Teachers' Views on Online Mathematics Teaching Barriers during the Covid-19 Pandemic: The Case of Turkey

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Abstract

Due to the COVID-19 pandemic, Turkey's 19 million students and 1.2 million teachers rely entirely on online instruction. This study looks at the perspectives of math teachers on the teacher, school, curriculum, and student hurdles to E-learning deployment during the COVID-19 epidemic. It also evaluates the connection between the degree of barriers and teachers' backgrounds. Furthermore, it assesses the relationship between barrier levels with teachers' demographic backgrounds. This study collected data through an online questionnaire, and random sampling was employed. The sample consisted of 364 participants (210 males and 154 females) who were middle school and elementary school mathematics teachers. According to the study's findings, the student-level barrier had the biggest influence on adopting e-learning. The school- and curriculum-level barriers are positively connected with the student-level barrier. The study found that barriers were unaffected by the backgrounds of teachers. This study highlights the significance of student voices in overcoming e-learning challenges and utilizing its advantages during this epidemic and beyond.

Keywords: COVID-19, E-Learning, Barriers to E-Learning in Mathematics Education

Introduction

The COVID-19 pandemic has significantly impacted the education sector worldwide, including Turkey. With school closures and social distancing measures in place, online teaching and learning have become essential in providing continued education to students. In Turkey, over 19 million students and 1.2 million teachers were affected by school closures (MNE, 2022). Online teaching and learning offer many benefits, including flexibility, resource access, and personalizing learning. However, it also comes with challenges, such as the need for technology and internet access, the potential for unequal access to education, and the need for teacher training and support in delivering effective online instruction. The pandemic has highlighted the importance of incorporating online teaching and learning as a part of the education system, not just as a temporary solution during emergencies. It will be essential to address the challenges and work towards providing equal and inclusive education for all students, regardless of their socioeconomic status or geographical location.

The Turkish government has taken measures to limit community mobilization and prevent the spread of COVID-19. One of the measures was temporarily closing schools and higher education institutions since March 16th, 2020. To ensure that the teaching and learning process continued during the school closures, the government and educational institutions in Turkey turned to electronic learning or e-

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learning (Takunyacı, 2021). E-learning utilizes information and communication technologies (ICT) to facilitate remote teaching and learning. E-learning has become essential for maintaining the education system during the pandemic. It allows teachers to deliver educational content to students through various online platforms, such as video conferencing, learning management systems, and digital resources. E-learning also allows students to access learning materials at their own pace and time. However, e-learning also poses challenges, particularly regarding access to technology and internet connectivity. Students from disadvantaged backgrounds may have limited access to the necessary devices and internet connectivity, which can result in unequal access to education. Overall, e-learning has played a crucial role in ensuring that the teaching and learning process continued in Turkey during the pandemic. However, it is essential to address the challenges and work towards providing equal and inclusive education to all students, regardless of their socioeconomic status or geographical location.

Understandably, the rapid implementation of e-learning during the COVID-19 outbreak may have posed challenges for schools and teachers unprepared for this mode of education. It is important for teachers to receive adequate training and support on using online applications and platforms effectively, to ensure that the learning experience for students is not compromised (Daniel, 2020). Additionally, it may benefit schools and teachers to explore other e-learning resources and platforms that can supplement their existing tools. Many other online learning platforms are available globally, such as Google Classroom, Edmodo, and Moodle, which can offer a range of features and benefits that can enhance the teaching and learning experience.

In Turkey, the e-learning platforms recommended by the government are EBA (Education Information Network) and Zoom. EBA is a free online learning platform developed by the Ministry of Education of Turkey as an alternative learning resource for school teachers and students. However, the implementation of e-learning can be challenging, particularly for schools and teachers who are not familiar with this mode of education. The rapid shift to e-learning during the COVID-19 outbreak has highlighted the need for adequate training and support for teachers and schools to use online applications and platforms effectively. To address these challenges, schools need to invest in professional development opportunities for their teachers to learn about e-learning best practices and how to use online tools effectively (Zaharah & Kirilova, 2020). Additionally, schools should provide technical support to ensure teachers and students can access the necessary equipment and resources to participate in e-learning.

