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A study on mathematics teachers' technological pedagogical content knowledge (TPACK) and frequency of use of educational information network (EBA) assessment tools

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Highlights

- The importance of technology integration in mathematics education
- The place and importance of using EBA, an online distance education platform, in education
- The importance of using EBA assessment tools to improve achievement in K-12
- The importance of the relationship between mathematics teachers' TPACK competencies and their use of EBA assessment tools

Abstract

Today, the rapid development of technology causes a great change and transformation process in the field of education. In this process, the importance of technological pedagogical content knowledge (TPACK) increases for teachers to use technology effectively. In this process, it is thought that mathematics teachers should improve their TPACK, especially in the use of measurement tools in EBA. In addition, for students to be successful in mathematics, mathematics teachers should have sufficient knowledge about teaching methods, materials, and the use of technological tools. At this point, teachers' TPACK is thought to be critical for optimizing students' learning process and providing an effective mathematics education. In this context, the aim of this study is to examine mathematics teachers' TPACKs within the framework of their demographic characteristics and frequency of using EBA assessment tools. The study was designed with the survey model of quantitative method. The study's participants are the math teachers employed by public and private schools in the province of Eskişehir. Within the scope of the study, the link of the relevant data collection tool was sent to the study group by obtaining the necessary application permissions and data were collected from 369 mathematics teachers. As a result of the study, it is concluded that mathematics teachers need to develop their TPACK to improve students' mathematics skills and optimize students' learning process and that teachers should have knowledge about the use of technological tools and online assessment tools such as EBA and be able to use these tools effectively. In addition, in light of this study, it is recommended that mathematics teachers should research technological tools and materials that they can use in mathematics education and use EBA assessment and evaluation tools more frequently to improve their TPACK. Finally, it is suggested that in-service courses, trainings, etc. on the use of technology in education should be organized for teachers to ensure their personal development.

Article Info: Research Article

Keywords: *TPACK, Assesment and Evaluation, EBA assessment tools, Distance Education, Online Learning*

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1. Introduction

Today, it is possible to say that education is one of the fields most affected by digital transformation and technological developments. Educators are expected to keep up with the rapid developments of this age and update their educational methods. In terms of supporting and strengthening education and training with technological developments and increasing the quality of education, it is of great importance to use teaching tools such as blackboards, whiteboards, projectors, computers, and interactive boards effectively and efficiently in learning environments (Akyüz et al., 2014). For effective technology integration in the realization of full learning, it is not enough to know the field, technology, and pedagogy alone, but also their relationships with each other (Kohler, Misra & Yahya, 2007). Perkmen and Tezci (2011) stress the significance of being sufficient as well as integrating the educational, technological, and subject knowledge that is required. examining teachers' technological pedagogical content knowledge (TPACK) is deemed significant in this setting.

The construct that covers technology, pedagogy and content knowledge is called TPACK. This construct was developed by Mishra and Koehler (2006) by expanding Shulman's idea of Pedagogical Content Knowledge (PCK) to include instructional technologies (Canbolat, 2011). TPACK is a conceptual framework that describes the knowledge that teachers need to integrate technology effectively into their teaching. The framework includes three main components: content knowledge, pedagogical knowledge, and technological knowledge.

Technological developments have impact on the field of education as in every field. Since the use of technology in the field of education transforms the educational process into a more effective and motivating one, it has become more and more widely used in educational institutions (Temizyürek & Ünlü, 2015). In this context, the EBA (Education Information Network) portal, which was established within the Ministry of National Education in 2011, was created to realize the reflection of technological developments and new educational approaches on education (Özen, 2019). In this context, it is thought that the Ministry of National Education established the EBA platform in order not to be indifferent to and adapt to the digital transformation in education. A lot of digital content (video, visual, audio, etc.) is available on this platform. EBA also offers learners different and flexible learning environments where they are responsible for their own learning. EBA is an online education platform that is provided free of charge by the General Directorate of Innovation and Educational Technologies. The platform offers a variety of resources, including videos, presentations, textbooks, and interactive exercises. EBA is available to individuals of all ages and levels of education (EBA, 2016). EBA, now in its fourth version, was launched in 2011 and consists of applications covering digital learning materials created for the use of technology in education. In addition, there are applications where teachers and students can store and share files such as presentations, documents, visuals, audio, video, etc., where teachers can prepare different types of exams, and where learners can follow portfolio evaluation processes.

EBA's relationship with TPACK stems from the fact that the platform's content and user interface guide teachers and students to integrate pedagogical principles and technology. EBA offers teachers a variety of features such as digital content, interactive materials, live lessons, and student tracking, allowing them to create a pedagogically rich teaching experience. It also includes the aim of integrating pedagogical knowledge with technological knowledge to support teachers to use technology effectively and to provide students with more effective learning experiences. This reflects an effort to integrate technology into educational processes to create a student-centered, interactive, and effective learning environment. In this context, it is considered necessary to examine the effect of teachers' Technological Pedagogical Content Knowledge (TPACK) competencies on the use of Education Information Network (EBA) assessment tools. In addition, to make the mathematics course more effective, efficient, and attractive, it is important to determine the TPACK levels of mathematics teachers and their use of EBA assessment tools.

