PROFICIENCY OF TEACHERS' PERCEPTIONS OF DISTANCE EDUCATION AND TECHNOLOGY USAGE COMPETENCIES: A META-ANALYSIS STUDY

Dr. Savas VARLIK
ORCID: 0000-0001-8894-2649
Ministry of National Education
Ankara, TURKIYE

Received: 19/03/2023 **Accepted:** 14/07/2023

ABSTRACT

In this meta-analysis study, it was aimed to examine the perceptions of distance education and the effect size of technology usage competencies by using meta-analysis method. In the meta-evaluation carried for this purpose, twenty-eight studies that met the criteria for inclusion in the research were reached. By combining these studies, 11.797 sample groups were studied. In order to reach a general decision in the research, a funnel plot graph was drawn before statistical calculations were made. Statistical calculations were performed in order to make a general impression decision about the publication bias in the funnel plot diagram. When the statistical analysis results and the diagram graph results were combined, it was determined that there was no publication bias in the studies included in the study. Then, a heterogeneity test was performed to determine the model type of the research. According to the results of the heterogeneity test, it was decided that this research should be interpreted according to the type of random effects model. For heterogeneity, publication type, school type, and branches were aimed as moderators. It was observed that the meta-analysis study had a small distribution of perceptions of distance education and technology usage competencies, that the variables of publication type, school type and distribution departments did not have a moderator unit in the calculations done on the moderator, but it was concluded that the effect sizes of the studies published as articles, the studies carried out in secondary education institutions and the studies on mathematics teachers had a relatively larger effect size than the others.

Keywords: Teacher, distance education, perception of distance education, technology use adequacy.

INTRODUCTION

The unpredictable rapid daily changes and innovations of technology have led to the diversity and proliferation in all areas of life (Moroz & Moroz, 2022), so that users can easily access the information they want (Avsec & Savec, 2021). These situation variables have made all institutions open and ready for constant change (Cachero-Gonzalez et al., 2019). Like all fast systems that occur in scientific, technological and social systems, significant changes have occurred in the functions that education expects to fulfill (Baptista et al., 2020). This has also led people towards a structure where educational environments and knowledge can be consumed outside of the traditional understanding of education (Gillet-Swan, 2017). The biggest payment suspicion in the direction of societies is education rights (Bell et al., 2013). Because education continues to meet the needs of society. For this reason, it is a fact that the education of students who adapt to the information age and technologies, desires and tries to regulate society education policies accordingly (Grabinski et al., 2020). The places where they emerged at times, surrounding them, social shelter differentiation was affected by education, and the programs that would constantly maximize learning were maintained on systems (Fis Erumit, 2021). In fact, distance education models have begun to be developed, in which a different approach is needed from the traditional education model dominated by the trio of students, classrooms and teachers (Adom, 2020; Kopcha, 2012). The need for the development of a distance education model, the integration of distance education with computer programs (Bulut et al., 2022), the need to access information over the

internet faster, easier and at lower prices by using multimedia tools and techniques (Gurcan et al., 2021). Lee et al., 2022) helped increase a user's interaction with emerging technologies. Rapid population growth, epidemics and other factors also required a structural replanning of the world's education systems (Celik et al., 2022). Educators and education stakeholders also believe in the need for replanning rather than the traditional structure in education (Alghamdi et al., 2022; Baleghi et al., 2017; Pittman & Gaines, 2015). Because countries have gone beyond traditional education structures and focused their efforts on finding ways to provide better and cheaper education to more people (Burac et al.,2019). As a result of all these, the distance education model approach has been adopted as a new approach in education (Goncalves, 2017). Distance education is an education model or approach in which teachers and students perform a learning-teaching activity in different places without time and place limitations (Adzobu, 2014; Bozkurt, 2020). Teachers believe that distance education appeals to a wide student population, is student-centered (Hamann et al., 2020), supports lifelong learning (Makokotlela, 2022), provides flexibility in terms of time and space (Palloff & Patt, 2007), has a small budget. They state that distance education is effective in the learning process (Park & Shea, 2020), based on the idea that more people can be reached with this program (Yu, 2021). However, although distance education is thought to be effective by teachers, this has also led to the questioning of teachers' technology use competencies around the world (Mnguni & Mokiwa, 2020). Because the role of teachers in the use of technology in the field of education is very important and great. The teacher's attitude towards technology, his or her efforts to use technology consciously (Stuart et al., 2022), his or her understanding of the nature of technology (Ozkan & Tekeli, 2021), his or her design of technology (Tondeur et al., 2017), questioning what the effects are on the society he or she lives in (Yavuz et al., 2020) and the effective use of technology in education and extracurricular activities (Panisoara et al., 2020) affect students. The main element that adds functionality, spirit and meaning to education and makes it efficient and effective is the teacher (Mashroofa et al.,2019). For this reason, world education ministries expect teachers to have the competence to use information and communication technologies effectively in the field of managing the learning and teaching process, in addition to the general competencies of the teaching profession (Agyei & Voogt, 2011; Topchyan & Zhang, 2014; Sangra et al.,2012; Zhang et al., 2020). In addition, it is emphasized that teachers and teacher candidates responsible for the qualified education of individuals should have the characteristics that can renew and develop themselves in the face of rapidly changing and developing conditions as a requirement of the information society (Koyuncu et al., 2022). Teachers are not only responsible for implementing the curriculum in the education process (Altunoglu, 2017; Hodges & Cullen, 2020). They are also responsible for acquiring, developing, and making permanent the knowledge, skills and equipment that students will need (Keegan, 1980; Morante et al., 2017). On the other hand, in the world education perspective, the qualifications that teachers should have are still the leading topics of discussion (Chugh et al., 2017; Sadaf et al.,2016). Hundreds of qualifications can be expected from a teacher (Leidner & Jarvenpaa, 1995), but qualifications are determined in educational institutions considering social needs (Lautenbach & Randell, 2020), individual needs (Yavuz et al., 2021), technological and scientific developments (Kim, 2020). However, the fact that teachers are technologically qualified and equipped is one of the most important competencies (Tilton & Hartnett, 2016). Therefore, the existence of technological competence among teachers' ability to perform and evaluate their duties effectively (Zawacki-Richter et al., 2009) can be considered as the basic criterion both for the distance education process and for the student to achieve the necessary gains.

When the studies on the subject in the related literature are examined, it was determined that hundreds of primary studies were done to determine the level of teachers' perceptions of distance education and technology use (Aldaghri & Oraif, 2022; Ali, 2020; Altinay, 2017; Amoozegar et al., 2018; Dalton, 2001; Elcicek, 2021; Elizabeth et al., 2020; Gorghiu et al., 2021; Hodges & Cullen, 2020; Kopcha, 2012; Makamure & Tsakeni, 2020; Makokotlela, 2022; Sadaf et al., 2016; Tilton & Hartnett, 2016; Tondeur et al., 2017; Wang, 2022; Yaylak, 2022). However, it was determined that the primary studies could not be synthesized and interpreted with a statistical result and a judgment could not be reached on whether they worked in practice or not. Due to the importance of research syntheses in the decision-making process, as highlighted by Borenstein et al. (2019), Chen & Peace (2021), Rothstein, Sutton & White (2021), Egger, Higgins & Smith (2022), Varlik & Gunbayi (2020), and Schmid, Stijnen & White (2021), it became necessary to synthesize teachers' perceptions of distance education and their effectiveness in technology use competencies. Relying solely on primary studies would not be sufficient for making informed decisions.

Therefore, the aim of this research was to investigate teachers' perceptions of distance education and the effectiveness of technology use competencies using the meta-analysis method.

In line with the research objective, the following hypotheses were formulated for the meta-analytical analyses:

H_1: The effect size of teachers' perceptions of distance education and technology use proficiency is positive.

H_2: The type of publication variable plays a moderator role in the effect size of teachers' perceptions of distance education and technology use competencies.

H_3: The type of school where teachers work plays a moderator role in the effect size of teachers' perceptions of distance education and technology use competencies.

H_4: The branch (subject area) variable plays a moderator role in the effect size of teachers' perceptions of distance education and technology use competencies.

METHOD

Model and Paradigm of the Research

With this research, it was aimed to investigate the effect size of teachers' perceptions of distance education and their technology use competencies by using meta-analysis method. Many definitions of the meta-analysis method have been made in the relevant literature, such as a statistical method a statistical method that combines studies on the same subject to make a general judgment (Cooper, Hedges & Valentine, 2019), which combines experimental findings from individual studies (Harrer et al., 2022), analyzes (Stangl & Berry, 2000), converts many research results into a common unit of measurement (Cheung, 2015) and calculates statistical effect sizes (Dias et al., 2018), combining the results of many small individual studies with one or more statistical methods (Khan, 2020), providing a systematic review to estimate effect sizes in the population (Cooper, 2017), consideration of primary studies conducted with a quantitative approach (Borenstein et al., 2019) and definitions of the meta-analysis method were made with the expressions of the method that combines these studies (Cooper, Hedges & Valentine, 2019) in order to reach a general decision about the primary studies conducted on similar topics. In addition, realism as philosophy and functional paradigm as a paradigm are based on this research. The functional paradigm is a paradigm approach in which reality is objectively considered, which argues that the social world we live in is also relatively unchangeable (Gunbayi & Sorm, 2020).

