MATHEMATICS TEACHERS' EPISTEMOLOGICAL BELIEFS AND TECHNOLOGY ACCEPTANCE IN EMERGENCY REMOTE TEACHING DURING THE COVID-19 PANDEMIC

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DECLARATION OF ORIGINALITY

I, Rumeysa Erol, certify that

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ABSTRACT

Mathematics Teachers' Epistemological Beliefs and Technology Acceptance in Emergency Remote Teaching During the Covid-19 Pandemic

This explanatory sequential mixed-method study examined middle school mathematics teachers’ emergency remote teaching (ERT) experiences in the Covid-19 pandemic in terms of their mathematics-oriented epistemological beliefs and technology acceptance levels. Quantitative data collected through Mathematics Oriented Epistemological Beliefs Scale (MOEBS) and Technology Acceptance Measure for Teachers Scale (T-TAM). Data from both scales are used to form four case groups. Participants (n=39) are invited to interviews based on their case groups. Qualitative data collected through semi-structured interviews and Concerns Based Adoption Model (CBAM) is used as a framework while collecting and analyzing the interview data. The results indicated that there is a positive but not statistically significant correlation between the mathematics-oriented epistemological beliefs and technology acceptance levels of middle school mathematics teachers. It is shown that teachers’ concerns about ERT practice are coherent with their MOEBS and T-TAM scores. Addition to concerns, teachers’ needs are mentioned to guide in-service training programs such crisis and future applications.

ÖZET

Matematik Öğretmenlerinin Epistemolojik İnançları ve Covid-19 Pandemisi Sırasında Acil Uzaktan Öğretim için Teknoloji Kabul Düzeyleri

Bu açıklayıcı sıralı karma yöntem çalışması, ortaokul matematik öğretmenlerinin Covid-19 pandemisindeki acil uzaktan öğretim (ERT) deneyimlerini matematiğe dayalı epistemolojik inançları ve teknoloji kabul düzeyleri açısından incelemiştir. Nicel veriler Matematik Odaklı Epistemolojik İnançlar Ölçeği (MOEBS) ve Öğretmenler için Teknoloji Kabul Ölçeği (T-TAM) aracılığıyla toplanmıştır. Her iki ölçekten elde edilen veriler dört vaka grubu oluşturmak için kullanılmıştır. Katılımcılar (n=39) vaka gruplarına göre görüşmelere davet edilmiştir. Nitel veriler yarı yapılandırılmış görüşmeler aracılığıyla toplanmıştır. Görüşme verileri toplanırken ve analiz edilirken Endişe Temelli Benimseme Modeli (CBAM) benimsenmiştir. Sonuçlar, ortaokul matematik öğretmenlerinin matematiğe yönelik epistemolojik inançları ile teknoloji kabul düzeyleri arasında pozitif ancak istatistiksel olarak anlamlı olmayan bir ilişki olduğunu göstermiştir. Öğretmenlerin ERT deneyimleri ilgili endişelerinin MOEBS ve T-TAM puanları ile uyumlu olduğu görülmüştür. Endişelere ek olarak, kriz süreçlerinde ve gelecekteki hizmet içi eğitim programlarına rehberlik etmesi için öğretmenlerin ihtiyaçlarından bahsedilmiştir.

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CHAPTER 1

INTRODUCTION

2020 has been a tough year for the whole world. Due to the covid-19 pandemic that affected the whole world, education suddenly had to be conducted remotely from homes, which came to be called emergency remote teaching (ERT). In this sudden change, teachers started to continue their lessons online using video-conferencing tools without any preparation. This study will focus on middle school Math teachers' experiences and online lesson designs during and after the ERT process within two perspectives.

Firstly, teacher beliefs which affect teachers' practices will be examined. Each individual is a part of school life from a certain age and her/his connection with the school continues for many years. Every experience has an effect on their personality, decisions and beliefs. Those who choose to be teachers combine their previous school experiences as a student and teaching experience as a teacher. Therefore, teachers' beliefs and decisions about knowledge and learning are related to both their student years and their teaching experience. Beliefs about knowledge and how learning occurs are called epistemological beliefs. It has been observed that teachers' epistemological beliefs have an effect on their practices and lesson designs (Cooney & Shealy, 1997). In addition, since these beliefs may differ depending on the area of expertise, or subject-matter, it is necessary to evaluate each subject-matter within itself (Schoenfeld, 1992). For these reasons, epistemological beliefs of mathematics teachers will be examined within the context of the ERT process. The second focus will be technology adoption. The outbreak of the epidemic forced all educational activities to be accessed through technology. Everything that was planned to be done face to face was moved to online platforms and teachers who had no experience in this field had to adapt in no time. Therefore, teacher experiences during the epidemic process cannot be considered separately from the field of educational technologies. When we look at the literature, another factor that affects teachers' practice and lesson designs is the ability to integrate technology into the lesson (Joo, Park & Lim, 2018). Much research has been done about teachers' technology practice, and how to integrate technology into lesson design to make learning more effective (Loague, 2003; Inan & Lowther, 2010). The effect of the field of educational technology, where technology and pedagogy are together, has increased for teachers and has become a part of teaching since the first PC was introduced into the classroom Many models and frameworks have been put forward over the decades, including the Technological Pedagogical Content Knowledge Model (TPACK) (Mishra & Koehler, 2006), Concern-Based Adoption Model (Hall, et al, 1974), Technology Adoption and Technology Acceptance Models (Davis, 1989) are some of them. This study makes use of these models to study teachers' technology acceptance during and after the first ERT semester. Teachers' ERT experiences may provide strong data when these two areas are examined together.

In addition, teachers sought help from many channels for their needs that came with the sudden change during the Covid-19 pandemic. The last research focus of this study is the kinds of needs the teachers faced, what kind of support was or was not available, and what should be the characteristics of support that will actually meet such needs t for forward planning. It is hoped that findings from this study can lead to guidelines for an online in-service training platform addressing the needs of middle school mathematics teachers.

Being a teacher starts from being a student. Every individual has experienced to be a part of a school or other learning environment. Memories, friends, teachers or other factors affect our thoughts/beliefs from beginning of our lives. Those beliefs have an influence both on our learning experiences as a student or teaching practice as a teacher. Specifically, the teachers' epistemological beliefs are shaped by their experiences both as a student and a teacher (Boehle, 2020). Epistemological beliefs have been studied since William Perry's work in 1970 about the interpretation of learning experiences. Then it triggered the theory of epistemological development by Hofer and Pintrich (1997) that focuses on beliefs about knowledge and the relation between different categories. On the other hand, Schommer (1990) pointed out that beliefs are too complex and cannot be explained or categorized based on single factors. Beliefs needed to be analyzed as less or more sophisticated in terms of certain knowledge and quick learning factors. In contrast, Hofer and Pintrich (1997) focused on beliefs about the nature of knowledge and beliefs about the nature of knowing.

Since then, epistemological beliefs have been studied in the educational research area. We know from the literature that epistemological belief theories help us to interpret students' thinking about knowledge, teachers' thinking about knowledge and how teaching practices are linked to their beliefs (Haney, Lumpe, Czerniak & Egan 2002; Mitchener & Anderson, 1989). This study will look from teachers' beliefs perspective during the Covid-19 pandemic.

From the beginning of the pandemic, immediate school closures and emergency remote teaching (ERT) practice started unexpectedly. Adapting to the new situation and maintaining new needs affected teachers' practice. Teachers' epistemological beliefs are one of the factors that affect their learning environment designs, but it is not the only factor. Especially for the emergency remote teaching practice, teachers' use and acceptance of technology played a significant role. For this reason, Technology Acceptance Model (TAM) defined as a theory by Davis (1989) will lead this study. TAM underlines the factors such as perceived ease of use and perceived usefulness of technology which affect teachers' use of technology (Teo, 2009; Teo, Chai, Hung & Lee, 2008; Huang & Liaw, 2005; Davis, 1989).

1.1 Statement of the problem and the purpose of the study

Since the immediate swift from face-to-face teaching to ERT, everything needed to adapt to the new situation. Although seemingly transitory, the drastic change brought by ERT required instructional designs to be reconsidered, technical issues to be solved or professional support be provided to colleagues, even after the hectic days of the switch. The adaptation process that teachers experienced was complex and lingered over the semesters, and may be linked to their epistemological beliefs and technology acceptance levels during the ERT practice (Koruyan, Meri-Yilan, & Karakaş, 2022; Xu, Jin, Deifell & Angus, 2021; Cobo-Rendon, Lobos Peña, Mella-Norambuena, Cisternas San Martin, & Peña, 2021; Li, 2021). For these reasons, there is a need to examine this new situation.

