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Teachers' Self-Efficacy on the Use of Information Technologies in the Distance Education Process: A Scale Development Study

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Abstract

The Covid-19 outbreak has compelled many countries to shift towards distance learning as a means to continue education while ensuring the safety of students and educators. Consequently, the usage of information technologies in education has increased significantly. This study focuses on developing a tool for measuring the information technology self-efficacy of primary school teachers in Balıkesir who have had to increase their use of technology for distance education during the academic year 2020-2021. The study participants are primary school teachers in Balıkesir. The scale structure, consisting of five factors and twelve items, was identified through analysis. The results indicate that the developed scale is reliable. The scale can help assess the self-efficacy of distance education teachers and support efforts to improve their use of information technologies.

Keywords: scale development, distance education, information technologies, self-sufficiency, teachers.

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Introduction

In today's continuously evolving world of information and communication technologies (ICTs), accessing information has become a critical need for individuals. With the continuous development of technology, the easiest and fastest way to access information is through technological tools (Katrancı and Uygun, 2013). Technology has found its way into various fields, and education is one of the areas where it is widely used. As technology continues to advance, the tools used in education are constantly evolving (Mert & Şen, 2019). Teachers use smart boards, tablets, and other advanced devices to deliver lessons. In contrast, in the past, they relied on maps, blackboards, and books (Yalçınkaya & Özkan, 2014; Mert & Şen, 2019). Technology has significantly transformed how teachers conduct their lessons, making teaching more efficient and interactive.

In the 21st century, the Covid-19 pandemic has affected people worldwide, and Türkiye has taken various measures, such as curfews and interrupting education, to protect people's health (Can, 2020). As a result, distance education (DE) was implemented to ensure the continuity of education, where students and teachers can teach lessons synchronously or asynchronously in a virtual environment using technological tools. While distance education provides advantages such as equal opportunity, cost, and time efficiency, it also has drawbacks such as limited socialisation and delayed feedback (Santana de Oliveira et al., 2018; Erfidan, 2019).

With the increasing importance of technological tools during the Covid-19 pandemic, teachers' and students' use of technological equipment has increased significantly. Thus, this research intends to construct a scale determining teachers' self-efficacy in using information technologies (IT).

Self-efficacy is based on the principle of mutual determination, which is a social-cognitive theory developed by Albert Bandura and expresses an individual's belief in being successful in a subject (Zimmerman, 1995). Teachers' self-efficacy in using ICT can be exemplified by working with cloud storage and preparing various materials with Web 2.0 tools. In the DE process, self-efficacy in using ICT can be demonstrated by conducting live lessons on different platforms and controlling the audio and video of students.

Teachers' self-efficacy on the use of information technologies is an important area of research in education. Several studies have explored the factors that influence teachers' self-efficacy in integrating technology into their teaching practices.

After reviewing the literature, various scale development and adaptation studies were found to determine computer, IT, and robotics self-efficacy. For instance, Işıksal and Aşkar (2003) conducted a study to develop a scale measuring primary school students' self-efficacy in mathematics and computers. Similarly, Horzum and Çakır (2009) adapted a 29-item 4-point Likert scale to assess undergraduate students' self-efficacy towards online technologies. In contrast, Ekici et al. (2012)

developed a 27-item 5-point Likert scale to evaluate pre-service teachers' and teachers' ICT self-efficacy perceptions. Şad & Nalçacı (2015) created a 30-item, 5-point Likert scale to assess pre-service teachers' attitudes towards the use of information and communication technology. Likewise, Göçer and Türkoğlu (2018) developed a 30-item 5-point Likert scale to assess the IT self-efficacy of secondary school students. Furthermore, Hamutoğlu (2018) conducted an adaptation study of the technology acceptance model scale, consisting of 16 sub-dimensions and 51 items. Şendurur and Yıldırım (2019) developed a scale aimed at assessing teachers' computer use, while Doğanç and Korucu (2020) adapted a 30-item 5-point Likert scale to measure pre-service teachers' safe internet use. Sun and Rogers (2020) developed a 31-item 4-factor scale to evaluate students' online learning self-efficacy, and Yavuzalp and Bahçivan (2020) adapted a 22-item 5-point Likert scale to measure students' online learning self-efficacy. Kaba and Doğan (2021) also developed a 50-item IT use scale for individuals between 13 and 19 years old. Tsai et al. (2021) conducted a scale development study to determine students' robotic learning self-efficacy.