Types of Meta-Analysis and Effect Size

This study is a group comparative meta-analysis aimed at examining the effectiveness of teachers' perceptions of distance education and their technology use competencies. Effect size is a value calculated in meta-analysis studies that reflects the magnitude of the relationship between two variables or the magnitude of the application effect (Hartung, Knapp & Sinha, 2008). It indicates how the independent variable positively or negatively influences the dependent variable. The weighted average of the studies included in the research is referred to as the overall effect (Littell, Corcoran & Pillai, 2008). The diamond-shaped symbol in the forest plot diagram represents the magnitude of the predicted sensitivity and also serves as an indicator of the effect size (Rothstein, Sutton & White, 2021). In meta-analysis studies, effect sizes are typically calculated as average differences, odds ratios, and correlation coefficients (Zoccai, 2018). Similarly, in this research, the effect sizes of the studies included in the meta-analysis were calculated based on average differences.

Model Selection and Identification of Outliers

In meta-analysis studies, the calculation of overall effect sizes is typically performed using both the random effects model and the fixed effects model. The fixed effects model (Cleophas & Zwinderman, 2017) assumes that all studies are the same, while the random effects model (Egger, Higgins & Smith, 2022) assumes that the included studies are different due to variations in measurement tools. In this research, the inclusion criteria and measurement tools of the studies were different. Therefore, the selection of the effect size model

was determined through the heterogeneity test. Heterogeneity tests can identify not only the determination of the effect size but also the presence of moderator effects (Cumming, 2012). However, the presence of outliers in the included studies may lead to unexpected increases (Schmid, Stijnen & White, 2021), and outliers can be particularly high in meta-analysis studies (Simske, 2019). Consequently, it may be challenging to detect errors in the original studies (Ellis, 2010; Patole, 2021). Hence, the weights of the studies in this research were calculated using both the random effects and fixed effects approaches. Even though the weights assigned to the studies included in the meta-analysis were similar, the analysis results presented in Table 8 were derived using the random effects model.

Publication Bias

Publication bias refers to the phenomenon where the published literature does not accurately represent the full population of completed studies in a particular field (Hedges & Olkin, 1985). It occurs when the available research differs in its findings from the results of all research conducted on a given topic, leading readers and reviewers to potentially draw incorrect conclusions (Hangji, 2017). This can have significant implications, especially when an ineffective or harmful treatment is mistakenly perceived as safe and effective (Riley, Tierney & Stewart, 2021). Publication bias is a concern across various research domains, including meta-analysis (Chen & Peace, 2021). While it is difficult to completely eliminate publication bias as long as research is conducted and reported, recent years have seen increased awareness and attention to this issue, particularly with the rise in the use of systematic review and meta-analytical methods to summarize research findings (Rothstein, Sutton & White, 2021). As review methods become more rigorous and quantitative, the process of reviewing and synthesizing research is increasingly regarded as parallel to the primary research process (Lipsey & Wilson, 2001). Formun Ustu

Data Collection and Inclusion Criteria

The aim of this study was to examine the effectiveness of teachers' perceptions of distance education and their technology use competencies. To achieve this objective, empirical studies conducted between the years 2020-2022 were sought, considering the extensive literature on distance education. The inclusion criteria for the research were as follows: studies conducted in Turkiye between 2020-2022, studies containing information suitable for meta-analysis calculation, studies with teachers as the sampling group, and studies available in the National Thesis database of the Council of Higher Education.

A literature review was conducted using keywords such as "distance education," "teachers' perceptions of distance education," and "teachers' technology usage competencies." The search was carried out in databases including Dergi Park, the Council of Higher Education National Thesis Center, Turkish Education Index, Tr Index, and Academic Directory. Purposeful sampling was employed in the screening process, which allowed for an in-depth examination of studies that met the desired research criteria (Creswell & Creswell, 2018). A total of 1.134 primary studies were initially identified based on the research inclusion criteria. Through the use of a flow diagram, 7 articles and 21 theses were selected for inclusion in the research. By combining these studies, the total sample size was determined to be 11.797 participants. It is worth noting that the specific findings and conclusions of the included studies were not mentioned in this description. The focus of the research was to gather relevant studies within the specified timeframe and determine the total sample size for the meta-analysis.

Coding Process

A coding form has been created in order to prevent errors in the coding of the studies included in the research and not to ignore the inclusion criteria of the research. Accordingly, the thesis or article type of the studies included in the research were processed into the form as publication type, sample sizes as N, arithmetic mean and standard deviation values as the binary group average difference. An observation was made about whether the same coding was performed using this form in the same way by another researcher. Then, the reliability coefficient between decoders was calculated and the reliability value between decoders was reached [K=.790, t=6.363, p<.05]. This finding showed that the confidence among decoders was high in the axis of inclusion criteria of the research (Landis & Koach, 1977).

Analysis of Data

Considering that the measurement tools included in the meta-analysis for the data analysis of the study were obtained from different scales, the process of standardizing the scores with the Hedges' g coefficient was justified (Leandro, 2005; Sterne, 2009). On the other hand, in the data analysis of the study, the large effect size for the effect size greater than 1, weak effect for effect size less than .20, with .21 the small effect of the effect decoupled among .50, the effect greater than .51 is exhausted according to the reference interval as the medium effect (Kulinskaya, Morgenthaler & Staudte, 2008). Due to the different inclusion criteria of the studies included in the study (Rosenthal, 1987) and the different measurement tools used (Hunter & Schimdt, 2004), the random effects model was used to calculate the effect sizes (Table 6). The data analysis of the research was carried out with the help of CMA (Comprehensive Meta Analysis V4) package program.

FINDINGS

Findings on Publication Bias

In order to assess the presence of publication bias in the meta-analysis study on teachers' perceptions of distance education and technology use proficiency, a funnel plot diagram was constructed. This diagram assists in examining the reliability and validity of publication bias by plotting the standard error values against the effect size of the included studies (Riley, Tierney & Stewart, 2021). The funnel plot diagram for the meta-analysis is presented in Figure 1. The X-axis in Figure 1 represents the effect size, specifically the Hedges's g effect, of the included studies on teachers' perceptions of distance education and technology use competencies. The Y-axis represents the standard errors of the studies included in the meta-analysis. The studies located at the top of the graph are those with larger sample sizes.

Constructing a funnel plot diagram is a commonly used method in meta-analysis studies to evaluate publication bias. It provides an initial visual impression for researchers and allows for calculations related to publication bias. By examining the shape and distribution of the plotted points, researchers can draw conclusions about the potential presence or absence of publication bias. It is important to note that specific findings and conclusions regarding publication bias were not mentioned in this description. The funnel plot diagram was used as a tool to assess publication bias in the meta-analysis study, and further statistical analyses may have been conducted to draw general conclusions (Egger, Higgins & Smith, 2022).

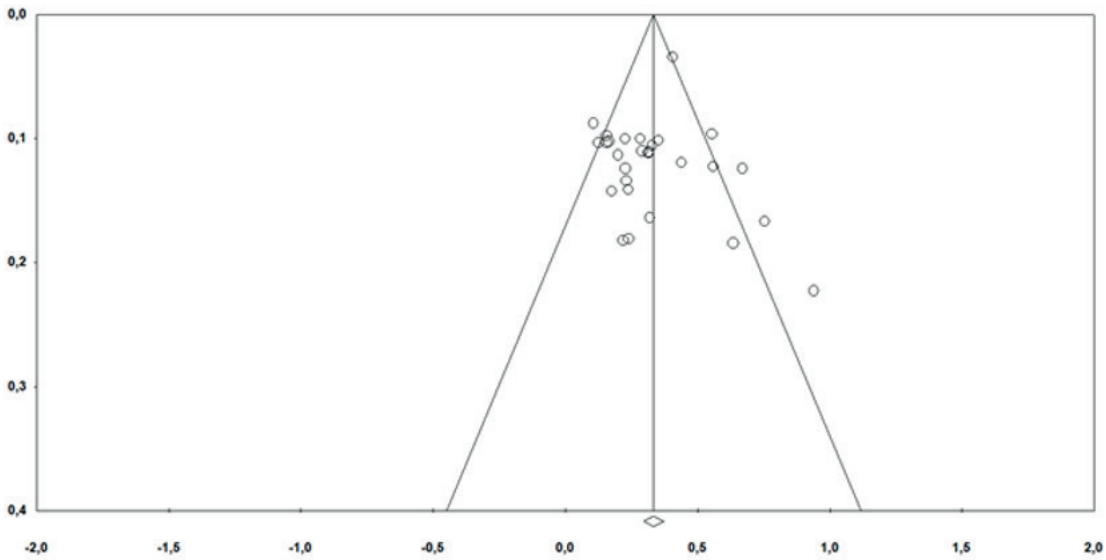


Figure 1. Funnel Plot Diagram of The Effect Sizes and Standard Errors of The Studies Included in The Meta-Analysis

If there is any presence of publication bias in the funnel plot diagram, the plotted points would demonstrate an asymmetrical funnel shape, suggesting the possibility of publication bias (Ellis, 2010). This asymmetry indicates the presence of missing studies in the meta-analysis (Cumming, 2012). However, in the present study, the distributions of the included studies demonstrated a symmetrical distribution, suggesting the absence of publication bias. Nonetheless, to arrive at a definitive conclusion, statistical calculations were conducted in the meta-analysis, as relying solely on the funnel plot diagram is insufficient. The following are the analysis results pertaining to this matter.