2. Purpose of The Study

In the 21st century, the use of technology in education has become a necessity rather than an option. The EBA (Education Information Network) portal, which was first established in 2011, was established to realize the reflection of technological developments and new educational approaches to education. The EBA system is both a mass and a learning management system that includes educational tools as well as educational content that both teachers and students can use. EBA includes resources in the form of video narration as well as text, audio, and picture resources. Some of the features that enrich the EBA system are file uploading and providing digital space, organizing competitions, lessons suitable for different levels, making announcements and the possibility of sharing by users, exam preparation, test evaluation, and student portfolio tracking system. In addition, the EBA system is considered to be both a mass open and distance learning platform and a learning management system. It is seen that there is a lack of sufficient information about the EBA education portal and new trends in education, and it is thought that it has become important to inform teachers in particular. In addition, EBA makes lessons more fun and makes students active. Thanks to the many useful contents shared, it has a very rich and fast information flow. All these features have brought EBA to an important point in today's education. EBA can fully fulfil the concept of equal opportunity in education in terms of contributing to education independently of time and space (EBA, 2018). In this context, all these emphasize the importance of technology's contribution to education.

Effective use of technology in education has a positive effect on academic achievement (Teo, Ursavas & Bahcekapili, 2012). Advancements in technology bring about some changes in students' learning, which, in turn, requires teachers to update their knowledge and competencies accordingly. Therefore, it is essential to measure teachers' and preservice teachers' techno-pedagogical educational competencies. TPACK is considered an appropriate model to develop a scale aiming to measure and evaluate teachers' and preservice teachers' background knowledge about technology integration (Onal, 2016). In the literature, some studies examine how successful educators use content, pedagogy, and technology knowledge in educational processes as well as those that are conducted to develop new scales integrated to TPACK oradopt already existing scales (Balcin & Ergun, 2018; Bagdiken & Akgunduz, 2018; Yarar, 2018; Ay, 2015; Karadeniz & Vatanartiran, 2015; Ay, Karadag, & Acat, 2015; Kartal, Kartal, & Uluay, 2016). These studies generally focus on determining the TPACK competencies of teachers from various disciplines and educational levels and examining the correlations between TPACK and various variables (Yilmaz, 2015). The technological pedagogical content knowledge (TPACK) concept, which brings together three important concepts, is important for effective and efficient education. In this respect, it is very important that our teachers have high TPACK knowledge. There are many studies on this subject; many results are obtained from the studies conducted according to different branches, genders, education levels, and age variables.

The studies conducted until today have been examined, but no study has been found that examines the effect of mathematics teachers' TPACK competencies and the use of EBA assessment tools on each other. For this reason, these two important concepts appear as an important study subject that should be emphasized. This study, which examines two popular concepts such as TPACK and EBA, is considered important in terms of filling an important gap in the literature and shedding light on new studies on the subject. In the context of all these statements, the study aims to determine the TPACK levels of mathematics teachers in Eskişehir province, to examine which assessment tools they use to evaluate their students in EBA, the frequency of using EBA assessment tools, demographic characteristics, EBA usage time, etc. and to examine their relationships with variables and to make suggestions in the light of the study.

3. Literature

3.1. Theorical Framework

3.1.1. Technological Pedagogical Content Knowledge (TPACK)

TPACK consists of the integration of technology knowledge, pedagogy knowledge, and content knowledge and these three types of knowledge are in close interaction with each other (Koehler, Mishra, & Yahya, 2007; Mishra & Koehler, 2006; Niess, 2005). Knowing how to use technology to be used in teaching a subject by facilitating student learning can be stated as an indicator of TPACK (Demir & Bozkurt, 2011).

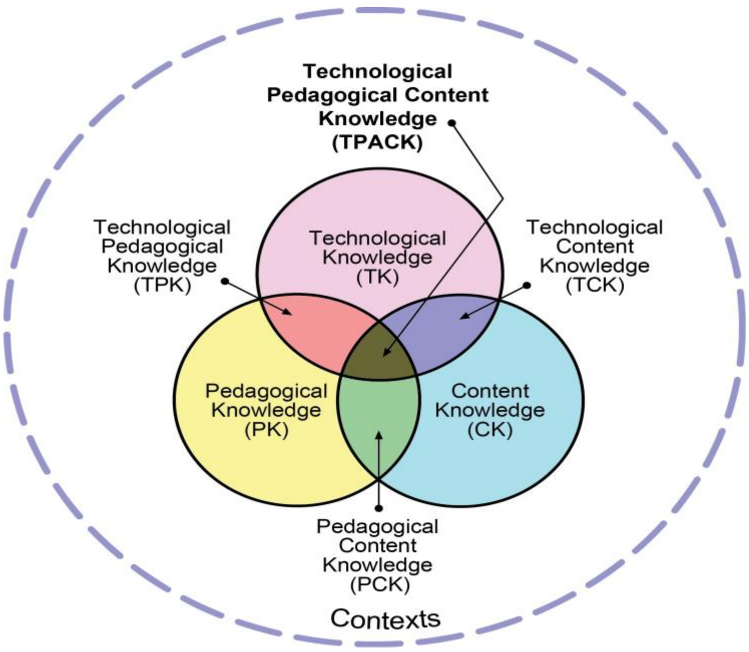

Figure 1. TPACK Framework (Mishra & Koehler, 2006)

As seen in Figure 1, TPACK is a type of knowledge at the intersection of content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK). With the mutual interaction of these knowledge types, technological content knowledge, technological pedagogical knowledge, and pedagogical content knowledge emerged. With the common intersection of these three types of knowledge, the concept of technological pedagogical content knowledge was formed.