Hew & Brush (2006) outlined general obstacles that K-12 schools encounter when integrating technology into the curriculum, including inadequate resources, institutional constraints, subject culture, attitudes and beliefs, and knowledge and abilities. In addition, they recommended solutions to overcome these obstacles, such as a shared vision and a plan for technological integration. Hardianto et al. (2022) did a review of the literature on optimising teacher self-efficacy in the face of the new norm. They highlighted the significance of administrators in fostering self-efficacy in teachers and presented an outline of the factors that influence teachers' self-efficacy. Jin and Hassan (2022) investigated the association between university organisational climate, teacher self-efficacy, and work happiness. They discovered a direct correlation between teachers' self-efficacy and their behaviour, emotions, cognition, and student participation. Işikli and Sezer (2022) evaluated pre-service social studies teachers' assessments of their technology integration self-efficacy and levels of acceptance. They discovered that the amount of interest in technological advancements and training on the use of technology in education had a substantial impact on self-efficacy views and acceptance levels. Saiqi et al. (2022) conducted a survey to determine the research self-efficacy of elementary school teachers. They discovered that the majority of elementary school teachers have high research self-efficacy, which was influenced by their educational background, years of teaching, research environment, and attitude towards research. Vivian et al. (2020) conducted a pilot international study on the self-esteem of K-12 computer science teachers. They discovered a correlation between teacher self-efficacy and job happiness, and that years of experience may not necessarily correspond with self-efficacy. In conclusion, the literature suggests that various factors influence teachers' self-efficacy on using information technologies, including knowledge and skills, attitudes and beliefs, outcome expectations, interest, training, and support from principals and cooperating teachers. Understanding these factors

can help develop strategies to enhance teachers' self-efficacy and promote effective technology integration in education.

Given the lack of a self-efficacy scale for teachers' use of ICT in the DE process in the literature, developing a scale to identify teachers' self-efficacy with their usage of IT in the DE process within the scope of this study is planned to contribute to the existing literature.

Method

This study intends to expand a reliable and valid scale that measures teachers' confidence in using IT during the distance education (DE) process, which became more prevalent during the Covid-19 pandemic.

Development of the Measurement Tool

While carrying out a scale development study, the structure to be measured should be determined (Özdamar, 2016). According to Erkuş (2012), determining the structure is the most critical step of scale development. While developing a new measurement tool, a literature review on the subject should be done after determining the structure to be measured (Karakoç & Dönmez, 2014). After the literature review, the format of the measurement tool should be determined, and an item pool related to the structure to be measured should be created (DeVellis, 2003). An item pool was created after the literature review for the measurement tool to be prepared to determine the teachers' self-efficacy in using IT. According to DeVellis (2017), the items to be written into the item pool should reflect the structure to be measured. In this process, at least 3 or 4 times the number of items targeted to be included in the measurement tool should be written into the item pool (Özdamar, 2016; Şeker & Gençdoğan, 2014). While creating the item pool, care should be taken to ensure that the items are clear and understandable, suitable for the level of the group that will answer the scale, comply with the grammar rules, that the items are not written in the form of a question sentence, and that the items do not contain double negative expressions (DeVellis, 2017; Özdamar, 2016; Şeker & Gençdoğan, 2014). An item pool consisting of 110 items was created, taking into account the points to be considered while creating the item pool. To determine the scope and face validity of the prepared item pool, the item pool prepared via Google Forms was shared with five academicians working in the Computer Education and Instructional Technologies Department. Considering the feedback received from the experts, some items were removed from the item pool, and necessary changes were applied to some items according to expert opinions. The number of items in the item pool, which was organised taking into account expert opinions, was reduced from 110 to 60. In order to carry out the pilot application, the measurement tool was applied via Google Forms to 178 classroom teachers working in primary schools in Balıkesir in the 2020-2021 academic year. Table 1 lists the demographic characteristics of the teachers who participated in the pilot study.