Table 1. Rosenthal's Fail-Safe N Results

For Observed researches		Alfa	Z for Alfa	Tails	Observed a number of research	Number of research (p>.05)
Z Value	p Value					
15.702	.001***	.0500	1.959	2.000	28	1770

*Note. *p<.05, **p<.01*

When the results of Rosenthal's fail-safe N method analysis on the publication bias of teachers' perceptions of distance education and the effectiveness of technology use proficiency were examined in Table 1, it was concluded that this study requires at least 1.770 studies with zero or negative direction. The 1959 z value was found by converting the p values for each study to the z value in Rosenthal 's safe N method. The fact that this value is >1 indicates that the meta-analysis results are also robust to future research and that there is no propagation bias in the study. The Begg rank correlation method is a statistical method that uses Kendal's tau rank correlation coefficient to explain the relationship between the order of effect sizes and the order of variances of these sizes (Borenstein et al., 2019). This method is a procedure that quantifies the result of the funnel plot, rather than the researcher-dependent interpretation (Hartung, Knapp & Sinha, 2008).

Table 2. Rank Correlation Analysis Results of Begg and Mazumdar

Kendall Statistics (P-Q)	84.000
Kendall Tau (Number of discordant pairs)	
Tau	.222
z-value (for tau)	1.659
P-value (1-tailed)	.048
P-degeri (2-tailed)	.097
Kendall Tau (Number of concordant pairs)	
Tau	.219
z- value (for tau)	1.639
P- value (1-tailed)	.050
P- value (2-tailed)	.101

*Note. *p<.05, **p<.01*

When the rank correlation analysis results of Begg and Mazumdar were examined in Table 2, it was found that the primary studies included in this meta-analysis study were not selected biased according to the results of the analysis [Tau=.219 p>.05].

Table 3. Orwin's Fail-Safe N Analysis Results

Average effect size of observed studies	.334
The reduction level of the effect size	.00100
Mean effect size of the studies that were not observed	.000
Number of studies needed to achieve a non-significant effect size	9.326

*Note. *p<.05, **p<.01*

The Orwin's fail-safe N analysis, which examines the protection number, provides a method to detect publication bias by considering a predetermined effect size as the criterion, rather than expecting the effect to be exactly zero (Cleophas & Zwinderman, 2017; Rothstein, Sutton & White, 2021). This method aims to determine how many studies with negative or null effects would be needed to reduce the average effect size of the studies included in the meta-analysis to a level determined by the researcher (Cooper, Hedges & Valentine, 2019). In this analysis, the average effect size is treated as a non-zero value for studies that may not have been reported in the literature (Hangji, 2017). Upon examining the results of the Orwin's fail-safe N analysis presented in Table 3, it was found that in order to reduce the average effect size of studies on teachers' perceptions of distance education and the effectiveness of technology use proficiency below 0.05, a total of 9.326 studies with an average effect size of .000 would need to be conducted or disregarded. This suggests that there is no significant publication bias present in this study.

Table 4. Trim and Fill Analysis Results by Duval and Tweedie

Observed Value of Effect Sizes	.323
Adjusted Value of Effect Sizes	.323
Number of Trimmed Studies in Meta-Analysis	000

*Note. *p<.05, **p<.01*

The trim and fill method is an iterative approach that is used to estimate the number of missing studies by assuming symmetry in the data (Cleophas & Zwinderman, 2017). It employs a non-parametric technique to adjust the data and create a more symmetrical funnel plot by estimating the number of studies that may be missing on one side of the graph (Dias et al., 2018; Kulinskaya, Morgenthaler & Staudte, 2008). Upon examining the results of the Duval and Tweedie fill and fill analysis, which aims to correct for publication bias rather than detect its presence, as shown in Table 4, it was found that the average effect size determined for the primary studies was.323. However, when twenty-eight hypothetical studies were added to the analysis, the estimated effect size remained.323. This indicates that there is no significant publication bias present in this meta-analysis study.

Table 5. Egger's Regression Constant Analysis Results

Intercept	**SE**	**df**	**t**	**p**	**LLCI**	**ULCI**
.234	.695	26	.338	.369	-1.663	.338

*Note. *p<.05, **p<.01*

In Egger regression analysis (Harrer et al., 2022), which proposes a linear regression approach to statistically test whether there is any bias in the data included in the meta-analysis, the standard normal deviation is regressed against its precision (Chen & Peace, 2021). In this analysis, the regression line of a research without publication bias is expected to coincide with the line in the center of the funnel plot (Cheung, 2015). If the funnel plot is not symmetrical, the regression line does not pass through the center (Patole, 2021). The application of Egger regression analysis is appropriate if primary studies have different sample sizes and at

least one study has a medium effect size (Schmid, Stijnen & White, 2021). When the regression constant analysis results were examined in Table 5, [t=.369 p>.05, -1.663 & .338] p significance value and this value calculated in the confidence interval fulfilled the p>.05 condition, which showed that there was no publication bias in this meta-analysis study.

Findings on Heterogeneity and Effect Size

After confirming that the general effect size value was not affected by publication bias, the heterogeneity test was conducted to assess the presence and degree of heterogeneity among the primary studies investigating teachers' perceptions of distance education and the effectiveness of technology use competencies. Heterogeneity is an assumption of the random effects model, as stated by Hunter and Schmidt (2004), as the presence of heterogeneity suggests the influence of various moderating factors, and assessing heterogeneity is a fundamental objective of meta-analysis, as noted by Cooper (2017).

In meta-analyses, Q statistics are used to determine the presence of heterogeneity, while I2 statistics are used to estimate the degree of heterogeneity, as explained by Leandro (2005). In this meta-analysis, the significance level for model selection was set at p <.05, with a 95% confidence level, for the statistical values of heterogeneity Q, I^2, and X^2. The analysis aimed to determine whether there were significant differences in heterogeneity levels. The results of the analysis are presented in Table 6.

Table 6. Analysis Results Regarding the Heterogeneity of The Effect Sizes of The Studies Included in The Meta-Analysis

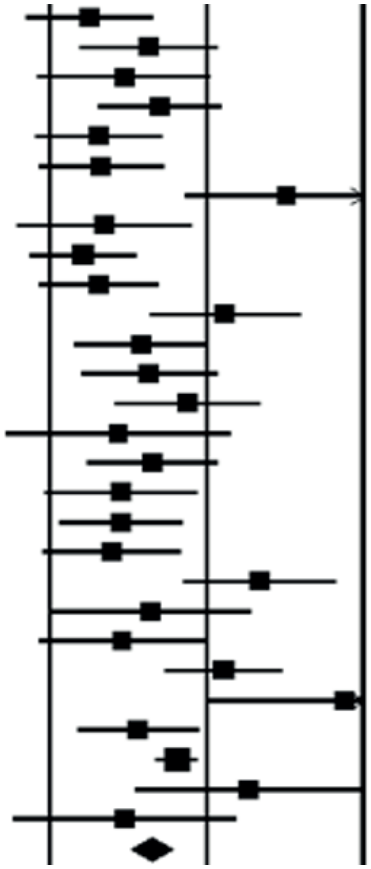
Model Type	ES	df	Q	X^2	SE	I^2	LLCI	ULCI
Random Effects Model	.323	27	63.947	40.11	.032	57.777	.260	.387

*Note. *p<.05, **p<.01 LLCI= Lower Confidence Interval; ULCI= Upper Confidence Interval*

One of the objectives of meta-analysis studies is to examine heterogeneity, which considers the possibility that the intervention's effect may vary across different sample subgroups or, in the case of observational studies, the effect of exposure may differ among individuals, as described by Hedges and Olkin (1985). Heterogeneity is related to the weights assigned to the studies and influences the choice between fixed effects and random effects models, as discussed by Littell, Corcoran, and Pillai (2008). Heterogeneity plays a crucial role in determining the differences between the results of these models, as mentioned by Card (2012). The Cochran Q statistics significance test is used to assess heterogeneity, indicating whether the studies share a common effect size (p<0.05). If the distribution of effect sizes is heterogeneous, it suggests that there are influential moderator variables at play, as explained by Lipsey and Wilson (2001). The analysis results regarding the heterogeneity of the effect sizes of the studies included in the meta-analysis are presented in Table 6, while the effect sizes and overall effects are shown in Table 7. Descriptive statistical analysis results of the variance values, lower and upper confidence intervals, z-values, and significance values of the included studies are provided in Table 8. Examining the heterogeneity analysis results in Table 6, a Q value of 63.947 was obtained. This value exceeded the chi-square value (X^2=40.11) corresponding to the degrees of freedom (df=27), indicating that the effect sizes exhibited a heterogeneous distribution according to the random effects model. The Higgins I^2 parameter represents the proportion of true heterogeneity to the total observed variance (Khan, 2020). It indicates the level of inconsistency between the confidence intervals, regardless of the location or spread of the true effects (Simske, 2019). Therefore, I^2 is more appropriately viewed as a measure of inconsistency among study findings rather than a measure of heterogeneity among actual effects (Rosenthal, 1987). It quantifies the percentage of variability in effect estimates attributable to heterogeneity rather than sampling error and is not directly affected by the number of studies in the analysis (Sterne, 2009).