Another aspect of this study is what kind of support teachers needed and where they got it during ERT and beyond. Even for those teachers who had access to support personnel or the ICT teachers of the school, help was limited and collaboration between colleagues needed to be increased (Hodges et. al, 2020). Therefore, the kind of professional support and teachers' learning needs will also be examined in this study. It is hoped that design guidelines will be offered based on the findings of this study.

The purpose of the study is to examine the relationship between middle school mathematics teachers' epistemological beliefs about mathematics and technology acceptance levels to their emergency remote teaching experiences in the Covid-19 pandemic. A secondary purpose is to identify the kinds of professional learning needs of teachers in this process so that guidelines can be offered for emergency contexts such as the Covid-19 context.

1.2 Significance of the study

Teachers' epistemological beliefs has been studied by many researchers and epistemological beliefs seemed to correlate with their teaching practices (Haney et al., 2002). Also, technology acceptance models pointed out how teachers' teaching practices and technology integrations are shaped. These studies mainly focused on face-to-face instructions with a regular school environment. People's beliefs and their choices for practice may change unexpectedly in a crisis environment, such as the Covid-19 pandemic of 2020-21. Therefore, this study attempts to examine in small scale how epistemological beliefs and technology acceptance levels may be related, if at all, in the context of such a new/unexpected and global crisis environment.

CHAPTER 2

LITERATURE REVIEW

2.1 Epistemological beliefs

Epistemological beliefs are beliefs about the nature of knowledge and the ways in which it is acquired (Hofer & Pintrich, 1997). It includes assumptions about knowledge that determine individuals' attitudes and behaviors (Deryakulu, 2006) and affect perception and interpretation processes (Schommer, 1998). Due to its determining effect on individuals, epistemological beliefs examined in terms of learning and teaching processes also affect teachers' preferences regarding teaching practices (Depaepe, De Corte & Verschaffel, 2016).

Epistemological beliefs have been accepted as a part of teachers’ professional proficiency (e.g., Blömeke, Felbrich, Müller, Kaiser, & Lehmann, 2008; Kunter et al., 2013), and studied for a long time, in different types of categorizations. Earlier studies have focused on the developmental process of epistemological beliefs (Schommer, 1990). Perry (1968) explained this process that people see knowledge as a certain structure at first, then they see the possible contradictions of knowledge which broke the certainty. Every stage was defined by a specific way of thinking and new experiences are needed to renew the beliefs, and therefor progression needs long-term interventions (Kienhues, Bromme & Stahl, 2008). Based on Perry’s (1968) work, these progression stages were fixed in a continuum. Schommer (1990) looked at an educational psychology perspective and claimed that these epistemological beliefs are a composition of multiple dimensions so there are no fixed developmental stages. She defined five dimensions: the structure, certainty, source of knowledge, and the control and speed of knowledge (Schommer, 1990).

She pointed out that these dimensions do not have to change synchronically (Kienhues et al., 2008).

As a general review of epistemological beliefs research history, there are six general issues summarized by Hofer and Pintrich (1997). These issues are (1) refining and extending Perry's developmental sequence (2) developing more simplified measurement tools for assessing such development (3) exploring gender-related patterns in knowing (4) examining how epistemological awareness is a part of thinking and reasoning processes (5) identifying dimensions of epistemological beliefs and (6) assessing how these beliefs link to other cognitive and motivational processes (Hofer & Pintrich, 1997). In addition to those issues, Hofer and Pintrich (1997) focused on whether beliefs are domain specific or not and how they can connect to disciplinary beliefs.

Many authors assumed that domain-general and domain-specific epistemological beliefs could be hold at the same time (Bromme, Kienhues, & Stahl, 2008; Buehl, Alexander, & Murphy, 2002; Muis, Bendixen, & Haerle, 2006). According to Muis et al. (2006), even if beliefs about knowledge and knowing in mathematics or any other field can be partially influenced by the individual's domain-general epistemological beliefs, people's beliefs can differ between fields. Also, they pointed out that domain-specific epistemological beliefs are more effective than domain-general epistemological beliefs in education (Kienhues et al., 2008). To measure domain-specific epistemological beliefs, Op‘t Eynde et al. (2006) argued that scales should be prepared domain-specific because the general epistemological beliefs scales will not be sufficient to see the difference between specific subject beliefs. Schommer-Aikins, Duell and Hutter (2005) studied students’ general epistemological beliefs and domain-specific mathematical problem-solving beliefs by asking whether these two belief systems are related and whether they predict academic performance. They used two different instruments to measure domain-general and domain-specific beliefs and found out that there is a strong relation exists between domain-general and domain-specific beliefs, and also indirect effects on academic performance. According to Peterson and Cohen's (2019) theoretical review about curiosity, they focused on specific domain (mathematics) since they underlined that the domain-general conceptualizations cannot give information about individuals' developments. Based on these, epistemological beliefs will be examined specifically based on mathematics subject in this study.

2.1.1 Mathematical epistemological beliefs

Mathematical Epistemological Beliefs have been categorized in different ways. Ernest (1989) analyzed three categories: An Instrumentalist, a Platonist and a problem-solving view. Blömeke, Felbrich, Müller, Kaiser, and Lehmann (2008) used scheme-related, formalist, process-related and application perspectives. Felbrich, Kaiser, and Schmotz (2012) combine Blömeke's epistemological beliefs' categories into two as mathematics as a static science and mathematics as a dynamic process (Depaepe, De Corte, & Verschaffel, 2016). Even if these categories help to examine beliefs with all other factors, the categorization of epistemological beliefs is a hard and complex process. According to Roesken and Törner (2010) categorization as static or dynamic depends on the kind of mathematics as a discipline or as a school subject. They claimed that beliefs are changeable whether they see mathematics as a discipline or a school subject. (Depaepe, De Corte, & Verschaffel, 2016). Personal opinions about the nature of mathematics, learning mathematics and teaching mathematics comes from the beginning of school life as a student so teachers' beliefs are not completely independent from students' beliefs.

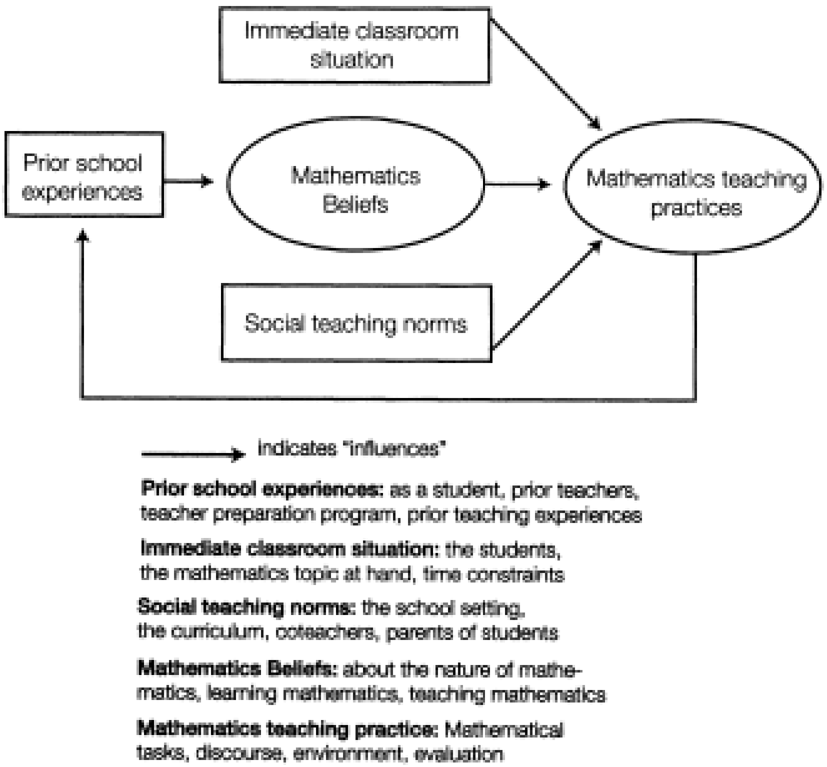

Figure 1. Scheme proposed by Raymond (1997)

In this model, Raymond (1997) defined mathematics beliefs as a combination of personal judgements about mathematics shaped by experiences in mathematics and beliefs about nature of mathematics, learning mathematics and teaching mathematics. Prior school experiences which have been shown to have an effect on mathematics beliefs, includes experience as a student, influence of prior teachers, influence of teacher training program and prior teaching experiences. From this model, it can be seen that teachers' beliefs began to form when they were students and shaped by experiences. Social teaching norms and the immediate classroom situations are the factors which have no direct influence but were named as mediating factors that can influence individuals who can be affected from outside factors (Brown & Borko, 1992; Leinhardt, 1989; Westerman, 1990).

