFI = .92, CFI = .93, IFI = .93, RMSEA = .46, SRMR = .41, RMR = .40) met acceptable criteria. These results provide significant evidence supporting the validity and reliability of 5 factors and 25 items of the E5DLTSES. In conclusion, this study shows that pre-service teachers have a positive level of self-efficacy in digital learning technologies based on Education 5.0.

Today’s generation has unique characteristics marked by a strong sense of self-efficacy and lives in digital age. This should be understood by education stakeholders (Cortino, 2019). With the emergence of Education 5.0, demanding competent individuals in research, community service, innovation, and industrialization (Chirume, 2020), underlining the impact of technology on both the business world and Generation Z. Therefore, the generation needs to develop the competencies (Taş et al., 2017). These include creative thinking, entrepreneurship, data analysis, analytical thinking, innovation, problem-solving, critical thinking, active learning, and the use of digital technology applications (Liang & Lim, 2020; World Economic Forum, 2020). Moreover, today’s generation should embrace technology as a facilitator for collaboration, information exchange, openness to new ideas, and creative approach in today's ever-evolving conditions. To achieve this, independent, critical, and constructive thinking skills need to be developed and fostered through hands-on experiences with digital applications (Akramova, 2017).

Future studies can address pre-service teachers’ self-efficacy on digital learning technologies with different dimensions. Adopting such an approach may provide valuable insights into the development of digital learning technologies self-efficacy, expecially in the context of Education 5.0. The growing importance of smart societies, cities, and campuses can not be ignored. In conclusion, it is believed that the results of this study will be an important resource to guide curriculum developments in the Education 5.0 framework. Moreover, the development a valid and reliable scale contributes significantly to the field by enabling evaluation pre-service teachers’ digital learning technologies self-efficacy within the framework of Education 5.0.

Genişletilmiş Özet

Giriş

Dijital çağın hızlı gelişimi, "yetenek tsunamisi" olarak adlandırılan yeni becerilerin öğrenilmesini kaçınılmaz hale getirmiştir (Auricchio, 2017). Japonya'nın "Toplum 5.0" projesi, bu gelişime cevap olarak ortaya çıkmıştır (Bundu & Patta, 2019). Bu proje, bireyleri merkeze alarak sosyal, ekolojik, ekonomik ve farlı birçok alandaki problemlere çözüm odaklı yaklaşımları ve teknolojiyi etkili kullanmayı hedeflemektedir (Japan Prime Minister's Office, 2017). Bununla birlikte, Nesnelerin interneti, büyük very analitiği, robotik gibi yapay zekâ ve veri güdümlü teknolojilerin birçok ülke için zorluklar yaratacağı öngörülmektedir (Fukuda, 2020). Bu nedenle, Toplum 5.0'a doğru ilerlerken eğitim-öğretim yaşantılarının dönüşmesi gerekmektedir. Bilgiyi etkili kullanma, değer yaratma ve eyleme geçme becerileri yenilikçilik açısından bilgi, beceri, yaşam ve kariyer becerilerinin gelişiminde önemli rol oynamaktadır (Dwiningrum, 2021). Bu beceriler, dijital teknolojilerin etkin kullanılmasına dayanmakta ve problem çözme süreçlerinde önemli görülmektedir (Reisoğlu & Çebi, 2022). Türkiye'de öğretim programları ve dijital dönüşüm projelerinin bu kapsamda geliştirilmesi (Karabacak & Sezgin, 2019) vurgulanmaktadır. Dijital teknolojileri etkili kullanabilen, dijital yetkinliklere ve üst-düzey düşünme becerilerine sahip bireyler, Türkiye'nin eğitim gündemi açısından önemlidir (Demirci-Celep, 2020). Bu doğrultuda, Türkiye'de Toplum 5.0 ve ilgili alanlardaki çalışmalar (Akın vd., 2021), öğretmenlerin eğitim verecekleri öğrencilerin özelliklerini anlamlarına olanak sağlamalıdır (Ömür, 2021); çünkü dijital dönüşümden en çok etkilenenler, yüksek öz-denetim özelliklerine sahip olan bugünün nesilleridir (Bağcı & İçöz, 2019). Bu kapsamda, geçerli ve güvenilir bir ölçek geliştirmek amacıyla literatür araştırması yapılmıştır. Türkiye'de ve yurt dışında dijital yeterlik kapsamında yapılmış ölçek çalışmaları (Akkoyunlu vd., 2010; Bayrakçı, 2020; Karakuş vd., 2022; Nordén vd., 2017; Ocak & Karakuş, 2018; Olur & Ocak, 2021; Şimşek & Yazar, 2016; Toker vd., 2021; Ulfert-Blank & Schmidt, 2022; Wang vd., 2021; Yazar & Keskin, 2016; Yılmaz vd., 2021) bulunmaktadır. Literatür araştırması sonunda öğretmen adaylarının dijital öğrenme teknolojilerine yönelik öz-yeterliklerinin Eğitim 5.0 bağlamında inceleyen herhangi bir ölçek çalışmasına rastlanmamıştır. Bu nedenle bu çalışma, öğretmen adaylarının dijital öğrenme teknolojilerine yönelik öz-yeterliklerinin Eğitim 5.0 bağlamında inceleyen bir ölçeğin geçerlik ve güvenirlik çalışmalarını yürütmeyi hedeflemiştir. Analiz sonuçları, ölçeğin geçerlik ve güvenirlik kriterlerini sağladığını ve gelecekteki çalışmalarda uygulanabilir bir ölçek modeli olduğunu doğrulamıştır.