Another important consideration is the need for schools to develop and adapt their curricula to the e-learning environment (Khirwadkar et al., 2020). Teachers should consider how they can best deliver content and engage students through online platforms and be prepared to adjust their teaching strategies as needed. Despite the challenges, e-learning has the potential to provide numerous benefits for students and teachers. By embracing e-learning and investing in the necessary support and resources, schools can create engaging and effective learning experiences for their students, in-person or online. While there may be challenges associated with implementing e-learning, it can also offer numerous benefits, such as greater flexibility, accessibility, and opportunities for collaborative learning (Moore, & Kearsly, 2011). With proper support and training, teachers can successfully integrate e-learning into their teaching practices and create engaging and effective learning experiences for their students.

Mathematics education involves a lot of hands-on practice and interaction, and the sudden shift to e-learning during the pandemic has presented several challenges for mathematics teachers (Almanthari et al., 2020; Perienen, 2020; Wijaya, 2021). Some of the challenges include:

- Limited interaction: The lack of face-to-face interaction between students and teachers makes it challenging for teachers to gauge students' understanding of mathematical concepts.
- Technological barriers: Teachers unfamiliar with technology-based teaching methods may struggle to adapt to e-learning platforms, which can impact the quality of their teaching.
- Reduced student engagement: Students may find it difficult to stay engaged during online classes, leading to reduced participation and understanding.
- Inequitable access to technology: Students from lower-income backgrounds may not have access to the necessary technology and equipment to participate fully in e-learning, further exacerbating the inequities in education.
- Limited access to resources: Teachers may not have access to the same resources as they would in a traditional classroom setting, such as manipulatives or textbooks.

It is crucial to identify these barriers and challenges and provide additional support and resources to teachers to ensure that students receive a quality mathematics education, even in an e-learning environment (Ward et al., 2010). This can include providing training and resources for teachers to help them adapt to e-learning platforms, offering additional support for students who may be struggling with technology or engagement, and ensuring equitable access to resources and technology for all students.

While e-learning in higher education has received significant attention, it is essential to acknowledge the unique challenges that K-12 teachers face when implementing e-learning, especially in mathematics education during a pandemic (Todhunter, 2013). Some of the challenges specific to K-12 education may include:

- Lack of parental involvement: Younger students may require more support to participate in e-learning, and some parents may not have the resources or knowledge to provide that support.
- Limited time for instruction: K-12 teachers often have limited time for instruction, and e-learning can reduce the time available due to technical difficulties and the need for additional preparation.
- Differentiated instruction: K-12 teachers are often responsible for providing differentiated instruction to meet the diverse needs of their students, and e-learning may make it more difficult to provide that individualized attention.
- Inequitable access to technology: As mentioned earlier, students from low-income backgrounds may not have access to the same technology and resources as their peers, which can create additional challenges for teachers trying to implement e-learning.
- Student motivation: Keeping younger students motivated and engaged in an e-learning environment can be challenging, as they may require more hands-on activities and interactive lessons to stay engaged.

By acknowledging these challenges and providing additional support and resources, policymakers and educators can help K-12 teachers overcome these obstacles and ensure that students receive a quality mathematics education, even in an e-learning environment (Almanthari et al., 2020). This can include

providing additional teacher training and resources, supporting parents and students, and investing in technology and infrastructure to ensure equitable access to resources.

The COVID-19 pandemic has forced many educational institutions to transition to online and remote learning, which has created many challenges for teachers and students, especially in mathematics education (Takunyacı, 2021). More research is needed to understand the challenges and barriers that arise when implementing e-learning in mathematics education during the pandemic. This research can help develop effective strategies and resources to support teachers and students in this new learning environment. For example, the research could explore the specific pedagogical approaches and strategies effective for teaching mathematics in an online or remote setting and the technological tools and resources that can support these approaches. Additionally, the research could investigate the impact of the pandemic on students' engagement and motivation in mathematics, as well as the role of parental support and involvement in e-learning (Khirwadkar et al., 2020). Overall, a better understanding of the challenges and opportunities presented by e-learning in mathematics education during the pandemic can help inform the development of effective strategies and resources that support teachers and students in this new learning environment (Daniel, 2020).