3.1.2. Education Information Network (EBA)

The Education Information Network (EBA) was launched in 2010 by the Ministry of National Education (MEB) General Directorate of Innovation and Educational Technologies (YEĞİTEK) and was updated in 2016 to include innovations such as mobile applications and offered to teachers and students. This system, which facilitates education independent of time and space, aims to support the effective use of materials through information technologies and to ensure the integration of technology with education.

EBA, which hosts a variety of content for students with different learning styles, facilitates the transition to student-oriented education. Thanks to the opportunities offered by EBA, teachers can also contribute to the adaptation of the education system to the changes in this century (EBA, 2022). In addition, to mention the opportunities provided by EBA, these are:

- Providing diverse, rich, and educational content,
- To contribute to courses with its rich and growing archive,
- To be able to reconstruct knowledge while learning and to produce knowledge from knowledge,
- To include students with different learning styles (verbal, visual, numerical, social, individual, auditory learning),
- Informing learners about their achievement of learning outcomes and providing feedback to learners
- To bring all teachers together on a common ground and to pave the way for them to direct education together,
- It is a social education platform designed to use technology as a tool, not as an end (MEB, 2014).

For all these reasons, EBA gathers many important elements for education in the digital environment under one roof. It also has a constantly changing and developing structure to keep up with the changing age and to use developing technologies in education (Çakmak & Taşkıran, 2017).

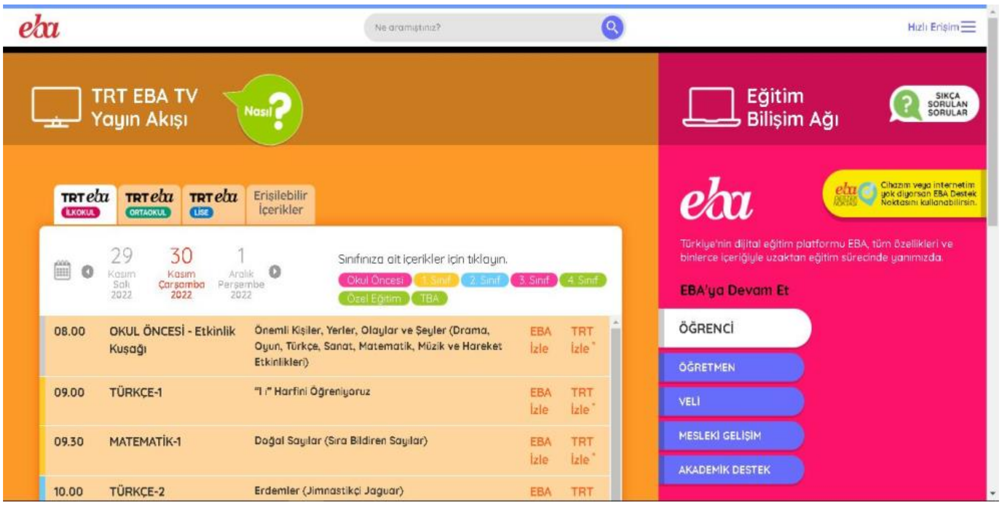

Figure. 2. EBA module Homepage

EBA is an education platform that is constantly being renewed and developed. It includes 16 different modules. These are lessons, live lessons, exams, lists, studies, reports, museum experiences, professional development, groups, portfolios, files, calendars, content production, and question and exam system modules. Among these modules, exams, reports, exam and question systems, and portfolio modules can be expressed as measurement and evaluation tools within the system.

2.2.1. EBA Assessment and Evaluation Modules

In the Exams section, you can access Screening Tests, Exercises, Practice Tests, Practice Tests, Study Questions, and Skill-Based Tests produced by Sebit within the EBA database. From the My Exams option, exams can be created from questions uploaded to the content production system question pool. Teachers can upload their own prepared exams from the My Leaf Tests option. All quiz types in the Quizzes section can be sent as homework to a desired student group or class and shared with other teachers. See Figure *3.*

Figure 3. EBA Exam Module

The process and results of the work submitted in the My Reports section can be evaluated on a student basis. It can be seen which student has succeeded or failed in which exam or outcome, and which subject expression has been completed or not. See Figure 4.