According to Depaepe et al. (2016), teachers' epistemological beliefs have a relation with other beliefs such as teacher authority and self-efficacy beliefs. Also, classroom practice has an effect on epistemological beliefs. In some cases, working conditions could affect the teachers' instructional design decisions and it might contradict their epistemological beliefs (Depaepe, De Corte, & Verschaffel, 2016). Therefore, the focus of this study will be specifically mathematical epistemological beliefs and teaching practice.

2.2 Epistemological beliefs and teaching practice

Teacher beliefs, teachers' ideas of knowledge and knowing are expected to have influence on teachers' practice (Kim et al. 2013; Pajares 1992). In the research on teachers' beliefs, Pajares (1992) reported that teachers' beliefs about teaching, learning, and also beliefs about students are significantly affect teachers' classroom practices. It also found that teachers' beliefs were more likely to influence the types of instructional strategies they applied in the classroom (Muis & Foy, 2010)

It has been argued that epistemic beliefs in education and instruction areas are related to how people learn, apply their knowledge and put their knowledge into practice (Schommer 1990, 1993; Vedenpää and Lonka 2014). As a result, many educators agree that teachers' epistemic beliefs may have influence on their teaching practices (Deng et al. 2014; Pajares 1992). Those beliefs also affect the knowledge transfer (or creation), the student's role, in-class organization and evaluation processes (Depaepe, De Corte & Verschaffel, 2016). In earlier studies, it was shown that epistemological beliefs were not the only factor affecting teaching experience, but the focus was determined according to these beliefs (Thompson, 1984). Raymond (1997), who worked with mathematics teachers, found that beliefs about mathematics were influenced by school experiences as a student, but mathematics teaching experience could also affect these beliefs. According to Boehle (2020), teachers' sharing experiences with their colleagues will provide an opportunity to evaluate the harmony between their beliefs and teaching practices. As can be seen, there is a two-way interaction between epistemological beliefs and teaching experiences.

Olafson and Schraw (2010) are the researchers who interested in measuring epistemological beliefs of practicing teachers and describing the relationship between them. They suggested that teachers' epistemological beliefs should be studied with ontological beliefs which refers to beliefs about the nature of reality. They conducted the study with twenty-four teachers. Those teachers rated a scale about their epistemological and ontological worldviews and wrote an essay to explain their ratings. In the second phase of the study, eight participants volunteered to interviews. They found several factors that affects classroom practice: administration, structured programs, accountability for practice, funding, testing, time, school context and classroom context. Factors related to administrative decisions were the most frequent finding they mentioned. Even if the participants underlined the teacher-centered instructions are generally mandated by the principal, some of them mentioned the support of the administrators as beneficial. Another important finding was that teachers with more sophisticated epistemological beliefs and worldviews were more likely to create student-centered instructional practices while teachers with less sophisticated beliefs focused on traditional curriculum and assessments. In the context of these factors influencing teaching practice and the relationships among them, teachers' design processes need to be considered as well. Changsri, Inprasitha, Pattanajak, and Changtong (2012) used three categories of beliefs to explore the beliefs of teachers based on their practice via a professional development project. The beliefs about mathematics teaching referred to teachers' roles, beliefs about students' behaviors in the classroom, and beliefs about social context referred to collaboratively designing a lesson. There were three schools and Fifty-nine teachers from three schools participated in study for a period of 4 or 5 years, and planned and implemented the lessons together. During the implementation, they observed each other's lessons and then conducted post-discussions. Quantitative data received was collected via a questionnaire and qualitative data from the observations of the lessons. It was found that planning lessons become more advanced with the collaborative planning process, observing students' behaviors turned teachers to be more conscious, and post-discussions helped them to see their colleagues' constructive criticism. Changsri et al. (2012) concluded that this recognizing of perceived beliefs was the critical stage before changing them.

Thomas and Hong (2013) have also stressed the importance of professional support for beliefs about teaching. They studied teachers' integration of technology into mathematics learning. They focused on two factors that enable the integration of technology into lessons: beliefs about how mathematics should be taught, and the trust in teaching through technology. As the pedagogical technological knowledge that develops with these two elements increases, teachers' beliefs and attitudes towards mathematics teaching also change. Thomas and Hong (2013) argued that the combination of mathematical content knowledge and pedagogical knowledge creates mathematical knowledge for teaching which is a requirement for pedagogical technology knowledge (PTK). Not only mathematical knowledge but also personal orientations and technology instrumental genesis are factors affecting PTK. These factors which influence teachers' role and their attitude about using technology is also related to the didactical contract between the teacher and the students. The framework called the Theory of Didactical Situations (TDS) of Brousseau (1997) explained that the situation created by the teacher was the important criteria for learning environment. The didactical contract has mutual aspects: expectations of students to learn and expectations of teachers that students want to learn. Since the contract is dynamic, situations could change based on affordances and constraints. The term affordance is used for creating the environment by the teacher who is in charge to decide the best option. Constraints are the time/technical issues, curriculum, classroom or any other personal factors. Thomas and Hong (2013) pointed out that when there were supportive colleagues in the work environment, this had a positive influence on the teachers' confidence and attitudes to epistemic value of teaching with technology.

In addition to the didactical contract, Artigue (2002) described two terms about the technology involved in the learning environment: epistemic value and pragmatic value. Epistemic value refers to "understanding of the objects they involve" (p.248) and pragmatic value refers to "productive potential (efficiency, cost, field of validity)" (p.248). To clarify, an instrument can show/present a detailed graph to the learner which means it has a pragmatic value but if it triggers mathematical thinking or what kinds of solutions can be produced, what other concepts are related to each other, it also has an epistemic value. Every technique includes both epistemic and pragmatic values but these techniques and mathematical needs can change in time, epistemic and pragmatic values can also evolve. As mentioned in the study, recognizing pragmatic values might be easier because epistemic value depends on context. While designing a learning environment or using an instrument, the epistemic value of those techniques or technologies should be thought carefully in terms of current situations and tasks (Artigue, 2002). So, using a technique or technology effectively in a specific learning environment will depend on its epistemic value, and it also affects the teaching practice which is also connected to teachers' epistemological beliefs.

Lastly, Kim et al. (2013) showed that teacher beliefs and technology integration practice coincided with their beliefs about what effective teaching is. They revealed that beliefs about the source and structure of knowledge are related to beliefs about the learning process. The level of technology use was also closely related to instruction design and the teacher's role.

2.3 Technology acceptance

2.3.1 Technology acceptance model

Another factor affecting teachers' learning environment design and choices they make is their level of technology acceptance. Technology Acceptance Model (TAM) proposed by Davis (1989), is one of the models used to examine how technology is adopted to teaching practices, defines the relationship between beliefs / attitudes and behaviors by focusing on the perceived usefulness and ease of use (Aldunate & Nussbaum, 2013). Perceived ease of use refers to beliefs about how easy and understandable that new technology is to use. Perceived usefulness refers to beliefs about how this new technology can affect the practice/learning/performance and is it meaningful to use. In this model, perceived usefulness and perceived ease of use affect the users' attitude, and attitudes affect their behavioral intentions which trigger the usage (Davis, 1989). In short, the model explains how user beliefs and attitudes affect their behavioral intentions (Aldunate & Nussbaum, 2013). When Davis (1989) created the TAM, the foci were two factors mentioned above. Davis and Verkatesh (1996) excluded the attitude from the model since it was the intermediate factor between other two and not confirmed by empirical research. The model was later revised by Lee et al. (2013) by suggesting external factors which affect both perceived usefulness and perceived ease of use. Those factors are classified into three categories: individual factors, task factors and organization factors. Individual factors refer to prior experience and computer self-efficacy of users, task factors refer to task characteristics and organization factors are the organizational support (Lee et. al, 2013). In the revision of the TAM model, compatibility, complexity, relative advantage, ability to try and observability attributes of innovation have also an influence on adoption of the new technology (Garaika & Margahana, 2020).

When teachers meet a new technology, they will not adopt it with ease and integrate it to their practice efficiently, even if they accept the need. According to Zellweger (2007), technology adoption has sequential process including development, institutional support, and reflection on the experimentation. The more time given the integration process, the more chance for adopting it (Zellweger, 2007). While some factors affect the process positively, others pose barriers. Mumtaz (2000) discussed that the lack of experience of using technology triggered avoidance for use in teaching too. Also, Inan and Lowther (2010) claim that teachers' age and years of teaching can have a negative correlation with integration of technology.

TAM was used in the studies during the Covid-19 pandemic. Cobo-Rendon, Lobos Pena, Mella-Norambuena, Cisternas San Martin and Pena (2021) analyzed the teacher technology acceptance and its relationship to resource viewing and academic performance of college students. There were 251 teachers and 12185 students as participants in their study. They found that the relation between teachers' acceptance and time spent on learning management systems (LMS) was significant and positive. Also, the usefulness factor of TAM is related to academic performance of the students at the end of the semester (Cobo-Rendon et al., 2021).