The majority of studies on e-learning implementation barriers have been conducted in normal situations where e-learning use is optional (Hadijah & Shalawati, 2017; Juliane et al., 2017). However, the COVID-19 pandemic has led to a sudden and massive shift toward e-learning, making it necessary to investigate the barriers faced by teachers and students during this unprecedented situation (Ash & Davis, 2009). Furthermore, most studies on e-learning barriers have been conducted in the higher education context, but the shift to e-learning during the pandemic has affected all levels of education, including primary and secondary schools (Astri, 2017; Kabilan & Khan, 2012). In addition, mathematics is a core subject in education taught at all levels, making it crucial to investigate e-learning barriers specifically for mathematics teachers (Rabiee, Nazarian, & Gharibshaeyan, 2013). Overall, understanding the challenges and barriers faced by mathematics teachers during the pandemic when implementing e-learning is critical to improving the effectiveness and accessibility of online education.

This study was conducted in Turkey, where three challenges for mathematics teachers are prevalent:

- First, Turkish students have consistently performed worse on international tests (PISA and TIMSS).
- Second, the content and pedagogical knowledge of Turkish mathematics teachers needs to be improved.
- Third, Turkey has a large student and teacher population with 26.1 million students and 1.3 million teachers worldwide.

The central government plays a significant role in administering educational policies, including curriculum and national exams. However, the implementation of e-learning during the COVID-19 pandemic has presented unique challenges that require a thorough investigation of the barriers faced by teachers in adapting to this new mode of education. Teachers are at the forefront of delivering education and are responsible for ensuring that their students receive quality education (Almanthari et al., 2020; Wijaya, 2021). Therefore, it is crucial to investigate e-learning integration barriers from their perspectives, as they are the ones who must navigate the challenges of delivering education through online platforms. Furthermore, understanding the challenges teachers face in implementing e-learning is essential for developing effective policies and interventions that support them in delivering quality

education. By identifying and addressing the barriers faced by teachers, the government can ensure that e-learning is implemented effectively and equitably across the education system (Mulenga, & Marbán, 2011).

The Barriers in Education System

E-learning integration in teaching and learning is a complex phenomenon that can present various difficulties or challenges for teachers. These challenges are commonly referred to as 'barriers' and can include a range of factors that impede the successful implementation of e-learning (Schoepp, 2005). Some common barriers teachers may encounter when integrating e-learning into their teaching practice include technological challenges, such as limited access to technology or inadequate training in using e-learning tools (Alper, 2020; Daniel, 2020). Other barriers may include the lack of support from school administrators or the broader education system, a lack of motivation among students, or a mismatch between the e-learning content and students' learning needs and preferences.

Identifying and addressing these barriers is essential to ensure that e-learning is implemented effectively and that teachers and students can reap the benefits of this approach to education. By understanding the challenges and barriers teachers face in integrating e-learning into their teaching practice, targeted interventions and policies can be developed to support them in delivering quality education through online platforms.

Various classifications for e-learning integration barriers have been proposed. One such classification was proposed by Ertmer (1999), who identified two sets of barriers: first-order and second-order barriers. First-order barriers include technical challenges such as hardware, access, and technical support. These barriers are often related to the infrastructure and logistics required for successful e-learning implementation. For example, limited computer access or inadequate internet connectivity can be significant barriers to effective e-learning implementation. Second-order barriers are related to pedagogy, beliefs, or personal preferences. These barriers are often related to teachers' and students' attitudes, beliefs, and practices (Mulenga & Marbán, 2011; Perienen, 2020). For example, teachers may be hesitant to integrate e-learning into their teaching practice because they lack the necessary training or are uncertain about the effectiveness of e-learning. Similarly, students may resist e-learning if they prefer traditional classroom-based learning or do not have access to the necessary technology.

Identifying and addressing these barriers is critical to successful e-learning implementation. By addressing first-order barriers such as technical challenges and infrastructure, we can ensure that teachers and students have the necessary tools and resources to effectively engage in e-learning. At the same time, addressing second-order barriers, such as beliefs and attitudes, can help to foster a positive and supportive e-learning environment.