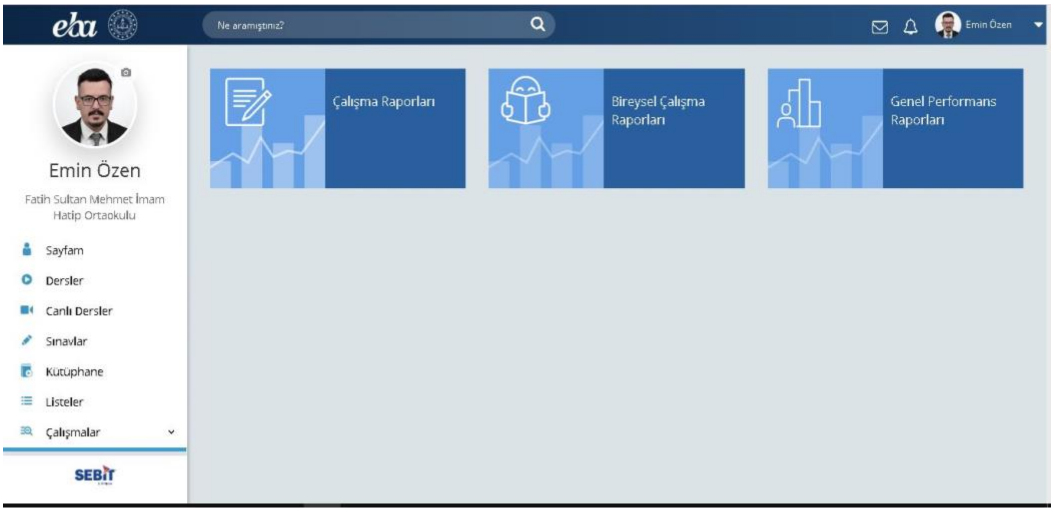

Figure 4. EBA Reports Section

In the Portfolios section, there is an overall scoring system for each student for a complete school year, showing their report card grades, performance level, work, teacher feedback, projects they have participated in, etc. See Figure 5.

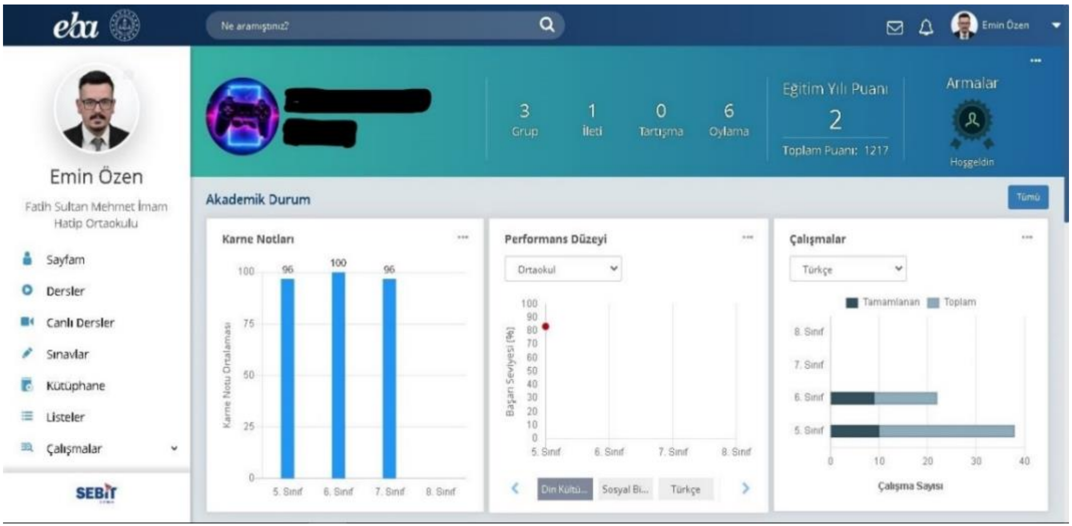

Figure 5. EBA Portfolio Section

In the exam and question system section, questions and exams can be created according to the desired grade level and school type, sent to the desired student or class, and followed up. In addition, the questions or exams created are included in the relevant pool and all platform users can benefit from the relevant questions or exams. See Figure 6.