Overall, in line with the literature, the TAM can still be considered a powerful model for understanding teachers' technology adoption. TAM can find direct and indirect factors leading to the use of technology and also it is suitable both for pre- and in-service teachers (Scherer, Siddiq & Tondeur, 2018).

2.3.2 Concerns based adoption model

To focus on the concerns that prevent teachers from integrating innovations to their practice, Concerns Based Adoption Model (CBAM) was developed. CBAM was developed at the University of Texas in 1970s and continued nearly for fifteen years (Anderson, 2002). The model defines technology usage levels through acceptance / anxiety stages (George et al, 2006). Three dimensions for measuring change is used: Stages of Concern, Levels of Use and Innovation Configurations. Since the aim of this study is to understand the ways in which the teachers' beliefs and technology acceptance levels may have affected their practice during COVID-19, stages of concerns will be the main focus in terms of CBAM model.

There are seven stages of concern, as explained in Figure 2.

IMPACT	6	Refocusing	The individual focuses on exploring ways to reap more universal benefits from the innovation, including the possibility of making major changes to it or replacing it with a more powerful alternative.
	5	Collaboration	The individual focuses on coordinating and cooperating with others regarding use of the innovation.
	4	Consequence	The individual focuses on the innovation's impact on students in his or her immediate sphere of influence. Considerations include the relevance of the innovation for students; the evaluation of student outcomes, including performance and competencies; and the changes needed to improve student outcomes.
TASK	3	Management	The individual focuses on the processes and tasks of using the innovation and the best use of information and resources. Issues related to efficiency, organizing, managing, and scheduling dominate.
SELF	2	Personal	The individual is uncertain about the demands of the innovation, his or her adequacy to meet those demands, and/or his or her role with the innovation. The individual is analyzing his or her relationship to the reward structure of the organization, determining his or her part in decision making, and considering potential conflicts with existing structures or personal commitment. Concerns also might involve the financial or status implications of the program for the individual and his or her colleagues.
	1	Informational	The individual indicates a general awareness of the innovation and interest in learning more details about it. The individual does not seem to be worried about himself or herself in relation to the innovation. Any interest is in impersonal, substantive aspects of the innovation, such as its general characteristics, effects, and requirements for use.
	0	Unconcerned	The individual indicates little concern about or involvement with the innovation.

Figure 2. Stages of concern: A manual for use of the SoC questionnaire (Gene, Hall, George, & Rutherford, 2014, originally published in 1979)

Generally, teachers start with a self-category (Stage 0, 1 and 2) concerns when they newly encounter an innovation. They progress to task category (Stage 3) with usage and then to the impact category (Stage 4, 5 and 6) as they become experienced in use (Dele-Ajayi, Fasae & Okoli, 2021). One study conducted by Hao and Lee (2015), studied 200 teachers' concern about integrating Web 2.0 tools in Taiwan. They found that majority were at informational stage and the personal and management stages came later. They suggested that those who have an awareness of the Web 2.0 tools are less worried and more interested in the technology (Hao et al., 2015). In another study conducted by Ashrafzadeh and Sayadian (2015) with 91

Iranian teachers, it was found that most common concerns were at information stage. Also, their results showed that instructors needed more information about how to integrate technology into their practice. Even the experienced ones who had training about using ICT in class, still had concerns and anxiety (Ashrafzadeh et al., 2015). Other researchers underlined the relationship between concerns and demographic information like gender, age and working experience. In a study by Dele-Ajayi et al. (2021), conducted with 340 Nigerian teachers, it was found that gender had no statistically significant correlation but teaching experience, experience with ICT, age and level of class taught made a significant difference in the stages of concern.

Kayaduman and Demirel (2019) investigated the concerns of first-time distance education instructors using CBAM. They conducted two-day training before the distance education with 9 instructors. They collected quantitative data via questionnaires and qualitative data via interviews. Their initial findings showed that instructors' concerns were at informational and personal stages (Stage 1 and 2), and not at a consequence stage yet (Stage 4), which indicated that the instructors' focus was not on the effects of distance education on students but the effects of implementation on themselves. After the implementation, the consequence stage increased in the results. They concluded that instructors needed pedagogical and technical training during the adaptation process because these results might be related to lack of knowledge about technical issues and instructional methods and strategies (Kayaduman & Demirel, 2019).

In another study conducted by Kayaduman and Delialioğlu (2021), with preservice teachers to determine their stages of concern for Web 2.0 technology integration, both quantitative and qualitative data was collected from 24 English language preservice teachers based on CBAM. The findings showed high level of unconcerned (stage 0), which lead the researchers to conclude that the preservice teachers might think technology integration depended on their major, or area of teaching. It was also pointed out that the preservice teachers' lack of teaching experience could be the predictor of this result.

Lastly, Kim et al. (2013)'s study has particular relevance for the current study, because how teacher beliefs are related to technology integration practices were investigated from a CBAM perspective. During a four-year professional development project with 22 participants, quantitative data was collected through Epistemological Belief Questionnaire and interviews were conducted with the participating teachers based on the CBAM framework. . The findings showed that teacher beliefs about the nature of knowledge and learning was significantly correlated with teacher beliefs about effective ways of teaching. Also, beliefs about effective ways of teaching were significantly correlated with technology integration practices. As a result, teachers who had more sophisticated epistemological beliefs were closer to a student-centered approach, their focus was more on learning not the technology itself, and there was a higher consistency between what the teachers said and what they actually did. (Kim et al., 2013).

The CBAM and Stages of Concern framework was used in this study to construct for the interview questions, because it is a well-established framework for investigating technology adoption and integration. Since the teachers' technology acceptance levels are examined for the relationship with their practice, their concerns about technology might give more detailed information.

2.4 Covid-19 pandemic and emergency remote teaching

When the coronavirus outbreak sprung from Wuhan, China, to the rest of the World in the early days of 2020, most of the countries closed down schools because of the risk of fast spread among children and their families (ETF, 2018; OECD, 2020a, 2020b), and on March 11th, the World Health Organization (WHO) called this a "pandemic" and asked for policies to reduce human interaction. With the Covid-19 global epidemic, which deeply affected all education systems in the world since the 2nd semester of the 2019-2020 academic year, teachers found themselves in a practice they had never experienced before., When the first case of Covid-19 in Turkey was announced in March 2020, the National Ministry of Education immediately decided to close all the schools around the country. It was impossible to create a well-planned online learning environment in such short notice and "emergency remote teaching", was produced in response to the sudden crisis (Hodges et al., 2020). Lessons designed for face-to-face education had to be quickly adapted to a new remotely accessible learning environment, but none of the teachers were prepared for this transition (Milman, 2020). In an environment of uncertainty, teachers had to redefine learning goals and select tools and decide how to make them work, although the teaching content could not be fully adopted (Hughes, Henry & Kushnick, 2020). Since there was almost no in-service training that could meet the urgent need, the most important support of teachers in this difficult process was their colleagues, and many teachers joined networks where they would learn from each other.

Researchers studied on how teaching and learning were affected in this sudden but permanent process. Early research has shown that teachers should focus on belief systems, attitude changes, and new sources of motivation affected by the pandemic. For teachers' practice, they needed to reconsider some characteristics regarding themselves and learners, and reflect on belief systems affected by the situation, attitudinal changes, and facilitator or motivators for teaching. Also, they needed to ask themselves how to rearrange the materials, what were the new learning goals for the new situation and what kind of ways were the best option to reach those goals (Hughes, Henry & Kushnick, 2020).

Another aspect is the teachers' background to use technology-based tools or online platforms for teaching. The importance of the use of technology and participation in online courses during teacher preparation programs come into prominence (Yıldırım, 2020). The teachers who were already familiar with Learning Management Systems (LMS) or video conferencing tools, had faster adaptation procedures than their colleagues. This situation also highlighted the need for communities for sharing experience and new information among teachers (Yıldırım, 2020).

Rahmadi (2021) who studied teachers' technology integration and distance learning adoption during the Covid-19 crisis with 572 teachers in Indonesia, found that the teachers chose to use familiar tools or devices that they already used in daily life such as WhatsApp, for remote instruction at such an emergency situation. He interpreted this result as an optimistic sign to adapt remote instruction to future formal schooling system. Beattie, Wilson and Hendry (2022) examined Scottish primary teachers' lived experiences of adapting to ERT practice. They assumed that understanding teachers' perceptions of ERT has an important link between teacher beliefs and their behaviors. 10 teachers participated to their study, and underlined that the vulnerable learners were affected by inequitable barriers of ERT, and the importance of parental support for students' engagement and how the teachers' work-life balance was impacted negatively. The participants suggested that their teaching practices could change after the ERT because they realized the need of implementing new skills to existing practice (Beattie et al., 2022).