Table 7. Overall Effect Sizes of The Studies Included in The Meta-Analysis

Name of the Study	Hedges's g	Standard Error	Hedges's g & Confidence Interval
Akman, 2021	.126	.103	
Aksoy et al., 2021	.315	.112	
Arabaci, 2021	.238	.141	
Bingol, 2022	.352	.102	
Cetin, 2022	.156	.103	
Cok, 2021	.165	.103	
Dolek, 2022	.754	.167	
Donmez, 2021	.176	.143	
Duzgun, 2022	.105	.088	
Elyildirim, 2022	.156	.098	
Gokce, 2022	.559	.123	
Guney, 2021	.291	.110	
Kilic, 2022	.317	.111	
Kiraz, 2021	.440	.119	
Kokosmanli, 2022	.219	.182	
Kosan, 2022	.328	.106	
Kurd et al., 2022	.228	.124	
Kurnaz et al., 2020	.227	.100	
Kuru, 2022	.198	.113	
Ozcan & Sarac, 2020	.669	.124	
Shaikh, 2021	.320	.164	
Soydan, 2021	.231	.134	
Toptas, 2022	.554	.097	
Ulus, 2022	.941	.223	
Ulutas, 2022	.283	.100	
Yilmaz & Toker, 2022	.406	.034	
Yilmaz, 2022	.635	.184	
Yumbul, 2021	.239	.181	
General Effect Size	**.323**	**.032**	



P.S. The leftmost vertical line "0.00" the middle vertical line "0.50" the rightmost vertical line "1.00" constitute the reference intervals. An I^2 value of 0% indicates that the variability is due to sampling error or chance, and closer to 100% indicates that the variability is largely due to the actual heterogeneity between studies (Stangl & Berry, 2000). The analysis of the effect sizes of the studies included in the meta-analysis revealed a high level of heterogeneity, with an I^2 value of 57.777%. This indicates that 57.777% of the observed variance can be attributed to actual differences between the studies and may be potentially explained by covariates at the study level (Zoccai, 2018). This finding aligns with previous research on the subject, which also highlighted a significant level of heterogeneity (Cleophas & Zwinderman, 2017). Based on these results, the random effects model was selected to estimate the effect size in this study. The effect size is a crucial piece of information that can be derived from the studies included in a meta-analysis (Riley, Tierney & Stewart, 2021). Therefore, it is essential to calculate the effect size based on the reported results. Reporting a measure of the absolute magnitude of the effect is recommended when the intervention's effect is deemed significant in hypothesis testing, as it provides an indication of the overall impact (Egger, Higgins & Smith, 2022). The effect size is a statistical value that indicates the extent to which the results obtained from the

sample deviate from the expectations defined in the null hypothesis (Borenstein et al., 2019). Additionally, it also expresses the effectiveness of the practice under investigation, regardless of the number of individuals involved (Rothstein, Sutton & White, 2021).

Table 8. Descriptive Statistical Analysis Results of The Studies Included in The Meta-Analysis

Name of the Study	Varyans	LLCI	ULCI	z	p	Study Weight
Akman, 2021	.011	-.077	.329	1.218	.223	4.08
Aksoy et al., 2021	.012	.096	.534	2.822	.005*	3.82
Arabaci, 2021	.020	-.039	.515	1.685	.092	3.00
Bingol, 2022	.010	.152	.551	3.456	.001	4.14
Cetin, 2022	.011	-.047	.358	1.508	.132	4.09
Cok, 2021	.011	-.036	.366	1.605	.108	4.11
Dolek, 2022	.028	.428	1.081	4.521	.001**	2.45
Donmez, 2021	.020	-.104	.455	1.231	.218	2.97
Duzgun, 2022	.008	-.067	.278	1.198	.231	4.62
Elyildirim, 2022	.010	-.036	.348	1.593	.111	4.27
Gokce, 2022	.015	.319	.800	4.553	.001**	3.49
Guney, 2021	.012	.075	.507	2.640	.008*	3.87
Kilic, 2022	.012	.100	.534	2.862	.004*	3.85
Kiraz, 2021	.014	.206	.674	3.682	.001**	3.59
Kokosmanli, 2022	.033	-.139	.576	1.200	.230	2.18
Kosan, 2022	.011	.121	.535	3.099	.002*	4.01
Kurd et al., 2022	.015	-.016	.471	1.830	.067	3.44
Kurnaz et al., 2020	.010	.030	.424	2.260	.024*	4.18
Kuru, 2022	.013	-.024	.421	1.749	.080	3.76
Ozcan & Sarac, 2020	.015	.426	.913	5.384	.001**	3.45
Shaikh, 2021	.027	-.002	.641	1.950	.051	2.50
Soydan, 2021	.018	-.032	.494	1.721	.085	3.18
Toptas, 2022	.009	.365	.744	5.734	.001**	4.31
Ulus, 2022	.050	.504	1.377	4.220	.001**	1.62
Ulutas, 2022	.010	.087	.479	2.825	.005*	4.19
Yilmaz & Toker, 2022	.001	.338	.473	11.774	.001**	6.48
Yilmaz, 2022	.034	.274	.997	3.443	.001**	2.14
Yumbul, 2021	.033	-.116	.594	1.322	.186	2.20
General Result	**.001**	**.260**	**.387**	**9.979**	**.001****	

*Note. *p<.05, **p<.01 LLCI= Lower Confidence Interval; ULCI= Upper Confidence Interval*

When examining the effect sizes and overall effects of the studies included in the meta-analysis, Table 7 presents a range of effect sizes from the lowest value of 0.105 to the highest value of 0.941. These effect sizes represent the estimated effects in the population and indicate the magnitude of the observed relationship between teachers' perceptions of distance education and the effectiveness of their technology use competencies. Based on reference intervals, an effect size below 0.20 is considered weak, between 0.20 and 0.50 is considered small, between 0.51 and 1.0 is considered medium, and above 1.0 is considered large (Cooper, Hedges & Valentine, 2019). In this meta-analysis, the effect sizes indicated a small but positive effect. Table 8 provides the results of the descriptive statistical analysis of the studies included in the meta-analysis, indicating their significance at the 95% confidence interval and a significance level of 0.05. The calculated z-values for each study (Aksoy et al., 2021; Dolek, 2022; Gokce, 2022; Kiraz, 2021; Kosan, 2022; Kurnaz et al., Ozcan &

Sarac, 2020; Toptas, 2022; Ulus, 2022; Ulutas, 2022; Yilmaz & Toker, 2022; Yilmaz, 2021) demonstrate the statistical significance of the individual studies. The overall variance was 0.001, with a lower confidence interval of 0.260, upper confidence interval of 0.387, z-value of 9.979, and a p-value of 0.001**, indicating that all studies included in the meta-analysis yielded significant results. The weights assigned to the studies ranged from 1.62% to 6.48%, suggesting a relatively balanced contribution from each study considering the analysis results from Tables 6, 7, and 8, it can be concluded that the hypothesis *"H1: The effect size of teachers' perceptions of distance education and technology use proficiency is positive"* is supported. Furthermore, the presence of high heterogeneity suggests the involvement of moderator variables in the meta-analysis studies. In this meta-analysis, the type of publication, type of school, and teachers' industry variables were identified as potential moderators, and further calculations were conducted accordingly.