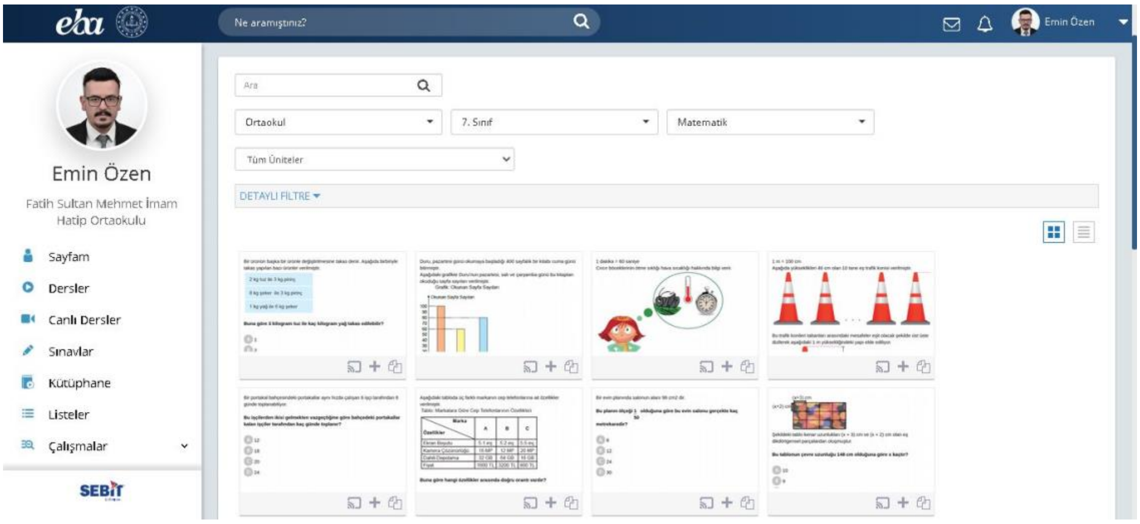

Figure 6. EBA Question and Exam System

3.2. Related Studies

This section presents examples of recent studies on TPACK and EBA that combine both concepts in the same research

Teker (2019) aimed to investigate the effect of teachers' Technological Pedagogical Content Knowledge (TPACK) levels on their use of the Education Information Network (EBA). **The relational** survey model, one of the quantitative research designs, was used in the study. The study group of the research consists of 103 teachers working in central schools in Isparta province affiliated **with** the Ministry of National Education. As a result of the study; while the TPACK and EBA levels of the teachers were found to be sufficient; it was seen that their attitudes towards the use of EBA were positive. No linear relationship was found between teachers' TPACK levels and their attitudes towards EBA use. In the light of the findings, it has been revealed that TPACK level **does not affect** EBA usage.

Çekerol and Özen (2020) aimed to examine the relationship between the Technological Pedagogical Content Knowledge (TPACK) of teachers working in educational institutions at different levels and their demographic information, technology, and Education Information Network (EBA) usage. The participants of the study were selected using a stratified sampling method among teachers teaching in state-run primary, secondary, and high schools in Eskişehir, Turkey. According to the results of the study, teachers find themselves sufficient in terms of TPACK factors and there are significant differences between TPACK factors and participants' demographic information and their use of technology and EBA. They concluded that increasing teachers' technology knowledge will also improve their pedagogy and content knowledge.

In their systematic literature review, Gezer and Durdu (2020) examined the theses written on EBA in the context of TPACK. In their study, they stated that thanks to the use of EBA, the lessons will be more effective and efficient, and the TPACK competencies of teachers will increase through the integration of technology into educational environments. They also stated that researches on technology integration in education with the development of teachers' skills such as TPACK will contribute to the analysis and planning of the steps to be taken for more effective use of EBA.

Topçu and Masal (2020) examined the TPACK perceptions of mathematics teachers and concluded that the in-service trainings they received for the effective use of the EBA portal positively affected teachers' technological content knowledge. He also emphasized that it is important for teachers to use EBA more in mathematics lessons.

Özen and Aykul (2022), in their study on German teachers' Technological Pedagogical Content Knowledge and Web 2.0 tools usage skill levels with German teachers in Eskişehir, found that TPACK knowledge levels were higher than teachers with medium and low usage skills. In addition, as a result of the analysis, it was concluded that the teachers with the highest level of knowledge also had high levels of skill in using Web 2.0 tools. This result shows that German teachers' technology use levels increase depending on their high level of technology, pedagogy, and content knowledge.

Boran and Genç (2022) conducted a mixed-methods study to explore the relationship between TPACK competencies and ICT use in primary school mathematics teachers. The quantitative phase of the study surveyed 185 primary school mathematics teachers, and the qualitative phase interviewed 30 primary school mathematics teachers. The findings showed that primary school mathematics teachers felt competent in TPACK and ICT use. The study also found that teachers' TPACK efficacy perceptions differed significantly according to gender, computer education status, computer knowledge level, and daily computer use.

Tiryaki and Hali (2022) conducted a study to determine whether teachers' TPACK self-efficacy perception levels predict their self-efficacy perception levels in using EBA. The study also examined whether teachers' TPACK and EBA self-efficacy perception levels differed according to factors such as age, professional experience, type of school, level of computer use, and in-service training for EBA use. The results showed that teachers' TPACK self-efficacy perceptions differed statistically significantly according to age, professional experience, and level of computer use. However, self-efficacy perceptions of using EBA did not show a significant difference according to these variables. On the other hand, teachers' perceptions of self-efficacy in using EBA differed statistically significantly according to the type of school and in-service training for EBA use.

4. Methodology

The research will be designed in the cross-sectional survey model of the quantitative research method (Büyüköztürk et al., 2012). The cross-sectional survey model aims to take a picture of the situation by collecting data simultaneously to illuminate a situation, variable, phenomenon and to reveal the situation, variables and relationships between variables by examining this photograph (Barış, 2015).

The dependent variable of the study is the level of technological pedagogical content knowledge competency of mathematics teachers working in Eskişehir. The independent variables in this study are as follows:

- Gender
- Task Level
- Year of Service
- Frequency of Use of EBA Assessment Tools
- Education Level

In this context, the sub-problems of the research are shaped around the following questions:

1- What is the Level of Mathematics Teachers' Technological Pedagogical Content Knowledge Competency Levels?