It is important to note that different studies may classify e-learning integration barriers differently, based on the context and objectives of the study. Quadri et al. (2017) identified four broad barriers affecting e-learning implementation: students, instructors, infrastructure and technology, and institutional management (Mulenga, & Marbán, 2011). This classification highlights the multifaceted nature of e-learning implementation and the need to address challenges at multiple levels to ensure successful implementation. Our study classified e-learning integration barriers based on the classification proposed by Assareh and Bidokht (2011). This classification identifies four broad areas of barriers, including teachers, schools, curriculum, and students (Table 1). This classification emphasizes

the importance of addressing challenges at the teacher and school level and the need for appropriate curriculum development to support e-learning implementation. Both classifications highlight the importance of addressing multiple levels of barriers to ensure successful e-learning implementation. By identifying and addressing barriers at different levels, we can create a supportive environment for e-learning and help to ensure that teachers and students have the necessary tools and resources to engage effectively in this mode of education.

Table 1

Classification of Barriers Faced by Teachers in Using E-Learning

Type of Barrier	Description
School Level	Availability of software and hardware, internet, textbooks, school policy, time, and technical support
Teacher Level	Confidence, knowledge, belief, and experience
Curriculum Level	Structure of contents, assessment, e-learning resource that is in line with the curriculum
Student Level	Skill and knowledge, motivation, e-learning infrastructure

Purpose of the Study

During the COVID-19 epidemic, the current study seeks to understand the e-learning barriers Turkish math teachers face. In addition to analyzing disparities in teachers' perspectives on the barriers based on their demographic backgrounds, the study also explores the relationships between each level of barriers. The study's findings will improve our understanding of the impediments to e-learning integration in the context of the COVID-19 epidemic. As a result, this study contributes insightful new information to the literature on e-learning and offers crucial recommendations to enhance e-learning practices. To accomplish those goals, the following research questions are sought-after in this study:

1. What are the barriers that mathematics teachers view as significant to e-learning use during the COVID-19 pandemic?

2. What is the relationship between each level of barrier to e-learning use?

3. Are there any significant differences in teachers' views on barriers to e-learning use according to their gender, school type and teaching experience?

Method

Research Design

This study followed a quantitative approach (Fraenkel et al., 2011). Quantitative methods can provide reliable, valid, objective, and generalizable findings. If the researcher collects data based on a representative population sample, generalizations can be made about the whole population (Fraenkel et al., 2011).

Participants

Random sampling was employed in this study. The sample consisted of 364 participants (210 male and 154 female) who were middle school and elementary school mathematics teachers. Further details of participants' demographic information are presented in Table 2.

Table 2

The Demographic Background of the Participant

	Demographic Background	N	%
Gender	Male	210	57.7
	Female	154	42.3
Teacher	Middle School Math Teacher	218	59.9
	Elementary School Math Teacher	146	40.1
Teaching Experience	0-5 years	68	18.7
	6-10 years	112	30.8
	11-15 years	96	26.4
	16-20 years	53	14.6
	More than 20 years	35	9.5

Most of the participants (76.9%) used a computer/laptop for e-learning whilst the remaining used mobile/handheld devices. Furthermore, the majority of participants (90.7%) used mobile phones for internet connection and the rest used landline connections (93.4%).

Table 3

Devices and Internet Connection Used for E-Learning

Devices for E-Learning Activities	Type of Internet Connection	N	%
Devices	Mobile/Handheld Device	150	41.2
	Computer/Laptop	280	76.9
Internet Connection	Mobile Phone	330	90.7
	Landline Connection	340	93.4

Research Instruments

The "E-Learning Implementation Barriers" scale developed by Mailizar, Almanthari, Maulina, and Bruce (2020) and adapted to Turkish within the scope of this study was used. It consists of four scales, namely school level barrier, teacher level barrier, student level barrier, and curriculum level barriers. An online questionnaire was collected from 364 middle and elementary math teachers**.** A crucial reason for operating an online questionnaire was compatibility with teachers' online work during the pandemic. Reliability and validity examinations were carried out for the Turkish adaptation of the scale

used in the study. To validate the questionnaire, we used convergent and divergent validation methods. Cronbach's alpha was calculated to assess the reliability, and .83 was calculated for the whole scale, which indicates that all items exhibit high levels of reliability and measure the same concept. Table 4 presents Cronbach's alpha coefficient of multi-constructs that indicate adequate reliability.