When the data in Table 1 are examined, it is seen that 64% (N=114) of the teachers are female, and 40.4% (N=72) are 50 years old and over. It is seen that all the teachers (N=178) who participated in the pilot study worked in public schools.

Table 1. Demographic characteristics of pilot study participants

Variable		f	%
Gender	Female	114	64
	Male	64	36
Age	22-30	2	1,1
	31-40	47	26,4
	41-50	57	32
	50 and above	72	40,4
Type of Institution	Government	178	100
Total		178	100

Results

Exploratory Factor Analysis

A factor analysis was conducted using the data received from the teachers who participated in the study. (Büyükoztürk, 2020) Factor analysis is a statistical technique that seeks to identify fewer irrelevant variables by grouping variables that are related to one another. Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) are the two subtypes of factor analysis (CFA) (Tabachnick & Fidell, 2015). EFA is utilised to expose the structure between variables (Uyumaz et al., 2016). To perform EFA, data should be collected with at least an equally spaced measurement tool, the sample group should be homogeneous, and the items of the measurement tool should be related to each other (Alpar, 2013; Güriş & Astar, 2015; Can, 2018). EFA was carried out using the statistical analysis package program (IBM SPSS Statistics) to determine the construct validity of the measurement tool prepared with the data obtained from 178 teachers participating in the pilot application. Construct validity is defined by Büyüköztürk et al. (2016) as the extent to which a construct that is intended to be measured can be measured with the scores obtained from a test. Kaiser-Meyer-Olkin (KMO) coefficient and Barlett test were examined to determine the suitability of the data for EFA. According to Büyüköztürk (2020), the KMO value is expected to be higher than 0.60 while giving information about the suitability of the KMO coefficient data structure for factor formation. As a result of the analysis calculated, the KMO value was 0.71, while the Barlett test was found as X^2 =1136,988, df=66, p=.000. EFA was started with 60 items. To say that an item measures a factor well, the factor load value is expected to be higher than .45 (Büyüköztürk, 2020). According to Büyüköztürk (2020), the factor load value can be reduced from 0.45 to .30 for items with a small number. In this direction, the analysis was repeated by removing the items with a factor load value less than .30. The curve graph of EFA is given in Figure 1.