2- Do Mathematics Teachers' TPACK Competency Levels differ according to gender variables?

3- Do Mathematics Teachers' TPACK Competency Levels differ according to their education levels?

4- Do Mathematics Teachers' TPACK Competency Levels differ according to their years of service?

5- Do Mathematics Teachers' TPACK Competency Levels and sub-factors differ according to the frequency of using EBA assessment tools?

4.1. Research Model/Design

The research design covers two main sections. In the first part, information such as gender, age, length of service, accessibility to technology, in-service training on technology, frequency of EBA usage, frequency of EBA evaluation tools usage, which evaluation tools they use in EBA, etc., which are accepted to affect teachers' TPACK, will be collected; in the second part, the TPACK Scale developed by Horzum, et al. (2014) will be used. The permission to use the scale was obtained via e-mail. The scale consists of 51 items with seven subscales. In collecting the data, the 'online survey' method, which is a faster, effective and economical method that is seen to be increasing in popularity in the literature, was used (Arıkan, 2018). The questionnaires were uploaded to the online survey platform called Google Forms and the link to access the form was shared with the teachers.

4.2. Data Collecting Tools

4.2.1. Participant Information Form

In this study, the Participant Information Form, which was prepared in accordance with the purpose of the research, will include questions related to gender, education level, computer program and application usage skills, frequency of EBA usage, frequency of EBA evaluation tools usage, which evaluation tools they use in EBA, school types, length of service, age, etc.

4.2.2. Technological Pedagogical Content Knowledge Scale

The TPACK scale developed by "Horzum, Akgun and Ozturk (2014) was used after getting the necessary permissions from the researchers. This 51-item scale has 7 factors: "Technology Knowledge", "Content Knowledge", "Pedagogy Knowledge", "Pedagogical Content Knowledge", "Technological Content Knowledge", "Technological Pedagogical Knowledge" and "Technological Pedagogical Content Knowledge". The scale has a 5-point Likert scale format (1: I do not agree at all, 5: I totally agree). The CFA performed revealed that the scale showed a good fit Chi-square value ($\chi^2=3823.81$, $N=724$, $df=1267$, $p=.000$) was found to be statistically significant at the end of the analysis. "χ^2/df" ratio was calculated as 3.02

and this value indicated that the model had an acceptable fitness. Fitness indexes of the model were found to be RMSEA=0.05, GFI=0.83, AGFI=0.82, CFI=0.97, NNFI=0.97, RMR=0.09, and SRMR=0.05. The Cronbach alpha coefficient calculated for the reliability analysis was found to be 0.82 and 0.89 for the sub-dimensions, respectively, and 0.9 for the total scale.

4.3. Sampling or Study Group

The population of this study consists of mathematics teachers (N=1798) working in public/private schools in Eskişehir province in the 2022-2023 academic year. Research ethics permission was obtained for this study on 22.03.2023 with the decision numbered E-88074293-605-01-65577715. Within the scope of the study, the link of the data collection tool was sent to the e-mail addresses of mathematics teachers from the automation system of Eskişehir Provincial Directorate of National Education. Within the scope of the study, data were collected from 369 (n=369) mathematics teachers. The representativeness of the sample to the population was calculated through Rao-soft (sample size calculation) program and it was concluded that data above 317 was sufficient for this study. In addition, Creswell (2013) states that 360 or more data generalize the universe in survey studies.

4.4. Data Analysis

The skewness and kurtosis coefficients of the scores obtained from The Scale of TPACK were found to be between +1.5 and -1.5. According to the obtained values, it can be said that the data provides the assumption of normality (De Carlo, 1997). Descriptive statistics of scale scores are presented in Table 1.

Table 1.

Descriptive statistics of scores

	n	Min.	Max.	Mean	SD	Skewness	Kurtosis
TPACK	369	1.00	5.00	4.24	.4243	.127	-.254
						,12	-1,039

The data were analysed using the SPSS package program. The findings were evaluated at the 95% confidence interval and the 5% significance level. For variables with two sublevels, a t-test was used to compare the quantitative data. For variables with more than two sublevels, one-way ANOVA was used. If there was a difference in the ANOVA test, Post-Hoc tests were used to determine the pairwise differences.

In Table 1, the arithmetic mean and standard deviation values of the scores of mathematics teachers from the TPACK scale are presented. The score ranges of the data obtained in Likert scale type should be accepted as equal and the average score range factor should be 0.79 (Büyüköztürk, 2010). In revealing the current score range; the lowest score value (1) is subtracted from the highest score value to be obtained from the scale item and this value is found by subtracting. In this context, the evaluation ranges of the related scale are shown in Table 2.

Table 2.

TPACK Scale Item Evaluation Ranges

Level	Item Value Ranges
1 – Very Low	1,00 – 1,79
2 – Low	1,80 – 2,59
3 – Medium	2,60 – 3,39
4 - High	3,40 – 4,19
5 – Very High	4,20 – 5,00

In the context of all these statements in Table 2, it is seen that the average TPACK level of mathematics teachers in Eskişehir province is at a "very high" level of 4.24.