While the effect of epistemological beliefs and technology acceptance levels on teaching experiences had been studied, it is worth investigating how these two factors affected teachers' adaptation processes and practice during ERT and post-ERT. On the other hand, as stated by Raymond (1997), although epistemological beliefs affect experiences, past experiences also affect practice.

Therefore, it can be expected that the experiences gained during ERT and in the immediately following semesters, may affect belief systems, technology perspective and acceptance levels, and the integration of technology into education. The primary aim of this study is to examine the relationship of mathematics teachers' epistemological beliefs with technology integration in the context of a continuous emergency remote teaching. The secondary aim is to investigate the needs of teachers which can meet by in-service trainings, including emergencies, in the light of these findings.

Research questions:

i. How do the middle school math teachers' epistemological beliefs about math relate to their emergency remote teaching (ERT) experiences during the Covid-19 pandemic?
   a. To what extend do the middle school math teachers' mathematics-oriented epistemological belief scores overlap with their scores in TAM scale, if at all?
   b. To what extent do their epistemological beliefs relate to the teachers' views of mathematics instruction in teaching remotely?

c. To what extent did their emergency remote teaching experience affect their epistemological beliefs about math, if at all?

ii. What are the middle school math teachers' thoughts about their emergency remote teaching (ERT) experiences during the Covid-19 pandemic?

a. How do the middle school math teachers' technology acceptance levels relate to their emergency remote teaching (ERT) experiences during the Covid-19 pandemic?

b. How are the teachers' technology acceptance levels related to their views of math instruction in remote teaching?

c. To what extent did their emergency remote teaching experience affect the participants' technology acceptance levels, if at all?

iii. What macro design guidelines can be identified for a remotely accessible in-service training support program based on the middle school math teachers' experiences of (post)ERT and the needs they have identified?

CHAPTER 3

METHOD

In this chapter, the research design, setting and participants, details of instruments, data collection procedures, and data analysis are explained.

3.1 Research design

This is an explanatory sequential mixed-method study (Creswell & Plano Clark, 2011) that aimed to examine how teachers' epistemological beliefs and their technology acceptance levels were related with teaching practices during the Emergency Remote Teaching semesters in 2020-21. The study includes collecting and analyzing quantitative and then qualitative data sequentially in a single study. Both types of data were connected and the results have been integrated, as recommended by Creswell (2012).

The quantitative components were the Mathematics-Oriented Epistemological Beliefs and the Technology Acceptance Measure for Teachers scales. The qualitative component is based on the semi-structured interview data.

3.2 Setting and participants

The teachers who participated in the study were determined by criterion sampling method. The criteria for determining the sample were being a middle school mathematics teacher, actively teaching during the pandemic from March 2020 to June 2021, and being accessible online. Invitations for MOEBS and T-TAM scales were sent to teacher groups on WhatsApp and Telegram applications. Teachers who responded to the invitation for scales gave their contact information at the beginning of the form they filled out, so that they could be contacted for the qualitative phase of the study. All mathematics teachers who filled out both of the scales, i.e., 39 teachers, comprised the participants of the study

After collecting the quantitative data, participants were invited to semi-structured interviews for the qualitative data. Not all 39 participants were invited to interviews since the time was limited. In order to have maximum variation, the data collected from the MOEBS and T-TAM scales were used. For neither of the scales, had the authors specify a range for differentiating between levels of sophistication of belief or technology acceptance. Therefore, the data from the two scales were used to create maximum variation groups within the participants to invite for an interview. First, the mean score obtained from each scale was calculated for the whole group. The participants were divided into two groups based on the means: those with higher and lower epistemological belief scores from the scale MOEBS, and those with higher and lower technology acceptance level scores from the scale T-TAM. The mean of MOEBS scores were 100,59 and the mean of T-TAM scores were 160,89. With this scoring, four case groups were created from the 39 participants. Group 1 consisted of the participants who have higher scores in MOEBS and higher scores in T-TAM, Group 2 Higher scores of MOEBS and Lower scores of T-TAM, Group 3 Lower scores of MOEBS and Higher scores of T-TAM and lastly Group 4 Lower scores of MOEBS and Lower scores of T-TAM within the participants. See Table 9 below.

Table 1. Range of Scores for Groups

	MOEBS Scores	T-TAM Scores
Group 1	100,59 <…< 135	160,89 <…< 185
Group 2	100,59 <…< 135	37<…< 160,89
Group 3	27 <…< 100,59	160,89 <…< 185
Group 4	27 <…< 100,59	37<…< 160,89

After this classification, 15 participants were included in Group 1, 7 participants in Group 2, 6 participants in Group 3 and 11 participants in Group 4. Groups of both higher scores or both lower scores have more participants than the other two groups. Table 10 shows the number of participants who correspond to case grouping in terms of their MOEBS and T-TAM scores.

Table 2. Number of Participants of Groups

	Scores		Number of participants
	MOEBS	T-TAM	
Group1	…>100,59	...>160,89	15
Group2	…>100,59	...<160,89	7
Group3	...<100,59	...>160,89	6
Group4	...<100,59	...<160,89	11

They were invited for a semi-structured interview. Some of them gave an e-mail address as contact information so they got an invitation e-mail while others got SMS since they provided phone numbers. 12 out of 39 answered the invitations and were interviewed.

3.3 Instruments

There were two scales to collect quantitative data for epistemological beliefs and technology acceptance levels and a semi-structured interview protocol to collect qualitative data.

3.3.1 The mathematics-oriented epistemological belief scale (MOEBS)

The Mathematics-Oriented Epistemological Belief Scale (MOEBS) (see Appendix A and B), developed by İlhan and Çetin (2013), was used to answer the first research question. The instrument consists of 27-items, rated on a 5-point Likert scale (1= strongly disagree; 5= strongly agree), with three factors, 1.the belief that learning depends on effort (BLDE), 2. the belief that learning depends on talent (BLDT), and 3. the belief that there is only one truth (BTOOT). The more sophisticated epistemological beliefs refer to higher scores of BLDE and lower scores of BLDT and BTOOT. Therefore, while calculating each participant's scores, belief that learning depends on talent (BLDT) which has 10 items, and belief that there is only one truth (BTOOT) which has 7 items were reverse coded. According to Ilhan and Cetin (2013), two items in the BTOOT component also required reverse coding. The sum of the three factor scores constituted the final MOEBS scores of participants. In the original scale, the internal consistency coefficients were .84 for the BLDE, .81 for the BLDT, and .71 for the BTOOT before the test-retest checking. Test-retest coefficients were found .96 for the BLDE, .95 for the BLDT, and .95 for the BTOOT. The Cronbach coefficient alpha was calculated for the sample in this study, and was found .846. The BLDE was .82, the BLDT 0.72 and the BTOOT was .86 in this study. When the alpha value is between .70 and .79 the reliability is fair, between .80 and .89 it is good, and for .90 and above it is excellent (Cicchetti, 1994).

The reliability of the MOEBS scale can be accepted as good for the data used in this study.

3.3.2 Technology acceptance measure for teachers scale (T-TAM)

The other scale used during the quantitative data collection phase was the Technology Acceptance Measure for Teachers (T-TAM) (see Appendix C and D), developed by Ursavaş, Şahin, and Mcilroy (2014). The instrument consists of 37-items, rated on 5-point Likert scale (1= strongly disagree; 5= strongly agree). None of the items had reverse coding. The original scale was structured around 11 factors: Perceived usefulness, perceived ease of use, attitude towards use, subjective norms, self-efficacy, facilitating conditions, technological complexity, anxiety, perceived enjoyment, compatibility, behavioral intention. The internal consistency coefficients were between .798 (self-efficacy factor) and .909 (perceived enjoyment) for these factors.

The reliability coefficient of the T-TAM data was calculated for the data collected as part of this study, and found .944. An alpha value between .70 and .79 indicates that the reliability was fair, while .80 - .89 indicates good, and .90 and above excellent (Cicchetti, 1994). Thus, the reliability of the T-TAM for this data was at an excellent level.

3.3.3 Interviews

Qualitative methodology was used to answer the second research question, as the purpose was to explore teachers' experiences through a specific point in time (i.e., ERT experiences and the relationship of these experiences with epistemological beliefs and technology acceptances), and to shed light onto professional needs of middle school Math teachers during an emergency situation. A qualitative approach was adopted at this phase of the study because the intention was to help “answer questions about experience, meaning, and perspective mostly from the participant's point of view” (Hammarberg, Kirkman, & Lacey, 2016, p. 499). The reason for conducting the interviews in addition to the quantitative data given by the participants was to “discover and understand a phenomenon, a process, the perspectives and worldviews of the people involved, or a combination of these” (Merriam, 2002, p. 6.). The aim was to gather detailed information about the middle school Math teachers’ teaching experiences to see how these might be related to their epistemological beliefs and technology acceptance levels.