Findings Related to Moderator Analysis

The results of the moderator analysis, presented in Table 9, examined the effect of publication type, school type, and teachers' branches on the effect size related to teachers' perceptions of distance education and the effectiveness of technology use proficiency. A heterogeneity value of Q_b = 0.055 was obtained for the included studies. This value was compared to the chi-square statistical value [df=1, 3.84] based on the degrees of freedom and significance level. Since the obtained heterogeneity value was greater than the critical chi-square value, it indicated that the publication type variable was not statistically significant in the meta-analysis studies [p=0.814]. In other words, the effect size of teachers' perceptions of distance education and technology use competencies did not differ significantly based on the publication type, whether it was an article [ES=.336] or a thesis [ES=.319]. However, it was observed that studies published as articles had a slightly larger effect size. Therefore, the publication type variable did not act as a moderator in the effect size of teachers' perceptions of distance education and the effectiveness of technology use competencies. This finding suggests that the hypothesis "*H_2: Publication type variable plays a moderator role in the effect size of teachers' perceptions of distance education and technology use proficiency"* was not supported.

Table 9. Moderator Analysis Results

Variables	Q_b	df	p	X^2	N	ES	LLCI	ULCI
Publication Type	**.055**	**1**	**.814**	**3.84**				
Article					7	.336	.213	.459
Thesis					21	.319	.241	.396
School Type	**1.374**	**2**	**.503**	**5.99**				
Primary school					12	.339	.253	.425
Middle School					7	.270	.165	.376
Secondary education					9	.365	.209	.521
Branch	**10.548**	**7**	**.160**	**14.07**				
Physical education					3	.359	.077	.641
Religious Culture and Moral Knowledge					2	.167	.012	.323
Science					7	.365	.220	.510
English					3	.392	.329	.456
Maths					2	.568	-.119	1.255
Music					2	.400	.078	.721
Pre-school					2	.228	.071	.385
Class Teacher					7	.291	.163	.419

*Note. *p<.05, **p<.01 LLCI= Lower Confidence Interval; ULCI= Upper Confidence Interval*

The heterogeneity value for the included studies was calculated as Q_b=1.374, which corresponds to a chi-square statistical value [df=2, 5.99] based on the specific degrees of freedom and significance level. The result indicates that the significance of the school type variable in the meta-analysis is not statistically significant [p=.503]. In simpler terms, teachers' perceptions of distance education did not lead to a significant difference in the effect size of their technology use competencies across primary school [ES=.339], secondary school [ES=.270], or secondary education [ES=.365]. However, it is worth noting that the effect size of studies conducted in secondary education institutions was relatively larger. Therefore, the school type variable does not play a moderator role in the relationship between teachers' perceptions of distance education and their effectiveness in using technology. Based on these findings, the hypothesis stating that "*H_3= Type of school variable plays a moderator role in the effect size of teachers' perceptions of distance education and technology use proficiency" was not supported.*

On the other hand, the studies included in the analysis had a heterogeneity value of Q_b=10.548. This value corresponds to a chi-square statistical value [df=7, 14.07] based on a certain degree of freedom and significance level. The fact that the observed heterogeneity value exceeds the expected value indicates that the significance of the teachers' branch variable is not statistically significant in the meta-analysis [p=.160]. In simpler terms, the effect size of teachers' perceptions of distance education and technology use competencies did not differ significantly across different branches, including Physical Education [ES=.359], Religious Culture and Moral Knowledge [ES=.167], Science [ES=.365], English [ES=.392], Mathematics [ES=.568], Music [ES=.400], Preschool [ES=.228], or Classroom Teacher [ES=.291]. However, it is noteworthy that the effect size of studies focusing on mathematics teachers was relatively larger. As a result, the branch variable does not act as a moderator in the relationship between teachers' perceptions of distance education and their effectiveness in using technology. These findings indicate that the hypothesis stating "*H_4= Branch variable plays a moderator role in the effect size of teachers' perceptions of distance education and technology use proficiency" was not supported.*

DISCUSSIONS AND CONCLUSION

Researchers sometimes choose not to publish non-significant results, leading to a potential bias in the published literature (Riley, Tierney & Stewart, 2021). Consequently, relying solely on reviews of published studies may result in biased conclusions (Cooper, Hedges & Valentine, 2019). Therefore, it is essential to assess whether there is publication bias in meta-analysis studies through appropriate statistical calculations. In this study, a funnel plot was constructed to investigate publication bias, and various methods such as rank correlation, trimming and filling, regression constant, and the N method were employed. Upon careful examination of the funnel plot, it was observed that the distribution of studies included in the meta-analysis exhibited a symmetrical pattern without any significant asymmetry. An asymmetrical funnel shape would indicate potential publication bias (Rothstein, Sutton & White, 2021). However, it should be noted that the funnel plot alone is not sufficient to draw conclusions in meta-analysis studies, particularly for larger studies (Borenstein et al., 2019). The calculated z-value in Rosenthal's fail-safe N method, which determines the number of studies needed to nullify the observed effect, was greater than a critical value, suggesting that the meta-analysis was robust against publication bias. The Tau value calculated in the Begg rank correlation method was not significant, indicating that the studies included in the meta-analysis were not selectively biased. Additionally, Orwin's fail-safe N analysis was conducted to estimate the number of studies with opposite effects required to nullify the results. Based on the analysis, it was concluded that there was no publication bias. Furthermore, the effect size value obtained from the trim and fill method closely aligned with the corrected effect size value. Considering these findings collectively, it can be concluded that the published studies on the relationship between teachers' perceptions of distance education and their technology use competencies were selected and included in the meta-analysis according to predefined criteria without significant publication bias.

The review period for publication of this research was set from March 1, 2022, to September 30, 2022, and it was intentionally kept long due to the extensive number of studies available on the subject. However, one of the main limitations of meta-analysis studies is that highly researched topics may not be investigated globally or cover long periods of time (Egger, Higgins & Smith, 2022; Harrer et al., 2022; Riley, Tierney

& Stewart, 2021; Rothstein, Sutton & White, 2021; Schmid, Stijnen & White, 2021). To address this concern, a comprehensive literature search was conducted using predefined keywords, resulting in the retrieval of tens of thousands of studies. Due to practical constraints such as time and budget limitations, the sample for this research was limited to studies conducted in Turkiye. The effect size of the studies examining teachers' perceptions of distance education and their technology use competencies in the Turkish sample was found to be small but positive. In other words, the primary studies indicated a small but positive effect on teachers' perceptions of distance education and their proficiency in using technology. This finding aligns with previous studies on the topic (Alghamdi et al., 2020; Ali, 2020; Burac et al., 2019; Cachero-Gonzalez et al., 2019; Celik et al., 2022; Elizabeth Noor Coutts et al., 2020; Fis Erumit et al., 2021; Goncalves et al., 2020; Gorghiu et al., 2021; Grabinski et al., 2020; Hamann et al., 2020; Makamure & Tsakeni, 2020; Makokotlela, 2022; Mnguni & Mokiwa, 2020).

In this study, the goal was to investigate teachers' perceptions of distance learning and the effectiveness of their technology use skills. Since the included studies in the meta-analysis provided estimates on different scales (Sterne, 2009), the effect sizes were calculated using the Hedges g coefficient and standardization of effect sizes (Leandro, 2005). Based on the analysis results of Q, I2, and X2 values, it was decided to interpret the studies using the random effects model. The type of publication, type of school, and teachers' branches were identified as potential sources of heterogeneity. However, the analyses revealed that these factors did not significantly influence teachers' perceptions of distance education and their proficiency in using technology.

This research aimed to investigate the effect size of teachers' perceptions of distance education and their technology use competencies using the meta-analysis method. To achieve this, primary studies published between 2020-2022 in databases such as the Council of Higher Education National Thesis Center, Dergi Park, Tr Index, Turkish Education Index, and Academic Directory were analyzed. The keywords used to retrieve relevant studies were "distance education," "teachers' perceptions of distance education," and "teachers' technology usage competencies." Publication bias is a common concern in meta-analysis studies. To address this, several methods were employed in this study, including the use of a funnel plot diagram, rank correlation, trim and fill analysis, fail-safe N numbers, and regression constant values. Through these calculations, it was determined that there was no evidence of publication bias in the primary studies included in the analysis of teachers' perceptions of distance education and their technology use competencies.