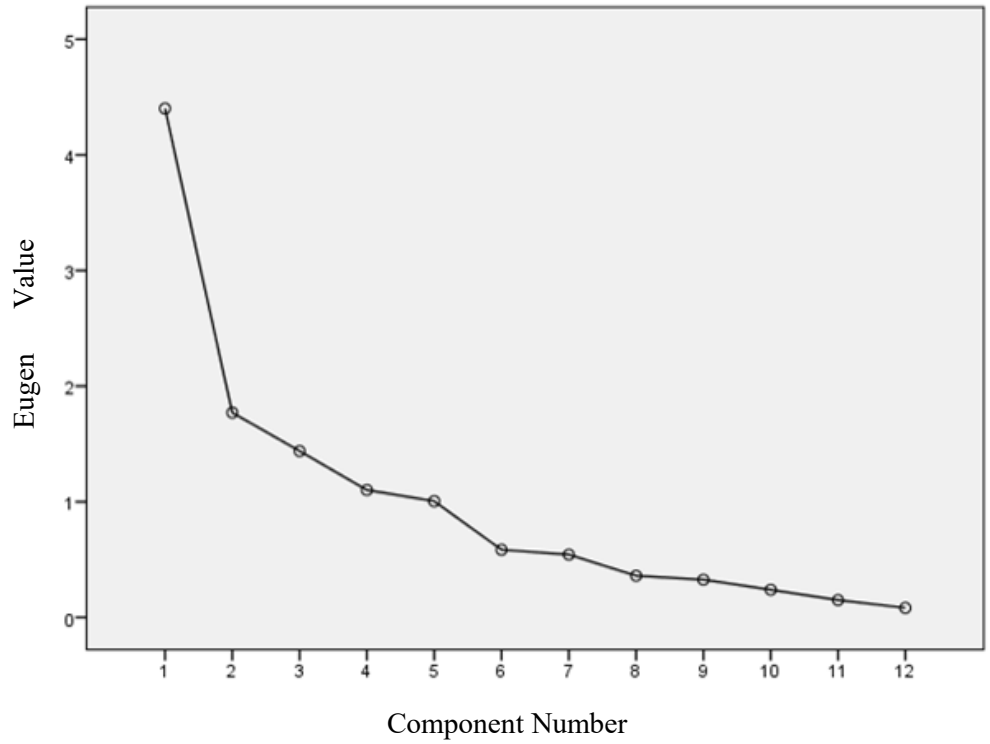

Figure 1: Scree Plot Graph

When Figure 1 is examined, it is seen that there are decreases in five different parts of the graph. This shows that the measurement tool consists of five factors. The factors and item loads resulting from the analysis are given in Table 2.

Table 2. Factors and item loads resulting from EFA Table

Item Number	F1 (Ability to Teach)	F2 (WEB 2.0 Applications)	F3 (The Use of Smartboard)	F4 (E-School Use)	F5 (Use of Technological Devices)
M4	0,875				
M5	0,844				
M8	0,741				
M15		0,858			
M26		0,839			
M12		0,821			
M28			0,946		
M29			0,938		
M48*				0,921	
M49*				0,912	
M1					0,841
M2					0,771

*Negative Items

As a result of the EFA, the variance value of the scale consisting of 5 factors and 12 items was calculated as 80,966%. The first factor (F1) accounted for 36.676% of the total variance, the second factor (F2) 14.753%, the third factor (F3) 11.985%, the fourth factor (F4) 9.178%, and

the fifth factor (F5) 8.373%. Explains its reputation. The prepared measurement tool is a 5-point Likert-type scale consisting of "I strongly disagree" (1), "I do not agree" (2), "I am undecided" (3), "I agree" (4) and "I strongly agree" (5). The lowest score that can be obtained from the scale consisting of 5 factors and 12 items is 12, and the highest score is 60. When the teachers' scores are evaluated out of 5, it is very low that their scores are between 1.00 and 1.80; between 1.81 and 2.60 is low; between 2.61 and 3.40 is moderate; between 3.41 and 4.20 is high; A score between 4.21 and 5.00 indicates that they have very high self-efficacy.

Confirmatory Factor Analysis

CFA was used to evaluate the adequacy of the factors formed in EFA in explaining the structure and the relationship between the determined factors (Erkorkmaz et al., 2013). CFA was performed to determine the accuracy of the data obtained from EFA. To perform the CFA, the main application was carried out with a different sample group. For CFA, according to Stevens (2002), it is sufficient to have 5 - 20 participants for each item in the scale, while according to Kline (2011), it is sufficient to have 5 - 10 participants for each item. In this regard, the primary application was submitted via Google Forms to 110 primary school teachers in the province of Balıkesir for the 2020-2021 academic year. Table 3 provides demographic information about the primary application participants.

Table 3. Demographics of the application participants

Variable		F	%
Gender	Female	70	63,6
	Male	40	36,4
Age	22-30	2	1,8
	31-40	27	24,5
	41-50	37	33,6
	50 and above	44	40
Institution Type	Government	107	97,3
	Private	3	2,7
Total		110	100

When the data in Table 3 are examined, 63.6% (N=70) of the teachers are female teachers, 40% (N=44) of the teachers are 50 years old and over, and 97.3% of the teachers (N=70) =107) are working in public schools. The X^2, p, X^2/df, RMSEA, SRMR, CFI, and GFI values obtained from the DFA performed according to the data obtained from the teachers participating in the main practice are given in Table 4.

Table 4. Obtained fit indices after CFA.