A semi-structured interview protocol was employed (see Appendix E and F) to allow interviewees to express themselves relatively freely. Both more and less structured questions were used to guide the interview (Meriam, 1998). There were 16 questions prepared by the researcher based on the Stages of Concerns framework of Concerns Based Adoption Model (Hall et. al, 2006), which was designed originally for curriculum innovations. The interview questions intended to identify the participants’ responses and concerns while adapting to new technologies that they came across and used during the ERT experience. While preparing the questions, similar studies were reviewed (Kayaduman & Demirel, 2019; Kim et al., 2013; Shwartz et al., 2016), and several questions were adapted from Kim et al. (2013).

3.4 Procedures

Before collecting the data, ethics approval was secured from the Institutional Review Board and Ethics Committee of Bogazici University (see Appendix I, J, K and L). The Mathematics-Oriented Epistemological Belief Scale (MOEBS) and Technology

Acceptance Measure for Teachers Scale (T-TAM) were sent to middle school mathematics teachers via e-mail, Telegram groups, and WhatsApp groups. Quantitative data from these two scales were examined and participants were distributed into four groups, based on their technology acceptance level scores (lower, higher) and epistemological beliefs scores (lower, higher) (see table 1).

Table 3. Scores of Scales

Participants	Epistemological Beliefs Scale	Technology Acceptance Scale	Interview Groups	Interviewed
P1	105	174	1	√
P4	105	185	1	
P6	101	177	1	√
P7	114	166	1	√
P9	106	175	1	
P13	104	168	1	
P16	104	178	1	
P17	106	175	1	
P20	121	184	1	
P23	106	184	1	
P24	100	176	1	
P25	110	183	1	
P33	111	181	1	
P34	105	185	1	
P35	100	165	1	
P11	108	144	2	√
P18	114	120	2	
P19	102	149	2	√
P26	105	150	2	√
P27	103	154	2	
P29	108	161	2	
P32	106	121	2	
P3	91	182	3	√
P5	93	170	3	
P14	88	177	3	
P21	98	187	3	√
P28	84	165	3	√
P38	59	188	3	
P2	98	156	4	√
P8	98	146	4	√
P10	91	159	4	
P12	98	146	4	
P15	93	148	4	
P22	89	132	4	√
P30	99	153	4	
P31	98	158	4	
P36	96	153	4	
P37	80	136	4	
P39	97	114	4	

The reason for grouping the participants was to get maximum variation in teacher profile, and determine whether or not their experiences would constitute a certain pattern or show any common features based on their epistemological beliefs and technology acceptance levels. As Table 2 shows below, there were 15 participants in Group 1, 7 in Group 2, 6 in Group 3 and 11 in Group 4. A minimum of 3 participants in each group was aimed, because of the difficulty of getting teachers to accept online interviews at the end of a hectic school year infiltrated with "Zoom fatigue."

Table 4. Number of Participants

	Number of participants	Interviewee
Group 1 = Higher EB X Higher TA	15	3
Group 2 = Higher EB X Lower TA	7	3
Group 3 = Lower EB X Higher TA	6	3
Group 4 = Lower EB X Lower TA	11	3

Before the interviews were conducted, the interview protocol was piloted with a teacher who did not participate in the study, and interview questions were updated, based on the feedback from the pilot. All the participants who provided contact information were invited for an interview as the next step. Those who responded to the invitation thereby joined the second phase of the study. Everyone who responded were interviewed.

Since the demographic information such as work experience was already collected in the scales (See Appendix G and H), the researcher had access to this information during the interviews. Meetings were held online via the Zoom platform and took nearly 20 to 30 minutes for each participant.

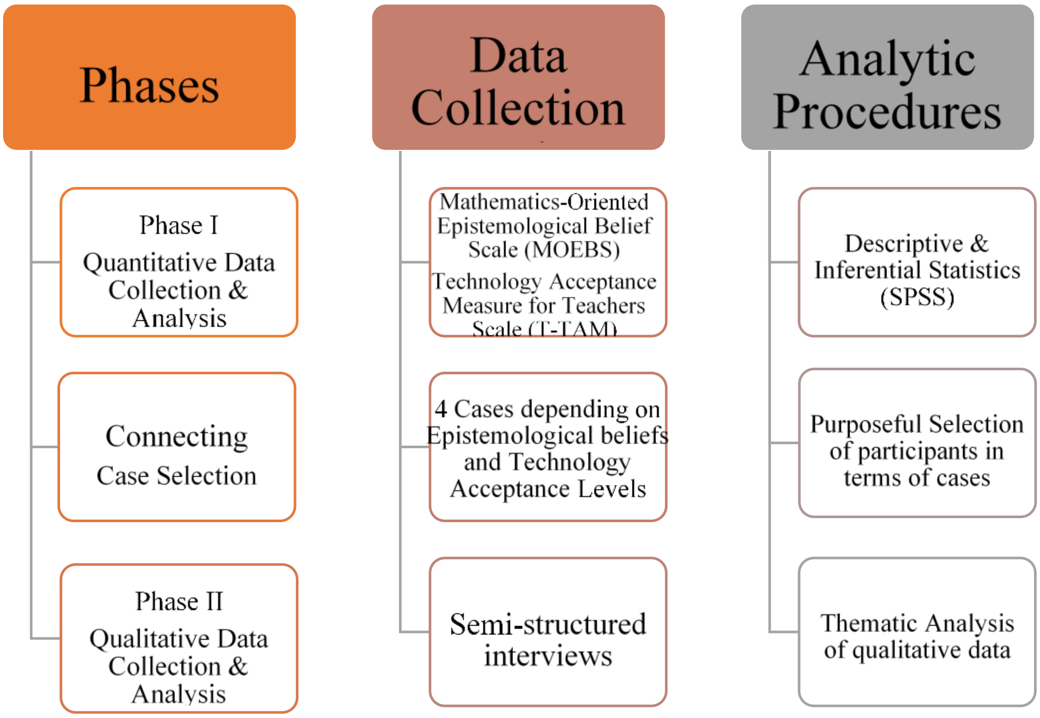

Figure 3. Procedure of the current study

3.5 Data analysis

3.5.1 Quantitative analysis

Quantitative data collected through the two scales was used for descriptive and statistical analysis, performed in IBM SPSS 25. Instead of the participant names, numbers were given to each participant as P1, P2, etc. The normality of the data was checked first for the Mathematics-Oriented Epistemological Beliefs (MOEBS) and Technology Acceptance Measure for Teachers (T-TAM) scales. The Shapiro-Wilk statistic test was used since the sample size was smaller than 50. Even if the MOEBS scores were distributed normally, the T-TAM scores were not, so a nonparametric test was used. Spearman's Rho test was conducted and the mean scores of the MOEBS and the T-TAM were compared. Also, the mean scores from both scales were used to create case groups and invite participants for an interview.

3.5.2 Qualitative analysis

The qualitative data collected through a semi-structured interview protocol was analyzed using thematic analysis, aligned with the qualitative research paradigm (Braun & Clarke, 2006; Creswell & Plano Clark 2011; Miller et al 2014). In addition to the themes and codes that emerged from the data, the stages of concern and levels of integration in the Concerns-Based adoption model (CBAM) was used in coding the interview data (George et al 2006).

The first step was the transcription of the audio-recorded interviews. Transcribing helped to get familiarized with the data before starting coding. Transcribed files were uploaded to MAXQDA software package which is used for qualitative and mixed method studies. The thematic analysis was used and the six steps were followed proposed by Braun and Clarke (2021). These steps were familiarization, coding, generating themes, reviewing themes, defining and naming themes and writing up. While coding, some phrases referred to multiple codes so those were reviewed a couple of times. In this situation, MAXQDA program enables to see all phrases of the same code in another window so there was no confusion. On the other hand, some phrases specifically referred to one code and fit the stages of CBAM. Paraphrasing was not used during the coding and organizing the themes process.

During data analysis, the steps proposed by Miles, Huberman, and Saldana (2014) were followed to reorganize data (reduction and editing of data), presentation of data (systematic presentation with charts, themes, etc.), and formatting and verification of results.

The issues of validity and reliability was addressed within the qualitative paradigm. In order to achieve trustworthiness, credibility, and rigor several strategies were employed. The researcher studied the themes that emerged through prolonged engagement, as data analysis and writing up the results was extended over 7 months (Creswell & Poth, 2018). This provided to go through a "verification step of reviewing the data for discrepancies, overstatements or errors" (Braun & Clarke, 2019, p. 289)

In an effort to triangulate the data, the themes that emerged from the interviews were compared to the factors identified in the two surveys used during the quantitative stage of the research, and the resemblances were noted, if detected. This provided an opportunity to strengthen internal validity (Brevik et al 2018) by referring to the theories underlying the surveys. The reliability of coding was addressed by the involvement of a critical peer, who helped establish intercoder agreement. Member checking was not possible, due to reasons mentioned in Braun & Clarke (2019).