Yöntem

Bu araştırma, ölçek geliştirme sürecini temel alarak gerçekleştirilmiştir. Madde havuzu oluşturmak için ilgili literatür incelenmiştir. Daha sonra, aday ölçek formunun kapsam ve görünüş geçerliği için sekiz uzman görüşüne başvurulmuştur. Ölçeğin kapsam geçerliğini belirlemek için revize edilmiş Lawshe Tekniği kullanılmıştır. Bu teknik için kapsam geçerlik oranı (KGO) ve kritik değer .05'dir. Uzman sayısı sekiz olduğu için ölçeğin içerik geçerlik oranı (CVR) kriteri .750'dir. Elde edilen sonuçlar, ölçeğin kapsam geçerlik indeksi ve kritik kapsam geçerlik oranının anlamlı (CVI = .85;CVR = α=.05) olduğunu göstermiştir. Ancak, .750'nin altında değer (.500) alan 3., 4., 8., 18. ve 31. maddeler için uzman görüşlerinin revize edilerek kullanılması yönünde gelen dönütler dikkate alınmıştır, bu nedenle maddeler yeniden düzenlenmiştir. Kişisel bilgi formu ve 40 maddeden oluşan ölçeğin herhangi bir belirsizlik taşımadığı belirlendikten sonra, "Her zaman (5)", "Çoğu zaman (4)", "Ara sıra (3)", "Nadiren (2)" ve "Hiçbir zaman (1)" olacak şekilde 5'li Likert-tipi ölçek derecelendirilmesi, bir ölçme değerlendirme uzmanının görüşü doğrultusunda uygulanmıştır. Katılımcılar, 2022-2023 akademik yılında Türkiye'deki üç farklı devlet üniversitesinin eğitim fakültelerinde öğrenim gören 1083 öğretmen adayından oluşmaktadır.