Index values	Perfect Fit Values	Obtained Fit Indices	Rationale
X^2	$0 \leq X^2 \leq 2df$	66,967<88	Yılmaz & Çelik (2009)
p	$0,05 \leq p \leq 1,00$	0,014	Hoyle (1995)
X^2/ df	$0 \leq X^2/df \leq 2$	1,522	Tabachnick & Fidell (2005), Şimşek (2007)
RMSEA	$0 \leq RMSEA \leq 0,08$	0,069	Steiger (2007), Hooper et. al. (2008)
SRMR	$0 \leq SRMR \leq 0,10$	0,0682	Kline (2005)
CFI	$0,90 \leq CFI \leq 1,00$	0,970	Hu & Bentler (1999), Çokluk et. al. (2010)
GFI	$0,90 \leq GFI \leq 1,00$	0,913	Hu & Bentler (1999)

The value of X^2 is a traditional measurement that tests the suitability of the hypothesis for the whole model (Erkorkmaz et al., 2013), and according to Yılmaz and Çelik (2009), the value of X^2 is expected to be between zero and twice the value of freedom. The p significance value is expected to be between 0.05 and 1 (Hoyle, 1995). The value of X^2 can be affected by the sample size (Demir, 2013). The value of X2 /df can also be examined in this direction. According to Tabachnick and Fidell (2005) and Şimşek (2007), the value of X^2 /df is expected to be between 0 and 2.

The RMSEA value allows us to examine the level of compliance of the covariance matrix obtained from the sample with the estimated covariance matrix (Erkorkmaz et al., 2013; Doğan, 2013). According to Steiger (2007) and Hooper et al. (2008), the RMSEA value is expected to be between 0 and 0.08. The SRMR value represents the square root of the standardised mean errors, and as the value approaches zero, the model's goodness of fit increases (Özabacı, 2011). According to Kline (2005), the SRMR value is expected to be between 0 and 0.10. The GFI value shows the covariance between the calculated changes and the defaults and is expressed as a good fit index (Özabacı, 2011). According to Hu and Bentler (1999), the GFI value is expected to be between 0.90 and 1. Conversely, CFI is a comparative fit index that compares the model's fit with the null hypothesis (Özabacı, 2011). According to Hu and Bentler (1999) and Çokluk et al. (2010), the CFI value is expected to be between 0.90 and 1. When the data in Table 4 are examined, it is seen that the indexes obtained as a result of CFA are within the expected ranges. The diagram regarding the loadings of factors and items according to CFA is given in Figure 2.