To establish the reliability of coding 25% of the interview data was coded by a critical peer using the coding scheme provided. The critical peer was a mathematics teacher and also a graduate student in the Educational Technology program. An online meeting was held with the critical peer to explain the meaning of the codes and to demonstrate how to code in the MAXQDA program. 94 codes out of 112 coded by the critical peer matched that of the researcher's, which meant that agreement was 83,93%.

The methodology and the results were then presented to an experienced researcher in the field, who was not involved in data collection or analysis, to enact a process of external audit (Creswell & Poth, 2018). This provided a thorough constructive critique of the research.

CHAPTER 4

RESULTS

In this chapter, both quantitative findings from MOEBS and T-TAM scales and qualitative findings from semi-structured interviews are reported.

4.1 The mathematics-oriented epistemological beliefs scale and technology acceptance measure for teachers scale

Research question 1: "How do the middle school math teachers' epistemological beliefs about math relate to their emergency remote teaching (ERT) experiences during the Covid-19 pandemic?" and research question 1a: "To what extend do the middle school math teachers' mathematics-oriented epistemological belief scores overlap with their scores in TAM scale, if at all?" Both MOEBS and T-TAM results are given below. The normality of MOEBS data was checked first. Shapiro-Wilk statistic is used since the sample is less than 50. Based on the Shapiro-Wilk statistic results, (see Table 5), epistemological beliefs scores with skewness of -.311 (SE = 0.388) and kurtosis of -.428 (SE = 0.759) are normally distributed. Two outliers were removed from both the scales' data so the sample size became 37.

Table 5. Tests of Normality of MOEBS

	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
MOEBS	.109	37	.200*	.972	37	.456

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

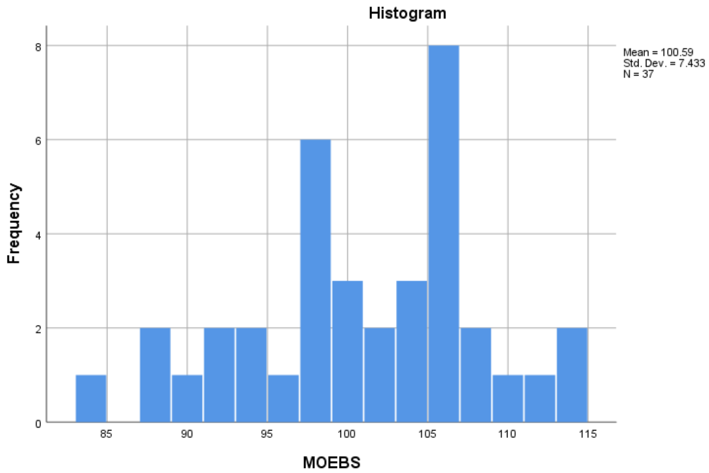

Figure 4. Histogram of MOEBS scores

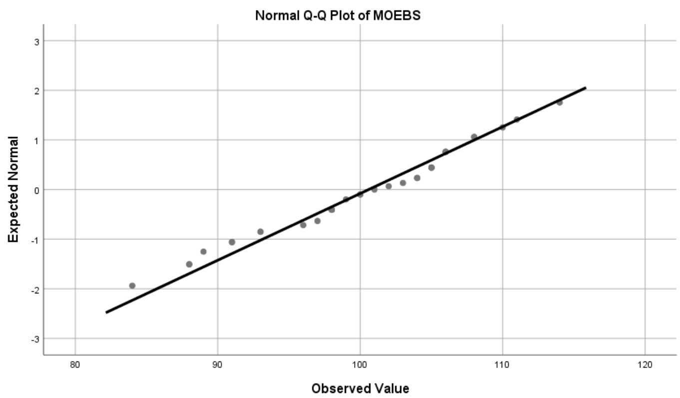

Figure 5. Q-Q plot of MOEBS

The mathematics-oriented epistemological beliefs scores were between 27 to 135 and the mean score of participants was 100,59. The minimum and maximum scores possible for each factor was 10 and 50 for BLDE and BLDT, and 7 and 35 for BTOOT.

Table 6. Descriptive Statistics for MOEBS

		MOEBS	BLDE	BLDT	BTOOT
N	Valid	37	37	37	37
	Missing	0	0	0	0
Mean		100.59	36.24	21.57	16.08
Std. Deviation		7.433	5.780	4.970	6.175

Table 6 shows the descriptive statistics of MOEBS scale. The histograms of MOEBS scores for each factor are showed in the figure 6.

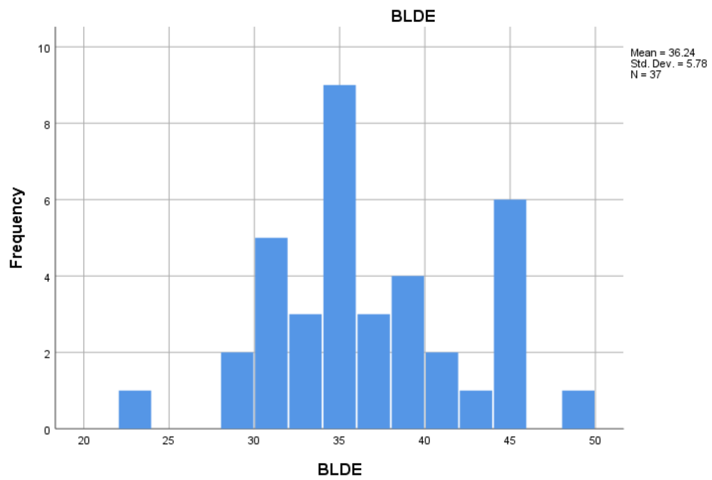

Figure 6. Histogram for the factor BLDE in MOEBS

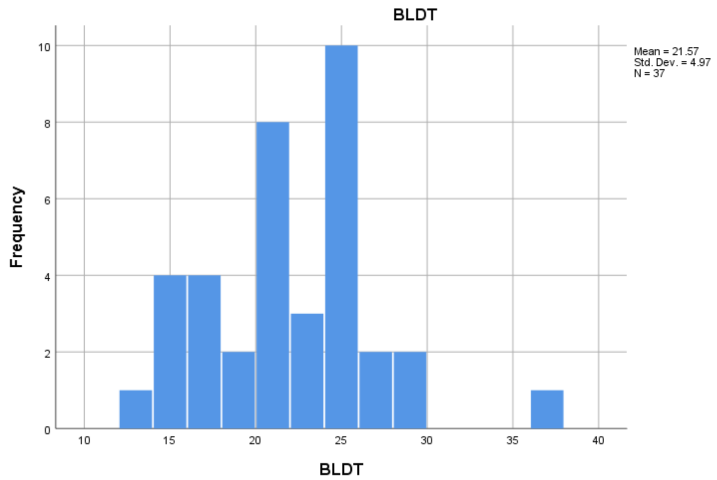

Figure 7. Histogram for the factor BLDT in MOEBS

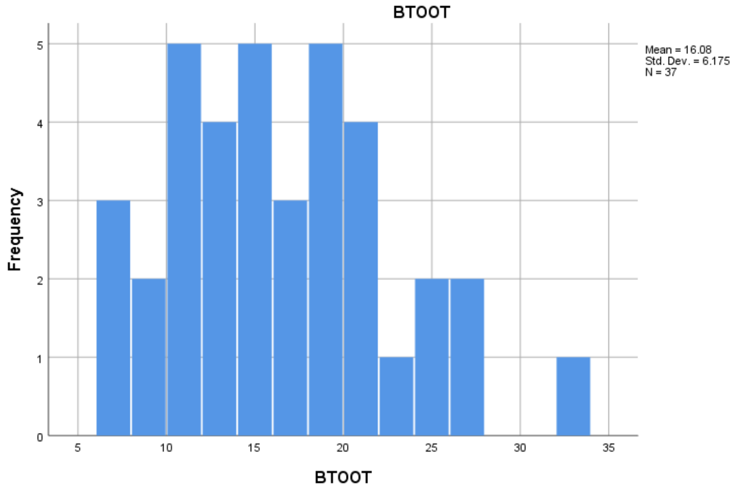

Figure 8. Histogram for the factor BTOOT in MOEBS

The results of the Shapiro-Wilk statistic, which assesses normality (see Table 7), showed that the T-TAM scores with skewness of -.704 (SE = 0.388) and kurtosis of -.159 (SE = 0.759) were not normally distributed. The same two outliers were removed from the both scales' data so the sample size became 37.