Table 4

Cronbach's Alpha Coefficient of the Questionnaire

Sub-dimension	Cronbach's Alpha Coefficient	AVE	CR
Teacher Level Barrier	.86	.62	.79
School Level Barrier	.78	.58	.76
Curriculum Level Barrier	.80	.71	.84
Student Level Barrier	.82	.65	.81

As can be seen in Table 4, when the convergent and divergent validity values for the sub-dimensions of the Scale; it was determined that AVE>.50 values were .62 (Teacher Level Barrier), .58 (School Level Barrier), .65 (Curriculum Level Barrier), and .71 (Student Level Barrier), CR>.70 values were .79 (Teacher Level Barrier), .76 (School Level Barrier), .84 (Curriculum Level Barrier), and .81 (Student Level Barrier). According to these results, it was concluded that the convergent and divergent validity of the scale was provided.

The findings obtained as a result of the analysis of the established model with confirmatory factor analysis are given below. $\chi 2/sd$, RMSEA, GFI, CFI, NFI, and AGFI are the most frequently used statistics calculated on model-data fit with confirmatory factor analysis (Harrington, 2009; Tabachnick ve Fidell, 2013). Each of the factor loads showing the item-factor correlation was found to be statistically significant ($p< .05$). Compliance statistics calculated in this analysis; Calculated as $\chi 2/df = 2.13$, RMSEA= .071, GFI = .90, CFI= .91, NFI = .90, AGFI= .92. According to these results, the statistical test of the item-factor relations obtained was carried out.

Data Collection and Data Sources

An online questionnaire was used to collect data. A crucial reason for using an online questionnaire was compatibility with teachers' online work during the pandemic. Moreover, the online questionnaire was also easily administered and accessed using various devices (Fraenkel et al., 2011). The questionnaires were distributed after schools had been closed and the participants had been requested to use e-learning methods. Most participants were approached through WhatsApp groups and Turkish teacher mailing lists, with a few teachers being approached through personal email. Participants were sent a link to a questionnaire hosted on Google online questionnaire tool. The questionnaire was open for three weeks.

Data Analysis

All responses on teachers' level barriers were coded on a 5-point scale. Descriptive and inferential statistical analyses were employed to answer the research questions. Furthermore, an independent t-test and ANOVA were used to examine the difference in barrier according to the participants' demographic background. Spearman correlation coefficients were calculated to assess relationships between barriers

across the levels, and Cohen's (1992) guidelines for the interpretation of a correlation coefficient was used to interpret the correlation.

Findings

Teacher E-learning Use Barriers

Table 5 summarizes e-learning barriers at each level. The results revealed that the most significant e-learning barrier was at the student level ($\bar{X}$ = 4.12). Moreover, the school level barrier ($\bar{X}$ = 3.78) and the curriculum level barrier ($\bar{X}$ = 3.20) came second and third, respectively. The lowest barrier was the teacher level barrier ($\bar{X}$ = 3.08).

Table 5

Summary of Barriers at Each Level

Construct	$\bar{X}$	SD
Teacher Level Barrier	3.08	.62
School Level Barrier	3.78	.71
Curriculum Level Barrier	3.20	.55
Student Level Barrier	4.12	.68

Correlation between Each Level of the Barriers

A Pearson product-moment correlation coefficient was computed to assess the correlation between categories of the barriers. As shown in Table 6, there were strong and moderate positive correlations across the levels. The strongest correlation was between the school-level barriers and curriculum-level barriers, r = .78.