Furthermore, Q statistics were utilized to assess heterogeneity in the meta-analyses, and Q, I^2, and X^2 statistics were calculated to determine the extent of heterogeneity and select the appropriate model. Based on the calculations, it was determined that the research should be reported using the random effects model. The effect size of teachers' perceptions regarding distance education and technology use competencies was found to be positive. This outcome provided support for the hypothesis that *"H_1: The effect size of teachers' perceptions of distance education and technology use proficiency is positive*." Publication type, school type, and teachers' branch were selected as moderators to investigate potential sources of heterogeneity. However, the p-value associated with the moderator variable of publication type did not reach statistical significance. Therefore, it was concluded that publication type did not have a moderating effect on the relationship between teachers' perceptions of distance education and their proficiency in technology use. As a result, the hypothesis stating that "*H_2: Publication type variable moderates the relationship between teachers' perceptions of distance education and technology use proficiency" was not supported.* Similarly, the p-value for the school type variable, included as another moderator, was not statistically significant. Hence, it was determined that school type did not play a moderating role in the relationship between teachers' perceptions of distance education and their effectiveness in technology use. This finding indicated that the hypothesis stating that "*H_3: Type of school variable moderates the relationship between teachers' perceptions of distance education and technology use proficiency" was not supported.* Furthermore, the p-value associated with the branch variable of the teachers, also included as a moderator, was not statistically significant. Therefore, it was concluded that the branch variable did not act as a moderator in the relationship between teachers' perceptions of distance education and their proficiency in technology use. Consequently, the hypothesis stating that "*H_4: Branch variable moderates the relationship between teachers' perceptions of distance education and technology use proficiency" was not supported.*

Based on the analysis of the effectiveness of research on teachers' perception of distance education and their competencies in technology use, the following recommendations are proposed for teachers, educational administrators, stakeholders, decision-makers, and researchers:

Research Recommendations

- The perception level of teachers towards distance education should be increased and necessary studies should be carried out by the ministries of education for the development of teachers towards distance education.
- Necessary in-service trainings should be given on the technology use competencies of teachers and the necessary support should be provided by the relevant education ministries or relevant education stakeholders for teachers to use technology effectively.

Recommendations for Researchers

- With this research, a meta-analysis study was conducted to determine the effect size of primary studies on teachers' perceptions of distance education and their technology use competencies. A meta-synthesis or systematic review study in qualitative systematic analysis design can be planned for interpreting the studies on this subject.

Acknowledgments: The author would like to thank Prof. Dr. Ilhan Gunbayi from the University of Akdeniz for critical reading and language editing.

BIODATA and CONTACT ADDRESSES of AUTHOR

Dr. Savas VARLIK is aHead Teacher at the Ministry of National Education of the Republic of Turkiye. His academic interests are statistics, artificial intelligence, and the digital transformation process. He has a doctoral degree in educational sciences from Akdeniz University. He gives training on educational statistics, measurement and evaluation, paradigms and philosophy, mixed method research, meta-synthesis, meta-analysis, bibliometric analysis, situational mediation models, scientific research methods, basic and advanced statistics, and academic writing. He has more than 10 articles published in international indexes, articles presented at international meetings, 2 books, and 1 translated book section.

Savas VARLIK
Address: Ministry of National Education of the Republic of Turkiye, Ankara, Turkiye
Phone: +90 539 715 33 03
E-mail: savasvarlik@yahoo.com

REFERENCES

Adom, D. (2020). Cultural and Educational implications of the COVID-19 global pandemic in Ghana. *International and Multidisciplinary Journal of Social Sciences, 9*(3), 202-229.

Adzobu, N. Y. A. (2014). Design, use and evaluation of e-learning platforms: Experiences and perspectives of a practitioner from the developing world studying in the developed world. *Informatics, 1*(2), 147-18.

Agyei, D. D., & Voogt, J. M. (2011). Exploring the potential of the will, skill, tool model in Ghana: Predicting prospective and practicing teachers' use of technology. *Computers & Education, 56*(1), 91-100.

Akman, A. (2021). *Ilkogretim din kulturu ve ahlak bilgisi ogretmenlerinin uzaktan egitime yonelik tutumlari* [Yayimlanmamis yuksek lisans tezi]. Necmettin Erbakan Universitesi.

Aksoy, N.C., Karabay, E., & Aksoy, E. (2021). Sinif Ogretmenlerinin Dijital Okuryazarlik Duzeylerinin Incelenmesi. *Selcuk Iletisim Dergisi, 14*(2),859-894.

Aldaghri, A. A., & Oraif, I. M. (2022). The impact of online teaching on students' engagement in writing during the pandemic of COVID-19. *Turkish Online Journal of Distance Education, 23* (3), 216-229.

Alghamdi, A., Karpinski, A. C., Lepp, A., & Barkley, J. (2020). Online and face-to-face classroom multitasking and academic performance: Moderated mediation with self-efficacy for self-regulated learning and gender. *Computers in Human Behavior, 102*, 214-222.

Ali, W. (2020). Online and remote learning in higher education institutes: A necessity in light of COVID-19 pandemic. *Higher Education Studies, 10*(3), 16–25.

Altinay, Z. (2017). Evaluating peer learning and assessment in online collaborative learning environments. *Behavior & Information Technology, 36*(3), 312-320.

Altunoglu, A. (2017). Initial perceptions of open higher education students with learner management systems. *Turkish Online Journal of Distance Education, 18*(3), 96-104.

Amoozegar, A., Khodabandelou, R., & Ebrahim, N. A. (2018). Major trends in distance education research: A combination of bibliometric and thematic analysis. *International Journal of Information Research and Review, 5*(2), 5352-5359.

Arabaci, S. (2020). *Ogretmenlerin uzaktan egitim algisi ve ogrencilerin uzaktan egitime yonelik tutumlari* [Yayimlanmamis yuksek lisans tezi]. Erzincan Binali Yildirim Universitesi.

Avsec, S., & Savec, V. F. (2021). Predictive modeling of pre-service science and technology teachers' innovative behavior. *Journal of Baltic Science Education, 20*(2), 171-183.

Baleghi, S., Ayub, A. F. M., Mahmud, R., & Daud, S. M. (2017). The influence of system interactivity and technical support on learning management system utilization. *Knowledge Management & ELearning, 9*(1), 50-68.

Baptista, M., Costa, E., & Martins, I. (2020). STEM education during the COVID-19: Teachers' perspectives about strategies, challenges, and effects on students' learning. *Journal of Baltic Science Education, 19*(n6A), 1043-1054.

Bell, R. L., Maeng, J. L., & Binns, I. C. (2013). Learning in context: Technology integration in a teacher preparation program informed by situated learning theory. *Journal of Research in Science Teaching, 50*(3), 348-379.

Bingol, H. (2022). *Uzaktan egitim surecinde ogretmenlerin dijital okuryazarlik duzeyleri ile mesleki motivasyonlarinin incelenmesi* [Yayimlanmamis yuksek lisans tezi]. Zonguldak Bulent Ecevit Universitesi

Borenstein, M., Hedges, L.V., Higgins, J.P.T. & Rothstein, H.R. (2009). *Introduction to meta-analysis* (1st ed.). Wiley.

Bozkurt, A. (2020). Koronavirus (Covid-19) pandemi sureci ve pandemi sonrasi dunyada egitime yonelik degerlendirmeler: Yeni normal ve yeni egitim paradigmasi. *Acikogretim Uygulamalari ve Arastirmalari Dergisi, 6*(3), 112-142.

Bulut, A., Kaban, A., & Bilen, O. (2022). Pre-service science and computer teachers' views on teaching practice courses. *Journal of Baltic Science Education, 21*(2), 179.

Burac, M. A. P., Fernandez, J. M., Cruz, M. M. A., & Cruz, J. D. (2019). Assessing the impact of e-learning system of higher education institution's instructors and students. *Materials Science and Engineering, 482*(1), 1-8.

Cachero-Gonzalez, M. L., Medina-Rivilla, A., Dominguez-Garrido, M. C., & Medina- Dominguez, M. (2019). The learning platform in distance higher education: Students' perceptions. *Turkish Online Journal of Distance Education, 20*(1), 71-95.

Card, N.A. (2012). *Applied meta-analysis for social science research* (1st ed.). The Guilford Press.

Celik, E., Ozdemir, G. B. & Isik, A. (2022). The effect of cluster teaching with worksheets on students' academic achievement in distance education. *Turkish Online Journal of Distance Education, 23*(3), 137-152.

Cetin, H. (2022). *Sinif ogretmenlerinin uzaktan egitime yonelik tutum, ozyeterlik ve motivasyonlarinin incelenmesi* [Yayimlanmamis yuksek lisans tezi]. Kocaeli Universitesi.

Chen, D.G. & Peace, K.E. (2021). *Applied meta-analysis with r and stata* (2nd ed.). CRC Press.

Cheung, M.V.L. (2015). *Meta-analysis a structural equation modeling approach* (1st ed.). Wiley.

Chugh, R., Ledger, S., & Shields, R. (2017). Curriculum design for distance education in the tertiary sector. *Turkish Online Journal of Distance Education, 18*(2), 1-15.

Cleophas, T.J., & Zwinderman, A.H. (2017). *Modern meta-analysis review and update of methodologies* (1st ed.). Springer.

Cok, C. (2021). *Ogretmenlerin uzaktan egitime iliskin oz-yeterlik algisi ve pandemi surecinde uzaktan egitimde karsilastiklari engeller* [Yayimlanmamis yuksek lisans tezi]. Van Yuzuncu Yil Universitesi.

Cooper, H. (2017). *Research synthesis and meta-analysis* (50th ed.). Sage Publication.