Cronbach's Alpha value was examined to determine the reliability level of the scale used in the research. It is seen that Cronbach's Alpha internal reliability coefficient is,976 and the scale has very high reliability.

5. Findings and Discussions

5. 1. Findings Concerning the Working Group

In this section, the frequency and percentage distributions of the data collected through the participant information form are shown in tables.

Table 3.

Distribution Table by Gender of the Teachers

Variables	Groups	f	%
Gender	Female	173	47.7
	Male	196	52.3
	Total	369	100

It is seen that 47.2% of the study group consists of female and 52.3% male participants.

Table 4.

Distribution Table by School Type of the Teachers

Variables	Groups	f	%
School Type	Secondary	315	85,4
	High	54	14,6
	Total	369	100

It is seen that 85.4% of the mathematics teachers participating in the study work in secondary schools and 14.6% in high schools. In this context, teachers working in secondary schools participated more in the study.

Table 5.

Distribution Table by Year of Services

Variables	Groups	f	%
Year of Services	0-10	113	30,1
	11-20	218	59.6
	21-	38	10,3
	Total	369	100

It is seen that 59.6% of the mathematics teachers who participated in the study have 10-20 years of service, 30.1% have 0-10 years of service, and 10.3% have 20 or more years of service. In this context, it can be said that the group with the highest participation in the study consists of mathematics teachers with 11-20 years of service.

Table 6 .

Distribution Table by Education Levels

Variables	Groups	f	%
Education Level	Bachelor's	182	49,3
	Master	159	43.1
	Doctorate	28	7,6
	Total	369	100

It is seen that 49.3% of the mathematics teachers participating in the study have bachelor's degrees, 43.1% have master's degrees and 7.6% have doctorate degrees. In this context, it can be said that the group with the highest participation in the study consists of mathematics teachers with bachelor's degrees.

Table 7.

Distribution Table by Frequency of Use of EBA

Variables	Groups	f	%
Frequency of Use of EBA Assessment Tools	never use it	80	21,4
	rarely	182	49.6
	often	77	20,3
	at all times	30	8,7
	Total	369	100

It is seen that 21,4% of the mathematics teachers participating in the research never use EBA assessment tools in teaching processes, 49,6% rarely use them, 20,3% often use them and 8,7% always use them. In this context, it is seen that the majority of mathematics teachers never or rarely use EBA assessment tools in their teaching processes.

5. 2. Findings Related to Research Questions

Do Mathematics Teachers' TPACK Levels differ according to gender variable?

Table 8.

T-test Table Related to Gender Variable

Variables	Groups	Mean	t	p	Cohen's
TPACK	Female	4,16	-3,531	,219	
	Male	4,33			

Independent samples t-test was conducted to test whether there is a statistically significant difference between the TPACK efficacy levels of mathematics teachers in different gender groups. As a result of the related analysis, there is no significant difference in TPACK efficacy levels of mathematics teachers in terms of gender variable (P=.219>.05).

Do Mathematics Teachers' TPACK Levels differ according to their education levels?

Table 9.

Anova Table Related to Education Status Variable

Variables	Groups	Mean	F	p	Difference
TPACK	(1) Bachelor's (2) Master (3) Doctorate	4,09 4,33 4,39	20,646	,000*	1-2 1-3

One-way ANOVA is performed to analyse the TPACK competency levels of mathematics teachers in Eskişehir according to their education levels. The result of Anova analysis t is seen that TPACK efficacy levels of mathematics teachers in Eskişehir differed significantly according to their education levels (P=,000<0.05). Post-Hoc analyses are used to find out from which groups the difference originates. As the variances are homogeneous (P=,147>,05), Hochberg GT2 test was performed because the sample distribution was not equal.

According to the Post Hoc test results of TPACK efficacy levels of mathematics teachers according to their educational status; it is seen that mathematics teachers with graduate education have higher TPACK efficacy levels than teachers with undergraduate education.

Do Mathematics Teachers' TPACK Competency Levels differ according to their years of service?

Table 10.

Anova Table Related to Service Year Variable

Variables	Groups (Services)	Mean	F	p	Difference
TPACK	(1) 0-11 (2) 11-20 (3) 21-	4,05 4,24 4,34	8,176	,000*	2-1 2-3

One-way ANOVA is performed to analyze the significant difference in TPACK efficacy levels of mathematics teachers in Eskişehir according to their years of service. As a result of Anova analysis, it is seen that TPACK competency levels of mathematics teachers in Eskişehir differ significantly according to their years of service (P=,000<0,05). Post-Hoc tests were used to determine between which groups the differentiation occurred. As the variances aren't homogeneous (P=,017<05), Games Howell test was performed since the sample distribution was not equal.

According to the Post Hoc test results of TPACK efficacy levels of mathematics teachers according to their educational status; it is seen that mathematics teachers with 11-20 years of service have higher TPACK efficacy levels than other service period groups.

Do Mathematics Teachers' TPACK Competency Levels and sub-factors differ according to the frequency of using EBA assessment tools

Table 11.