Table 6

Summary of the Correlation Matrix

	a	b	c	d
a: Teacher Level Barrier	1			
b: School Level Barrier	.62**	1		
c: Curriculum Level Barrier	.65**	.78**	1	
d: Student Level Barrier	.54**	.67**	.60**	1

**p<.01

Teacher Level Barriers According to Their Background

To assess differences in barriers according to teachers' backgrounds (Gender, School Type), we performed an independent t-test, and we performed ANOVA for teacher experiences.

Table 7

Results of the Independent T-test

Teacher Background	Results
Gender	$\bar{X}$ (Male = 3.64; Female = 3.42); p = .065; t = -.012
School Type	$\bar{X}$ (Middle School = 2.94; Elementary School = 3.15); p = .089; t = 1.002)

The results showed that there was no significant difference in barriers between male teachers and female teachers (t = -.012; p > .05). Furthermore, there was no significant difference in barriers between middle school math teachers with elementary school math teachers (t = 1.002; p > .05).

The results showed that there was no statistically significant difference between groups of teaching experience as demonstrated by one-way ANOVA ($F_{(5,323)}$ = .578, p = .067) and there was no statistically significant difference in barriers according to teachers' backgrounds.

Table 8

Results of ANOVA

Teacher Background	Results
Teaching Experience	Mean (0-5 Years = 3.37; 6-10 Years = 3.46; 11-15 Years = 3.40; 16-20 Years = 3.34; More than 20 Years = 3.43); p = .067; t = -1.13)

Discussion

This study showed how mathematics teachers felt about the hurdles to using e-learning during the COVID-19 pandemic, how each degree of barrier related to the others, and how teachers' perspectives varied according to their educational backgrounds. The results highlight three crucial discussion issues.

First, according to this study, student-level barriers to e-learning implementation were the biggest. This is demonstrated by the fact that most participants concurred that students lacked the knowledge and abilities to use e-learning tools effectively. Most participants also concurred that access to gadgets and an internet connection for e-learning was lacking among their students. The current study adds to the body of knowledge about the biggest obstacle to using online learning when schools are closed. The results show that before this pandemic, students lacked the necessary skills for e-learning. As a result, it is difficult for teachers in this situation to prepare their students for learning online.

Second, this study reveals a strong positive link between the curriculum-level barriers and those at the student, school, and institutional levels. Given that there is a well-established link between school culture and student accomplishment (MacNeil et al., 2009), this high correlation may help to partially explain why student level became the biggest obstacle to ICT integration in the classroom. As a result,

this research suggests that schools, one of the most significant education stakeholders, must play a significant role in helping students overcome their challenges with using e-learning in this tough time.

Third, no differences in barriers were seen in this study based on instructors' demographic backgrounds. This discovery emphasizes two key ideas.

- ✓It is no longer true that male teachers predominate over female teachers when it comes to the usage of e-learning (Mailizar, 2018). These results refute the assertion made by Vitanova, Atanasova-Pachemska, Iliev, and Pachemska (2015) and Markauskaite (2006) that technology-related activities have historically been seen as a "male domain."
- ✓Many people agree that more experience teaching at a higher level is crucial to develop the abilities necessary for effective teaching. This widely held misconception contradicts instructors' opinions on the difficulties in integrating e-learning, as teachers with various teaching backgrounds stated opinions that were quite similar.

Overall, this study shows how difficult it was for Indonesian secondary math instructors to use online learning as a teaching tool while their schools were closed due to the COVID-19 pandemic. Their most significant barriers came from the students, who lacked the necessary knowledge and skills for using e-learning and access to equipment and an internet connection. The barrier at the school level has a significant link with the barrier faced by students. This study adds to previous research on the usage of e-learning in schools, notably in the area of pandemic-related hurdles to e-learning. It means that the current use of e-learning in Indonesia confronts tremendous problems that might result in students failing to learn in this challenging period and beyond. Overcoming these difficulties facing growing nations is essential.

This study's results point to policymakers' need to develop comprehensive plans for e-learning readiness among schools in particular. To be proactive with student education, these strategies might involve giving students vouchers for internet access and gradual instruction in using e-learning before a crisis like a pandemic. Given the realities of the internet age, pupils will probably need to learn anything online sometime in their adult lives. Providing them with the necessary abilities now will benefit them later in life as working adults.

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