Cooper, H., Hedges., L.V. & Valentine, J.C. (2019). *The handbook of research synthesis and meta-analysis* (3nd ed.). Russel Sage Foundation.

Creswell, J.W., & Creswell, J.D. (2018). *Research design qualitative, quantitative, and mixed methods approaches* (50th ed.). Sage Publications.

Cumming, G. (2012). *Understanding the new statistics effect sizes, confidence intervals and meta-analysis* (1nd ed.). Routledge.

Dalton, B. (2001) Distance education: A multidimensional evaluation. *Journal of Technology in Human Services, 18*(3-4), 101-115.

Dias, S., Ades, A.E., Welton, N.J., Jansen, J.P. & Sutton, A.J. (2018). *Network meta-analysis for decision-making* (1st ed.). Wiley.

Dolek, P. (2022). *Covid-19 surecinde fen bilimleri ogretmenlerinin uzaktan egitime yonelik tutum ve goruslerinin incelenmesi* [Yayimlanmamis yuksek lisans tezi]. Firat Universitesi.

Donmez, A. (2021). *Fen bilimleri ogretmenlerinin uzaktan egitime yonelik tutumlarinin cesitli degiskenler acisindan incelenmesi* [Yayimlanmamis yuksek lisans tezi]. Adiyaman Universitesi.

Duzgun, S. (2022). Ogretmenlerin uzaktan egitimdeki oz duzenlemeli ogrenme oz yeterlikleri. *TEBD, 20*(1), 303-322.

Egger, M., Higgins, J.P.T., & Smith, G.D. (2022). *Systematic reviews in health research meta analysis in context* (3rd ed.). Willey.

Elcicek, M. (2021). Tendencies in Turkey-based academic studies on distance education during the COVID-19 pandemic. *Journal of Educational Technology and Online Learning, 4*(3), 406-417.

Elizabeth Noor Coutts, C., Buheji, M., Ahmed, D., Abdulkareem, T., Buheji, A., Buheji, B., ... & Perepelkin, N. (2020). Emergency remote education in Bahrain, Iraq, and Russia during the COVID-19 pandemic: A comparative case study. *Human Systems Management, 39*(4),473-493.

Ellis, P.D. (2010). *The essential guide to effect sizes* (1st ed.). Cambridge University Press.

Elyildirim, E. (2022). *Okul oncesi ogretmenlerinin uzaktan egitim deneyimleri: Bir karma yontem calismasi* [Yayimlanmamis yuksek lisans tezi]. Kirsehir Ahi Evran Universitesi.

Fis Erumit, S. (2021). The distance education process in K–12 schools during the pandemic period: Evaluation of implementations in Turkey from the student perspective. *Technology. Pedagogy and Education, 30*(1),75-94.

Gillett-Swan, J. (2017). The challenges of online learning: Supporting and engaging the isolated learner. *Journal of Learning Design, 10*(1), 20-30.

Gokce, O. (2022). *Muzik alaninda uzaktan egitim teknolojilerinin kullanilmasi* [Yayimlanmamis yuksek lisans tezi]. Gazi Universitesi.

Goncalves, S. P., Sousa, M. J., & Pereira, F. S. (2020). Distance learning perceptions from higher education students-the case of Portugal. *Education Sciences, 10*(12), 374.

Gorghiu, G., Pribeanu, C., Manea, V.L., Lamanauskas, V., & Makarskaite-Petkeviciene, R. (2021). The usefulness of online learning during the COVID-19 pandemic as perceived by engineering education students: A multidimensional model. *Journal of Baltic Science Education, 20*(5), 716-728.

Grabinski, K., Kedzior, M., Krasodomska, J., & Herdan, A. (2020). Embedding e-learning in accounting modules: The educators' perspective. *Education Sciences, 10*(4), 1-19.

Guney, I. (2021). *Ogretmenlerin bilisim teknolojileri oz yeterlik algilari ile uzaktan egitime yonelik tutumlari arasindaki iliski* [Yayimlanmamis yuksek lisans tezi]. Ataturk Universitesi.

Gurcan, F., Ozyurt, O., & Cagitay, N. E. (2021). Investigation of emerging trends in the e-learning field using latent dirichlet allocation. *The International Review of Research in Open and Distributed Learning, 22*(2), 1-18.

Hamann, K., Glazier, R. A., Wilson, B. M., & Pollock, P. H. (2020). Online teaching, student success, and retention in political science courses. *European Political Science, 20*, 427-439.

Hangji, M.B. (2017). *Meta-analysis in psychiatry research* (1st ed.). CRC Press.

Harrer, M., Cuijpers, R., Furukawa, T.A. & Ebert, D.D. (2022). *Doing meta-analysis with r* (1st ed.). CRC Press.

Hartung, J., Knapp, G. & Sinha, B.K. (2008). *Statistical meta-analyis with applications* (1st ed.). John Wiley & Sons.

Hedges, L.V. & Olkin, I. (1985). *Statistical methods for meta-analysis* (1st ed.). Academic Press.

Hodges, C. B., & Cullen, T. A. (2020). Teacher readiness to implement technology innovations. *I-Manager's Journal on School Educational Technology, 16*(2), 1.

Hunter, J.E. & Schmidt, F.L. (2004). *Methods of meta-analysis* (2nd ed.). Sage Publications.

Keegan, D. J. (1980). On defining distance education. *Distance Education, 1*(1), 13-36.

Khan, S. (2020). *Meta-analysis methods for health and experimental studies* (1st ed.). Springer.

Kilic, Y. (2022). *Ogretmenlerin egitim teknolojilerini kullanim durumu ile uzaktan egitime yonelik tutumlari arasindaki iliski* [Yayimlanmamis yuksek lisans tezi]. Ataturk Universitesi.

Kim, J. (2020). Learning and teaching online during COVID-19: Experiences of student teachers in an early childhood education practicum. *International Journal of Early Childhood, 52*(2), 145-158.

Kiraz, Z. (2021). Okul yoneticilerinin uzaktan egitim surecinde bilgi teknolojileri kullanimi oz yeterlikleri ile yonetim becerilerinin donusturucu liderlik davranisi uzerindeki etkisi. *e- Kafkas Egitim Arastirmalari Dergisi, 8*, 703-719.

Kokosmanli, P. A. (2022). *Fen ve teknoloji ogretmenlerinin uzaktan egitime yonelik algi ve tutumlarinin incelenmesi* [Yayimlanmamis yuksek lisans tezi]. Erzincan Binali Yildirim Universitesi.

Kopcha, T. J. (2012). Teachers' perceptions of the barriers to technology integration and practices with technology under situated professional development. *Computers & Education, 59*(4), 1109-1121.

Kosan, D. (2022). *Sinif ogretmenlerinin uzaktan egitime iliskin tutumlari ile motivasyon duzeyleri arasindaki iliski* [Yayimlanmamis yuksek lisans tezi]. Van Yuzuncu Yil Universitesi.

Koyuncu, I., Kilic, A. F. & Orhan Goksun, D. (2022). Classification of students' achievement via machine learning by using system logs in learning management system. *Turkish Online Journal of Distance Education, 23*(3), 18-30.

Kulinskaya, E., Morgenthaler, S. & Staudte, R.G. (2008). *Meta analysis a guide to calibrating and combining statistical evidence* (1st ed.). John Wiley & Sons.

Kurd, E., Korkmaz, O., & Ozden, M.Y. (2022). Pandemi donemi baglaminda ogretmenlerin teknolojik formasyon duzeyleri ve canli ders etkilesim duzeyleri. *Uluslararasi Turk Egitim Bilimleri Dergisi, 10* (18), 18-55.

Kurnaz, A., Kaynar, H., Barisik, C. S., & Dogrukok, B. (2020). Ogretmenlerin uzaktan egitime iliskin gorusleri. *Milli Egitim, 49*(1), 293-322.

Kuru, T. (2022). *Beden egitimi ogretmenlerinin meslegine yonelik tutumlari ile uzaktan egitim yeterlikleri arasindaki iliskinin incelenmesi* [Yayimlanmamis yuksek lisans tezi]. Bartin Universitesi.

Landis, J. R. & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics, 33*, 159-174.

Lautenbach, G., & Randell, N. (2020). Through the COVID-19 looking glass: Coping skills for STEM educators in the time of a pandemic and beyond. *Journal of Baltic Science Education, 19*(n6A), 1068-1077.

Leandro, G. (2005). *Meta-analysis in medical research* (1st ed.). Blackwell Publishing.

Lee, A. R., Bailey, D. & Almusharraf, N. (2022). South Korean University Students' views of online learning during the COVID-19 pandemic. *Turkish Online Journal of Distance Education, 23*(4), 39-52.

Leidner, D. E., & Jarvenpaa, S. L. (1995). The use of information technology to enhance management school education: A theoretical view. *MIS quarterly*, 265-291.

Lipley, M.W. & Wilson, D.B. (2001). *Practical meta-analysis* (1st ed.). Sage Publications.