Anova Table Regarding the Frequency of Use of EBA Assessment and Evaluation Tools

Variables	Groups (Services)	Mean	F	p	Difference
	(1) Never use it	4,05			1-2
TPACK	(2) rarely	4,24	8,039	,000*	1-3
	(3) often	4,34			1-4
	(4) all of time	4,46			

One-way ANOVA is performed to analyze the TPACK competence levels of mathematics teachers in Eskişehir according to the frequency of use of EBA evaluation tools. As a result of the ANOVA analysis, it is seen that the TPACK competency levels of mathematics teachers in Eskişehir differ significantly (P=,000<0.05) according to the frequency of using EBA assessment tools. Post-Hoc tests were used to determine between which groups the differentiation occurred. Since the variances were not distributed homogeneously (P=,004<05), the Games Howell test was performed since the sample distribution was not equal.

According to the Post Hoc test results of TPACK competency levels of mathematics teachers according to their educational status; it is seen that the TPACK competency levels of mathematics teachers who say that they never use EBA assessment tools and rarely use EBA assessment tools are lower than the other groups.

6. Conclusion and Suggestions

In the context of the results of the descriptive findings obtained from this study, it is seen that the number of male teachers participating in the study is higher than the number of female participants, the number of mathematics teachers working in secondary schools is higher in the current sample, teachers with 10-20 years of service are the largest group participating in the study within the current sample, and in terms of the frequency of use of EBA assessment tools, it is seen that the majority of teachers have never or rarely used the assessment tools on the platform.

Within the scope of the inferential findings that emerged as a result of the analysis of the sub-objectives of the study; it is seen that there is no significant difference in mathematics teachers' TPACK competence levels according to gender. This finding is in parallel with the results obtained in the study of Özen and Aykul (2022) and it is concluded that TPACK competencies of teachers cannot be associated with the gender variable. In addition, there is a significant difference in the TPACK efficacy levels of Mathematics teachers as a result of the related analyses in the context of other demographic variables of the participants, namely years of service and education levels. It is seen that TPACK efficacy of those with 10-20 years of service is higher than the other groups. Considering the education level variable, it is seen that TPACK efficacy levels of mathematics teachers with bachelor's degree are lower than those with master's degree and doctoral degree. These findings are in parallel with the results of Boran & Genç (2022) and Tiryaki &

Hali (2022) studies and in this context, it is concluded that the TPACK competence levels of mathematics teachers increase as the level of education they study increases.

As a result of the analyses related to the TPACK competency levels of mathematics teachers in the context of the frequency of participants' use of EBA evaluation tools, significant differences are observed between the groups. It is seen that the participants who say that they use EBA assessment tools frequently and always have higher TPACK competence than the other groups. These findings support the results obtained from the study of Özen and Çekerol (2020). In this context, it is concluded that as the use of EBA platform assessment tools, which is an online distance education platform and integrated with technology, increases, teachers' TPACK competencies also increase. In addition, the increase in TPACK in the current study may be due to the fact that the teachers participating in the study were active in the use of EBA. As a matter of fact, Suharwoto and Niess (2001) stated that teachers' using the tools and techniques they learned during the study in the real classroom environment and transferring their experiences to each other during the study made it easier for them to integrate technology into their lessons.

In the context of the results of the study, it shows that mathematics teachers' TPACK competencies are generally at a high level. It was concluded that the deficiencies in teachers' TPACK competencies can be overcome with more training and support for technology-based education methods. In addition, the frequency of mathematics teachers' regular use of EBA assessment tools was examined. The results show that teachers generally use EBA for basic functions such as finding course materials and keeping track of students. However, it was determined that more effective and interactive use of EBA should be encouraged. In addition, it is emphasized that it is important to organize training and support programs for mathematics teachers to improve their TPACK competencies and to use EBA more effectively. In this way, mathematics teachers will be able to incorporate technology into classroom environments more effectively and improve students' mathematical skills.

Finally, within the scope of this study, the following suggestions are presented to help mathematics teachers use technology more effectively and efficiently in their classroom environments and to contribute to increasing students' learning experience:

- *Developing TPACK Competencies:* In order to overcome the deficiencies in TPACK competencies identified in the study, technology-oriented training programs should be organized for mathematics teachers. Teachers should be trained on tools that will improve TPACK such as digital teaching tools, learning management systems and interactive content.
- *Improving EBA Usage:* Mathematics teachers should be trained on using EBA more effectively and preparing more interactive content. Teachers should be encouraged to use EBA not only for finding course materials and tracking students, but also for encouraging student participation and active learning.
- *Support for Technology Integration:* School administrators and principals should support mathematics teachers' integration of technology. Providing the necessary infrastructure and equipment for technology use will help teachers to use technology more easily.
- *Creating Collaboration and Sharing Environments:* Platforms should be created where mathematics teachers can share their experiences with each other and collaborate on the use of technology. Such sharing environments will contribute to teachers' more effective use of TPACK and EBA
- *Monitoring Student Progress:* Monitoring student performance is important to evaluate the effectiveness of EBA and other digital teaching tools. Mathematics teachers should regularly assess this data to track student progress and identify gaps.

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