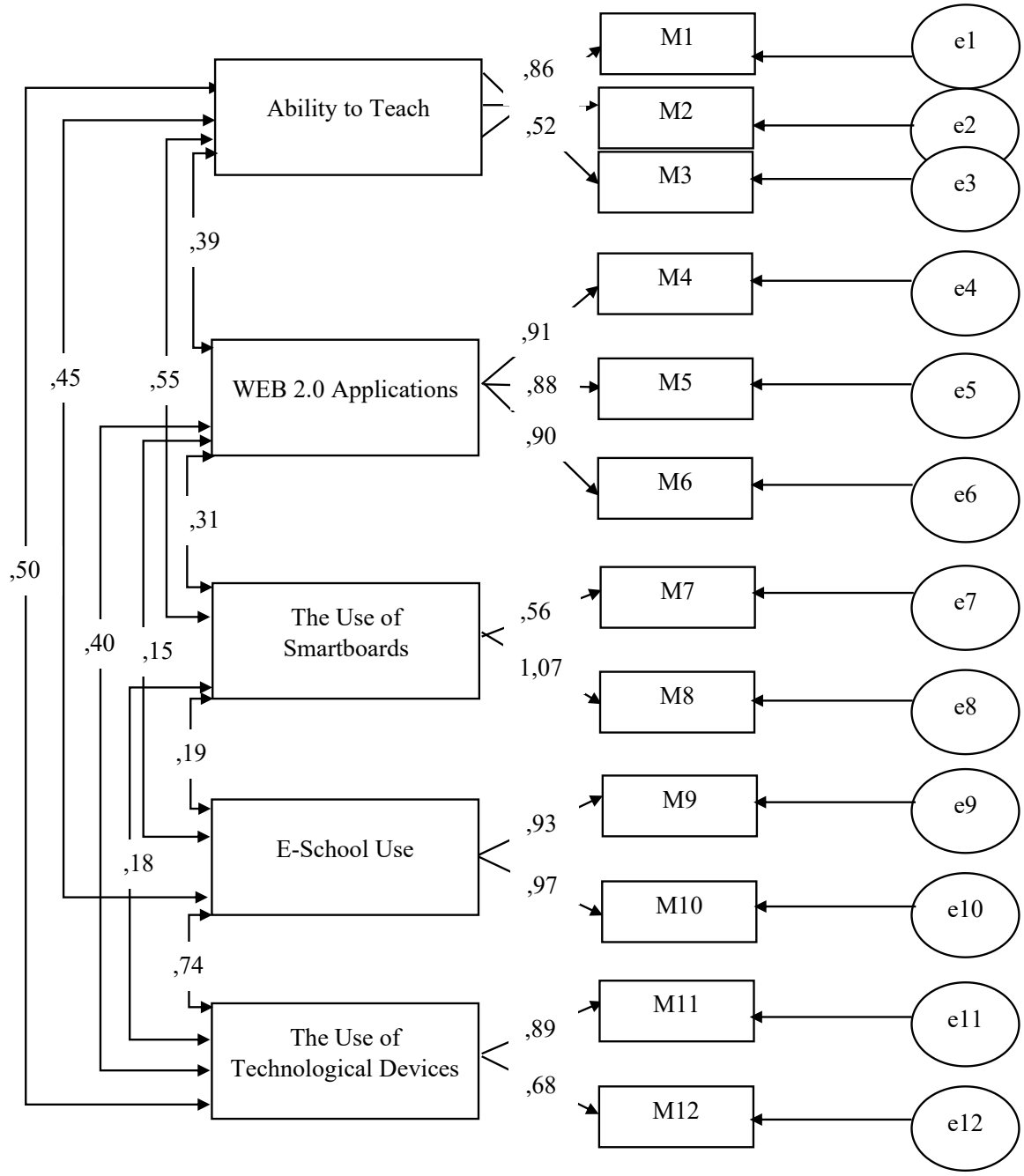

Figure 2. DFA correlation diagram (standardised model).

When Figure 2 is examined, the first factor and the second factor are composed of 3 items; it is seen that the third factor, the fourth factor and the fifth factor consist of 2 items. The factors and items in the scale are given in Table 5.

Table 5. Factors and items in the scale

Factor Name	Item Number	Item
Ability to Teach	M1	I can provide voice control to my students in live lessons.
	M2	I can control the video of my students in live lessons.
	M3	I can process my live lesson with different applications (Zoom/ Google Meet etc.).
WEB 2.0 Applications	M4	I can prepare various materials with Web 2.0 tools (such as Kahoot, Canva).
	M5	I can design posters for my students.
	M6	I can prepare fun question-and-answer activities for my students with the help of various applications (Kahoot etc.).
The Use of Smartboards	M7*	I may have difficulty transferring the files on my USB stick to the smart board.
	M8*	I may have difficulty installing a program on the smart board on my USB stick.
E-School Use	M9	I can record student absences in the E-School system.
	M10	I can save student information to the E-School system.
The Use of Technological Devices	M11	I can use technological tools in my lessons.
	M12	Using different materials with technological tools can make the lesson more active.

* Negative Items

Reliability Analysis

The internal consistency coefficient of Cronbach Alpha was measured to determine the scale's reliability. The Cronbach Alpha values calculated for the whole scale, and the sub-factors are given in Table 6. To evaluate the reliability of the scale that we used in our study, we performed a statistical analysis and calculated the Cronbach Alpha internal consistency coefficient for the whole scale as well as its sub-factors. The Cronbach Alpha scores indicate the consistency with which the scale's items assess the same construct. We present the Cronbach Alpha values for the scale and its sub-factors in Table 6.

Tablo 6. Cronbach Alpha values for the scale and its factors

Factors	Number of Items	Cronbach Alpha
Factor 1	3	,748
Factor 2	3	,923
Factor 3	2	,748
Factor 4	2	,947
Factor 5	2	,727
Whole Scale	**12**	**,843**

The fact that the Cronbach Alpha coefficient calculated according to Alpar (2020) is between 0.60 and 0.79 indicates that the developed scale is quite reliable and between 0.80 and 1.00, which indicates that the developed scale has high reliability. When Table 6 is examined, the calculation of the Cronbach Alpha coefficient as 0.843 shows that the developed scale has high reliability. The development stages of the Teachers' Self-Efficacy on the Use of Information Technologies in the Distance Education Process (UITDEP) scale are given in Figure 3.