Bulgular

Ölçeğin yapı geçerliği analizleri uygulanmadan önce, veri setinin örneklem uygunluk testi, Kaiser-Meyer-Olkin (KMO) testi ve değişkenler arasındaki ilişki ise Barlett küresellik testi ile incelenmiştir. Elde edilen sonuçlar, (X^2 (780)=9186.729;p=.00) veri setinin faktör analizi için uygun olduğunu göstermiştir. Örneklem büyüklüğü yeterlik testinden sonra, veri setinin normal dağılımını değerlendirmek için çarpıklık ve basıklık katsayıları hesaplanmıştır. Sonuçlar, -1,5 ile +1,5 arasında normal dağılım değerlerine işaret etmiştir. Bununla birlikte, maddeler arası korelasyon matrisi değerleri r > .30 ile korelasyon matrisinin Determinant > .01 uygun değeri, diğer tanımlayıcı analiz sonuçları arasında bulunmaktadır. Faktör sayısını belirlenmek için yamaç birikinti grafiği testi kullanılmıştır. Grafik incelendiğinde, birinci faktörden başlayarak ikinci faktöre doğru devam eden ve beşinci faktörden sonra yatay bir düzleme geçiş yapan dik bir düşüş eğilimi görülmektedir. Bu grafiğe göre, toplamda yedi potansiyel faktör olduğu görülmektedir. Ölçeğin, yapı geçerliğini sağlamak için açımlayıcı faktör analizi uygulanmıştır. Bu analizde, gerçek verinin ortak varyansını oluşturan faktörleri analiz eden ve evrene genelleme yapan temel eksen faktör analizi ile varimax döndürme tekniği kullanılmıştır. Analiz sonucunda, 25 madde ve 5 farklı boyuttan oluşan bir yapı elde edilmiştir. Cronbach Alpha içtutarlık katsayısı ≥.91, olarak belirlenmiştir. Bununla birlikte, açımlayıcı faktör analizi sonuçlarına dayanarak elde edilen yapıyı doğrulamak için doğrulayıcı faktör analizi yöntemi kullanılmıştır. Doğrulayıcı faktör analizi sonuçlarına göre, uyum indeks değerleri (x^2/df = 2.145; p <.01; AGFI = .90, GFI = .92, CFI = .93, IFI = .93, RMSEA = .46, SRMR =.41, RMR =.40) uygun düzeydedir. Sonuç olarak, Yaratıcı Düşünme & Girişimlik Yeterliği, Eleştirel Düşünme Yeterliği, Veri Yeterliği, Nesnelerin Interneti Yeterliği ve Gizlilik Yeterliği olmak üzere 5 farklı boyuttan ve 25 maddeden oluşan 5'li Likert tipi bir ölçme aracı elde edilmiştir.

Tartışma, Sonuç ve Öneriler

Bu çalışma ile öğretmen adaylarının dijital öğrenme teknolojilerine yönelik öz-yeterliklerinin Eğitim 5.0 bağlamında değerlendirmek için bir ölçek çalışmasının geçerlik ve güvenirlik analizleri yapılmıştır. Elde edilen sonuçlarına göre, 25 pozitif madde ve 5 farklı boyuttan oluşan 5'li Likert-tipi, bir ölçme aracı elde edilmiştir. Bu çalışma, gelecek nesil Alfa kuşağının öğretmen adaylarının dijital öğrenme teknolojilerine yönelik öz-yeterliklerinin değerlendirilmesi açısından önemlidir.

Günümüzde bireylerin sürekli değişen koşullara etkili çözümler üretebilme ve teknolojiyi üst-düzey becerilerle kullanabilme yeteneklerini geliştirmeleri son derece önemlidir. Bu beceriler, sosyal, ekonomik, çevresel, sağlık ve eğitim gibi birçok alanda karşılaşılan farklı zorlukların üstesinden gelmek ve toplumsal yaşama etkin şekilde katılmak için hayati önem taşımaktadır. Geliştirilen ölçeğin, gelecekteki çalışmalarda kullanılmasıyla birlikte, Eğitim 5.0 kapsamında dijital öğrenme teknolojileri öz-yeterliklerin değerlendirilmesine ve dolayısıyla alana katkı sağladığı düşünülmektedir.

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EK: Ölçek Formu

Öğretmen Adayları için Eğitim 5.0 Dijital Öğrenme Teknolojileri Öz-Yeterlik Ölçeği
Education 5.0 Digital Learning Technologies Self-Efficacy Scale for Pre-Service Teachers