Littell, J.H., Corcoran, J., & Pillai, V. (2008). *Systematic reviews and meta-analysis* (1st ed.). Oxford University Press.

Makamure, C., & Tsakeni, M. (2020). COVID-19 as an agent of change in teaching and learning STEM subjects. *Journal of Baltic Science Education, 19*(n6A), 1078-1091.

Makokotlela, M. V. (2022). Student teachers' experiences in using open education resources in the open distance learning context. *Turkish Online Journal of Distance Education, 23*(4), 108-120.

Mashroofa, M. M., Jusoh, M., & Chinna, K. (2019). Research trend on the application of "e-learning adoption theory": A scientometric study during 2000-2019, based on web of science and scopus. *Collnet Journal of Scientometrics and Information Management, 13*(2), 387–408.

Mnguni, L., & Mokiwa, H. (2020). The integration of online teaching and learning in stem education as a response to the COVID-19 pandemic. *Journal of Baltic Science Education, 19*(6A), 1040.

Morante, A., Djenidi, V., Clark, H., & West, S. (2017). Gender differences in online participation: Examining a history and a mathematics open foundation online course. *Australian Journal of Adult Learning, 57*(2), 266–293.

Moroz, S., & Moroz, V. (2022). Distance learning and face-to-face learning: student perception of quality assurance and prospects for improvement in education management technologies. *Turkish Online Journal of Distance Education, 23*(4), 159-182.

Ozcan, B., & Sarac, L. (2020). COVID-19 pandemisi surecinde ogretmen cevrim ici uzaktan egitim rol ve yeterlikleri: beden egitimi ogretmenleri ornegi, 49(1), 459-475.

Ozkan, B., & Tekeli, F. N. (2021). The effects of information and communication technology engagement factors on science performance between Singapore and Turkey using multi-group structural equation modeling. *Journal of Baltic Science Education, 20*(4), 639-650.

Palloff, R. M., & Pratt, K. (2007). *Building online learning communities: Effective strategies for the virtual classroom*. John Wiley & Sons.

Panisoara, I. O., Chirca, R., & Lazar, I. (2020). The effects of online teaching on students' academic progress in STEM. *Journal of Baltic Science Education, 19*(n6A), 1106-1124.

Park, H., & Shea, P. (2020). A review of ten-year research through co-citation analysis: Online learning, distance learning, and blended learning. *Online Learning, 24*(2), 225–244.

Patole, S. (2021). *Principles and practice of systematic reviews and meta-analysis* (1st ed.). Springer.

Pittman, T., & Gaines, T. (2015). Technology integration in third, fourth and fifth grade classrooms in a Florida school district. *Educational Technology Research and Development, 63*(4), 539-554.

Riley, R., Tierney, J., & Stewart, L.A. (2021). *Individual participant data meta-analysis* (1st ed.). Wiley.

Rosenthal, R. (1987). *Judgment studies design, analysis and meta-analysis* (1st ed.). Cambridge University Press.

Rothstein, H.R., Sutton, A.J. & Borenstein, M. (2005). *Publication bias in meta analysis prevention assesment and adjustments* (1st ed.). John Wiley & Sons.

Sadaf, A., Newby, T. J., & Ertmer, P. A. (2016). An investigation of the factors that influence preservice teachers' intentions and integration of web 2.0 tools. *Educational Technology Research and Development, 64*(1), 37-64.

Sangra, A., Vlachopoulos, D., & Cabrera, N. (2012). Building an inclusive definition of e-learning: An approach to the conceptual framework. *The International Review of Research in Open and Distributed Learning, 13*(2), 145-159.

Schmid, C.H., Stijnen, T., & White, I.R. (2021). *Handbook of meta-analysis* (1st ed.). CRC Press.

Shaikh, G. (2021). *Uzaktan egitim surecinde Ingilizce ogretmenlerinin goruslerinin degerlendirilmesi* [Yayimlanmamis yuksek lisans tezi]. Mardin Artuklu Universitesi.

Simske, S. (2019). *Meta-analytics consensus approaches and system patterns for data analysis* (1st ed.). Elsevier.

Soydan, M. (2021). *Ogretmenlerin salgin doneminde uzaktan egitime yonelik tutumu* [Yayimlanmamis yuksek lisans tezi]. Ondokuz Mayis Universitesi.

Stangl, D.K., & Berry, D.A. (2000). *Meta-analysis in medicine and health poli*cy (2nd ed.). Marcel Dekker.

Sterne, J. (2009). *Meta-analysis in stata: An updated collection from the Stata Journal* (1st ed.). Stata Press.

Stuart, J., O'Donnell, A.W., Scott, R., O'Donnell, K., Lund, R., & Barber, B. (2022) Asynchronous and synchronous remote teaching and academic outcomes during COVID-19. *Distance Education, 43*(3), 408-425.

Tilton, J., & Hartnett, M. (2016). What are the influences on teacher mobile technology self-efficacy in secondary school classrooms? *Journal of Open, Flexible and Distance Learning, 20*(2), 79-93.

Tondeur, J., Van Braak, J., Ertmer, P. A., & Ottenbreit-Leftwich, A. (2017). Understanding the relationship between teachers' pedagogical beliefs and technology use in education: A systematic review of qualitative evidence. *Educational technology research and development, 65*(3), 555-575.

Topchyan, R., & Zhang, J. (2014). Validation of virtual learning team competencies for individual students in a distance education setting. *American Journal of Distance Education, 28*(4), 264–279.

Toptas, H. T. (2022). *Pandemi surecinde uzaktan egitim veren ogretmenlerin oz-yeterlik algilari ile uzaktan egitim tutumlari arasindaki iliskinin incelenmesi* [Yayimlanmamis yuksek lisans tezi]. Eskisehir Osmangazi Universitesi.

Ulus, S. O. (2022). *Ortaokul matematik ogretmenlerinin teknolojik pedagojik alan bilgisi algilari ile uzaktan egitime yonelik tutumlari arasindaki iliskinin incelenmesi* [Yayimlanmamis yuksek lisans tezi]. Maltepe Universitesi.

Ulutas, A. (2022). *Turkiye'deki uzaktan egitim uygulamalari ve ogretmenlerin uzaktan egitime yonelik tutumlari ile dijital okuryazarliklari arasindaki iliskinin incelenmesi* [Yayimlanmamis yuksek lisans tezi]. Gaziantep Universitesi.

Varlik, S., & Gunbayi, I. (2020). E-okul sistemi uygulamasinin etkililigi: Meta analiz calismasi. *Akdeniz Egitim Arastirmalari Dergisi, 14*(34), 573-590.

Wang, Y. (2022) Exploring the relationships among the dimensions of a community of inquiry in an online learning environment. *Distance Education, 43*(3), 353-368.

Yavuz, M., Kayali, B., & Tutal, O. (2021). Trend of distance education research in the COVID-19 period: A bibliometric and content analysis. *Journal of Educational Technology and Online Learning, 4*(2), 256-279.

Yavuz, M., Kayali, B., Balat, S., & Karaman, S. (2020). Salgin surecinde Turkiye'deki yuksekogretim kurumlarinin acil uzaktan ogretim uygulamalarinin incelenmesi. *Milli Egitim Dergisi, 49*(1), 129-154.

Yaylak, E. (2022). Distance education in Turkiye during the COVID-19 pandemic: What do stakeholders think? *Turkish Online Journal of Distance Education, 23*(4), 65-92.

Yilmaz, E. O., & Toker, T. (2022). COVID-19 salgini ogretmenlerin dijital yeterliliklerini nasil etkiledi? *Milli Egitim, 51*(235), 2713-2730.

Yilmaz, F. N. S. (2022). *Pandemi donemi fen bilimleri ogretmenlerinin uzaktan egitime karsi tutumlarinin belirlenmesi* [Yayimlanmamis yuksek lisans tezi]. Akdeniz Universitesi.

Yu, Z. (2021). The effects of gender, educational level, and personality on online learning outcomes during the COVID-19 pandemic. *International Journal of Educational Technology in Higher Education, 18*(1), 1-17.

Yumbul, E. (2021). *Liselerde gorev yapan ogretmenlerin uzaktan egitime yonelik tutumlarinin incelenmesi* [Yayimlanmamis yuksek lisans tezi]. Ondokuz Mayis Universitesi.

Zawacki-Richter, O., Backer, E. M., & Vogt, S. (2009). Review of distance education research (2000 to 2008): Analysis of research areas, methods, and authorship patterns. *The International Review of Research in Open and Distributed Learning, 10*(6), 21-50.

Zhang, W., Wang, Y., Yang, L., & Wang, C. (2020). Suspending classes without stopping learning: China's education emergency management policy in the COVID-19 outbreak. *Journal of Risk and Financial Management, 13*(55), 1-6.

Zoccai, G.B. (2018). *Diagnostic meta-analysis* (1st ed.). Springer.