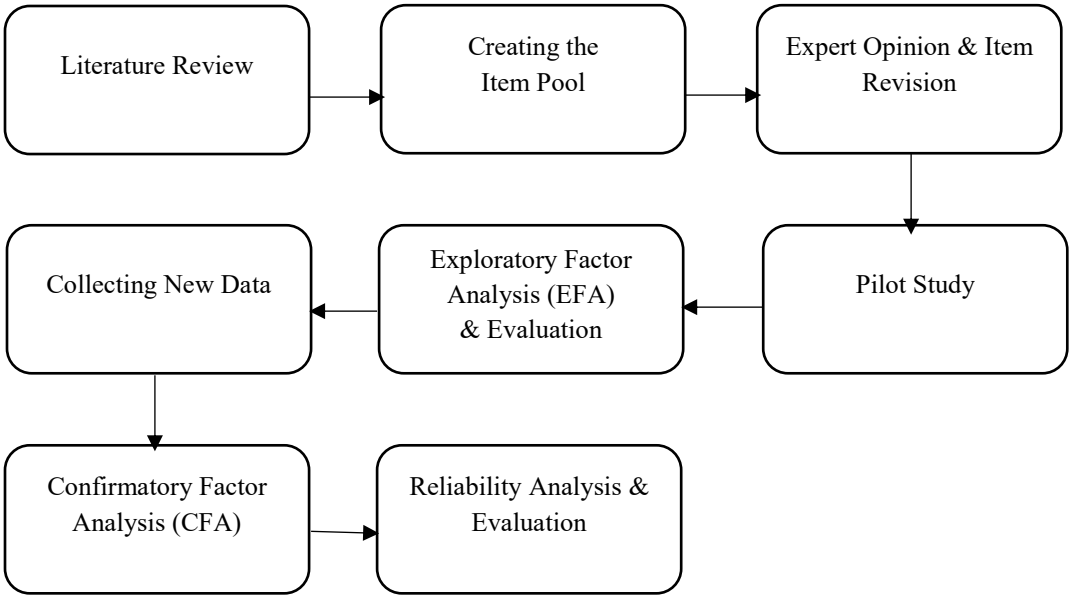

Figure 3: Steps of scale development

Discussion, Conclusion and Recommendations

Today, technology has become an indispensable part of us and has an essential place in many areas of our lives. One of the areas where technology is used intensively is education. Education and technology are seen as complementary parts (Taşdemir, 2017). Technology in education increases the student's interest in the lesson while enabling active participation (Katrancı & Uygun, 2013; Dargut & Çelik, 2014). With the Covid-19 pandemic, which we encountered in the current century, it was decided to continue education as UE. In this process, teachers came together with their students through platforms such as EBA Live Lesson, Microsoft Teams and Zoom, ensuring education continuity. With continuing education and training in a completely virtual environment, the use of technology by teachers and students has increased daily. In this direction, it is aimed to carry out a scale development study in which the teachers' self-efficacy in using IT will be determined.

As a result of the literature review, various scale development and adaptation studies were found (Işıksal & Aşkar, 2003; Horzum & Çakır, 2009; Ekici et al., 2012; Şad & Nalçacı, 2015; Göçer & Türkoğlu, 2018; Hamutoğlu, 2018; Şendurur & Yıldırım, 2019; Doğanç and Korucu, 2020; Sun and Rogers, 2020; Yavuzalp and Bahçivan, 2020; Kaba and Doğan, 2021; Tsai et al., 2021). The scale development study is thought to contribute to the literature since there is no self-efficacy scale regarding teachers' use of DE in the IT process in the literature.

An item pool has started to be created for the measurement tool that will be prepared to determine the teachers' self-efficacy in using IT. In this process, an item pool consisting of 110 items was prepared. The academicians employed by the Department of Computer Education and

Instructional Technologies were consulted for their expertise to determine the content validity and face validity of the prepared item pool. According to the response from the experts, necessary adjustments were made to the items and the 110 items in the item pool were reduced to 60. A pilot application was carried out with the prepared measurement tool, and EFA was performed with the data collected. As an outcome of EFA, the KMO value was determined to be 0.71, and the variance value of the scale with 5 factors and 12 items was assessed to be 80.966%.