		Maddeler	Her zaman	Çoğu zaman	Ara sıra	Nadiren	Hiçbir zaman
Yaratıcı Düşünme ve Girişimcilik Yeterliği	1	Bir problemin çözümüne yönelik özgün fikirlerimin uygulanabilirliğini dijital ortamdan yararlanarak inceleyebilirim.					
	2	Bir problemin çözümü için dijital ortamda gerçekleşen bilimsel etkinliklerden (seminer, konferans vb.,) yararlanabilirim.					
	3	Bir problemle ilgili çözüm oluşturmak için ihtiyaç ve fırsatları dijital ortamdan yararlanarak keşfedebilirim.					
	4	Bir problem için geliştirdiğim çözüm önerisini hayata geçirmek için gerekli olan tüm bağlantıları dijital ortamda kurabilirim (örneğin uzman insan kaynaklarına veya ilgili kurum ve kuruluşlara ulaşma).					
	5	Dijital ortamda bilgi ve kaynakları kullanarak bir problemin çözümü için özgün bir çözüm önerisi geliştirebilirim.					
	6	Dijital ortamda bilgi ve kaynaklardan yararlanarak gerçekleştirmek istediğim bir girişim için öngörülerde bulunabilirim.					
	7	Bir girişimi gerçekleştirmek için gerekli eylem planlarını dijital ortamdan yararlanarak oluşturabilirim.					
	8	Bir fikrin/önerinin toplumsal ve küresel açıdan istihdam gücünü dijital ortamda araştırarak değerlendirebilirim.					
Eleştirel Düşünme Yeterliği	9	Bir problemin çözümüne yönelik elde ettiğim bilgileri dijital ortamdan yararlanarak bulunduğu bağlam içerisinde yorumlayabilirim (örneğin çevresel kirliliğin çözümüne yönelik elde edilen bilgilerin toplumsal açıdan ele alınıp alınmadığını).					
	10	Dijital ortamda çalışmama (ödev, proje vb.,) yönelik elde ettiğim bilgiler hakkında çözümlemede bulunabilirim (örneğin düşük eğitim ve düşük gelirin, düşük hayat standartlarıyla ilişkisini analiz edebilme).					
	11	Dijital ortamda elde ettiğim bilgi ve kaynakların içerdiği farklı görüş ve yargıları yansız/objektif olarak değerlendirebilirim.					
	12	Bir problemin alternatif çözümlerinin sonuçlarıyla ilgili dijital ortamda elde ettiğim bilgiler hakkında farklı çıkarımlarda bulunabilirim (örneğin deniz kirliliğinin azaltılmasının biyoçeşitliliğe olası faydaları hakkında).					
	13	Bir çalışmayla (ödev, proje vb.,) ilgili dijital ortamlarda elde ettiğim bilgilerin önemini açıklayabilirim (örneğin öğrenme etkinliklerini gerçekleştirmede teknolojiyi kullanmak neden önemlidir).					
	14	Kullandığım dijital öğrenme uygulamalarının etkililiğini değerlendirebilirim.					
Veri Yeterliği	15	Dijital ortamda diğer kullanıcıların veri güvenliğine yönelik gerekli yasal ve etik sorumluluklara göre davranırım.					
	16	Dijital ortamda çalışmalarıma (ödev, proje vb.,) yönelik en uygun verileri seçebilirim.					
	17	Çalışmalarımın (ödev, proje vb.,) toplumsal açıdan değer oluşturması için önemli bilgiler hakkında dijital ortamdan yararlanarak kritik değerlendirmelerde bulunabilirim.					
	18	Öğrenmeyle ilgili ihtiyaç duyduğum verilerin doğruluğunu dijital ortamda kontrol edebilirim.					
Nesnelerin İnterneti Yeterliği	19	Bir çalışmam (ödev, proje vb.,) sürecinde tablo/grafik gibi görsel metinleri oluştururken dijital ortamdaki uygun programları kullanabilirim (Adobe Illustrator, Canva, Crello, Excel vb.,).					
	20	Eş zamanlı olarak iki farklı dijital cihazla bir çalışma (ödev, proje vb.,) amacıyla iletişim kurabilirim (örneğin dijital cihazımla başka bir kullanıcının dijital cihazıyla kurulan iletişim).					
	21	Bir öğrenme materyalini dijital bir uygulamayla başka bir dijital kullanıcıya iletebilirim (örneğin bir metin, grafik, slayt veya video vb.,).					
	22	Öğrenme amaçlı olarak dijital cihazımdaki bir uygulamayla iletişim kurabilirim (örneğin yapay zekâ uygulaması olan Alexa, Siri veya Google Assistanla kurduğun iletişim gibi).					
Gizlilik Yeterliği	23	Dijital ortamdaki bilgilerimin kullanılmasıyla ilgili gizlilik risklerinin neler olduğunu bilirim (örneğin yetkisiz kişiler veya zararlı yazılımlar yoluyla bilgisayarınıza fiziksel veya uzaktan erişimin olası riskleri).					
	24	Dijital cihazımda şüpheli olduğunu düşündüğüm donanımların/yazılımların hangi kaynaktan geldiğini kontrol edebilirim.					
	25	Ağ iletişimiyle dijital cihazımda güvenlik riski oluşturabilecek bir durumun üstesinden gelebilirim (örneğin risk oluşturan bir uygulamayı gizleme, devre dışı bırakma veya kaldırma gibi).					