CFA was conducted to determine the precision of the measurement instrument created using EFA. The main application was carried out with a different sample group to perform the CFA. It is seen that the fit indexes of X2, p, X2/df, RMSEA, SRMR, CFI and GFI obtained as a result of DFA are within the expected ranges. Calculation of the internal consistency coefficient of Cronbach Alpha to determine the dependability of the scale. The Cronbach Alpha coefficient for the entire scale was revealed to be 0.843. The data acquired from primary school teachers in Balıkesir are the sole basis for the developed measurement tool. The "Instructors' Self-Efficacy on the Use of Information Technologies in the Distance Education Process" [UITDEP] scale, which consists of 5 variables and 12 items, can be used to measure the ICT self-efficacy of teachers at all levels.

Our findings show both similarities and differences with other studies in the literature. For example, the Information Communication Technology Self-Efficacy (ICIT) scale designed by Tondeur consists of two dimensions: the ability to direct students to use information technologies in the classroom and the ability to use information technologies in instructional design. These dimensions partially overlap with the skills and attitude dimensions in our scale. However, our scale also includes other dimensions such as motivation, anxiety and awareness. These dimensions also reflect the psychological aspects of using information technologies in the distance education process. The importance of our findings is that they contribute to the determination of primary school teachers' self-efficacy in using information technologies in the distance education process. Self-efficacy is individuals' beliefs that they can do a certain task successfully (Bandura, 1977). Self-efficacy is an important variable that affects individuals' motivation, skills, attitudes, concerns and awareness. In particular, self-efficacy in using information technologies can help teachers communicate effectively with their students in the distance education process, enrich their learning environments and increase students' success. Therefore, measuring and developing teachers' self-efficacy in using information technologies is important to increase the quality and efficiency of the distance education process. This study also has some limitations. One of them is that the study is limited to primary school teachers working only in Balıkesir. For this reason, the scale should also be tested with teachers in different provinces or at different educational levels. Another limitation is that the study was carried out during the distance education process due to the Covid-19 outbreak. Therefore, it should be investigated whether the scale is valid and reliable in the face-to-face education process. Based on this study, some of the studies that should be done in the future are as follows: First of all, applying the developed scale

with teachers in different provinces or at different education levels and comparing the results. Secondly, to determine the self-efficacy levels of primary school teachers in using information technologies by using the developed scale and to analyse these levels according to variables such as gender, age, professional seniority and educational status. Third, to develop and implement effective intervention programs to increase primary school teachers' self-efficacy in using information technologies.

Policy Implications

This paper contributes to education policy by offering a robust and accurate instrument for measuring the information technology self-efficacy of primary school teachers in the remote education process. The research also discusses the elements that influence teachers' self-efficacy, such as experience, emotional challenges, leadership position, and topic area. Based on these findings, the report provides policymakers and educational leaders with recommendations for enhancing the quality and effectiveness of the distance education process. A few of these suggestions include:

To provide teachers with sufficient and ongoing professional development opportunities to enhance their abilities and confidence in utilising information technology for distance education. These opportunities should include formal, informal, and autonomous learning activities that give teachers access to self-efficacy, source knowledge and promote reflection.

To promote the well-being and motivation of educators by addressing their emotional difficulties and obstacles during emergencies. This can be accomplished by creating a friendly and collaborative school environment, providing feedback and acknowledgment, and providing counselling and mentoring services.

To inspire teachers to assume a leadership position in the classroom by sharing their knowledge, launching creative projects, and mentoring their peers. This can assist teachers in establishing a sense of self-efficacy and success and foster an innovative and excellent culture.

To differentiate teachers' support and guidance based on their subject area and pedagogical strategy. This can aid teachers in adopting more student-centred and constructivist methods, which can maximise the potential of information technologies to improve student learning.

Conflict of Interest

No potential conflict of interest was declared by the authors.

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Ethical Statement

Ethics committee approval within the scope of the research has been obtained from Balıkesir University Science and Engineering Ethics Committee with the permission numbered 52899066/302.08.01/7484 on 02/02/2021.

Credit Author Statement

The authors contributed equally to this research.

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