Table 7. Tests of Normality of T-TAM

	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
T-TAM	.127	37	.140	.934	37	.030

a. Lilliefors Significance Correction

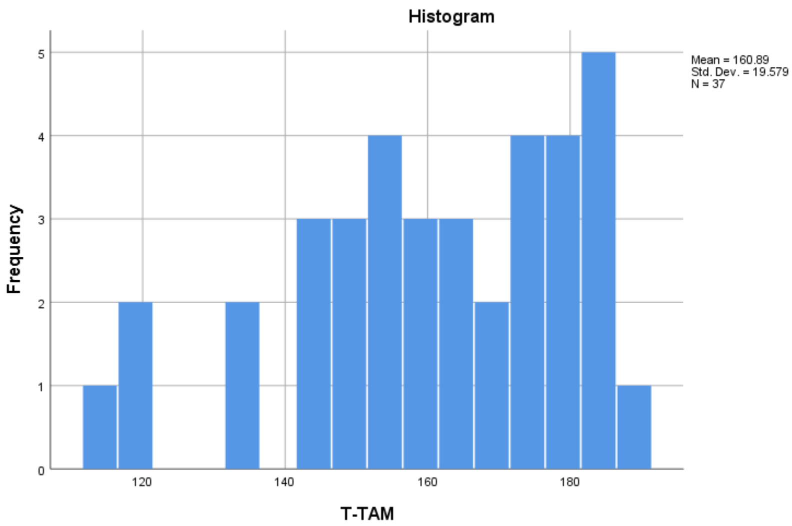

Figure 9. Histogram of T-TAM scores

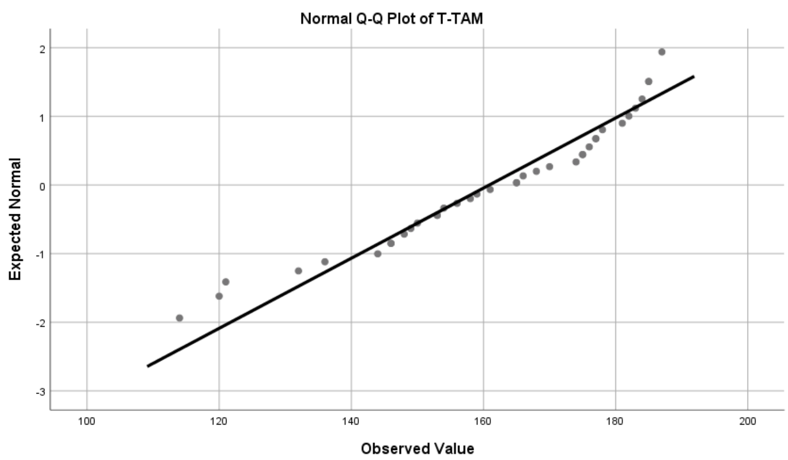

Figure 10. Q-Q plot of T-TAM scores

Table 8. Descriptive Statistics for T-TAM

N	Valid	37
	Missing	0
Mean		160.89
Std. Deviation		19.579

T-TAM scores were between 37 to 185 and the mean score was 160,89 (see Table 6)

Since one of the scale data was not normally distributed, nonparametric correlation analysis was used. Spearman's rank correlation was computed to assess the relationship between epistemological beliefs and technology acceptance. There was a positive but statistically not significant correlation between the two variables, r(37) = .20, p = .25.

Table 9. Correlations Between MOEBS and T-TAM

			MOEBS	T-TAM
Spearman's rho	MOEBS	Correlation Coefficient	1.000	.195
		Sig. (2-tailed)	.	.249
		N	37	37
	T-TAM	Correlation Coefficient	.195	1.000
		Sig. (2-tailed)	.249	.
		N	37	37

Also, the correlation between three factor scores of MOEBS and T-TAM scores was checked separately. There was a negative but statistically non-significant correlation between T-TAM and beliefs that learning depends on talent (BLDT), r(37) = .-24, p = .15, and between beliefs that there is only one truth (BTOOT), r(37) = .-03, p = .86. Lastly, there was a positive but not statistically significant correlation between T-TAM and beliefs that learning depends on effort (BLDE), r(37) = .11, p = .50. Both of the factors that were reverse coded in the MOEBS scale, had negative correlation results with TAM scores, while correlation between BLDE factor and TAM scores was positive, however, none were statistically significant.

Table 10. Correlations Between T-TAM and MOEBS Factors

			BLDT	BTOOT	BLDE	T-TAM
Spearman's rho	BLDT	Correlation Coefficient	1.000	.011	.108	-.242
		Sig. (2-tailed)	.	.948	.525	.148
		N	37	37	37	37
	BTOOT	Correlation Coefficient	.011	1.000	.577**	-.031
		Sig. (2-tailed)	.948	.	.000	.857
		N	37	37	37	37
	BLDE	Correlation Coefficient	.108	.577**	1.000	.112
		Sig. (2-tailed)	.525	.000	.	.509
		N	37	37	37	37
	T-TAM	Correlation Coefficient	-.242	-.031	.112	1.000
		Sig. (2-tailed)	.148	.857	.509	.
		N	37	37	37	37

4.2 Findings based on interview data

The demographic information of the interviewee are listed in the Table 11 below. The majority were new in the profession, with an average work experience of 3,75 years. Ten of the 12 interviewees were female, and 25% worked in a private middle school, 66,67% in public middle school and 8,34% in public imam hatip middle school. Lastly, all the interviewees graduated from the department of elementary mathematics teaching program.

Table 11. Demographic Characteristics of the Interviewee

Participant numbers	Case Group	Graduated faculty/department	School type	Gender	Work experience (years)
P1	1	Department of elementary mathematics teaching	Public middle school	Female	3
P2	4	Department of elementary mathematics teaching	Public middle school	Female	3
P3	3	Department of elementary mathematics teaching	Private middle school	Female	4
P6	1	Department of elementary mathematics teaching	Private middle school	Female	3
P7	1	Department of elementary mathematics teaching	Public middle school	Female	1
P8	4	Department of elementary mathematics teaching	Public middle school	Female	2
P11	2	Department of elementary mathematics teaching	Public middle school	Male	8
P19	2	Department of elementary mathematics teaching	Public middle school	Female	2
P21	3	Department of elementary mathematics teaching	Private middle school	Female	3
P22	4	Department of elementary mathematics teaching	Public middle school	Female	3
P26	2	Department of elementary mathematics teaching	Public imam hatip middle school	Female	6
P28	3	Department of elementary mathematics teaching	Public middle school	Male	7

The findings from the interview data were structured by organizing themes, and codes based on the dimensions addressed in the research questions. Table 12 shows these dimensions, themes, and the codes with their frequency numbers in parentheses. There are 4 themes which are in-service training, epistemological beliefs, technology, emergency remote teaching, experience, and teachers' needs. Under the dimensions, there are 12 themes and 49 codes, which emerged from the data, except for the 6 stages of concern What the dimensions and themes mean will be explained briefly.

Table 12. Interview Data: Themes and Related Codes Based on the Dimensions Researched

Dimensions	Themes	Codes
Epistemological Beliefs (37)	Change in mathematics teaching (9)	Change in teaching practice (5), No change in teaching practice (4)
	Change in beliefs (8)	No change in beliefs (6), Change in beliefs (2)
	Teaching & learning Math (20)	Visualization needed in teaching math (7), teaching math is hard (3), teaching should be step by step (2), games make learning math fun (3), BLDE (4), BTOOT (1)
Technology (151)	Stages of Concern (88)	Stage 0 (1), Stage 1 (6), Stage 2 (15), Stage 3 (17), Stage 4 (20), Stage 5 (15), Stage 6 (14)
	Technology skills & integration (37)	discovered and used new tools (16), positive change in using technology (11), perceived enjoyment of use (10)
	Future techuse (37) (behavioral intention)	Balanced technology use in the future (5), Continue using technology in teaching in the future (21)
ERT teaching experience (100)	Advantages (26)	Content-rich education (12), saving of time (11), Education anytime/anywhere (2), comfortable environment for introverted students (1)
	Disadvantages (59)	Lack of monitoring (11), lack of eye contact (8), learning loss (6), absenteeism (6), technical difficulties (6), decrease in the average student's performance (4), not being in the physical classroom (3), inability to take notes (3), inability to perform kinesthetic activities (3), inability to teach effectively (2), lack of social learning (2), lack of importance of lesson (2), distractibility (1), fatigue (1), decrease in literacy skills (1)
	Pandemic effect (15)	Perceived positive change of attitude towards using technology in teaching (9), Perceived negative change of attitude towards using technology (1), no change in attitude towards use technology (5)
Teachers' needs (20)	In-service Training Access to resources	Instructional design for remote teaching, and creating online content (5), Available platforms and tools for distance education (6), Differentiated training based on grade level and field of teaching (2) Need for more content (3), Free subscription for applications (4)

Epistemological Beliefs dimension includes three themes. Change in mathematics teaching refers to the perceived changes in the teachers' thoughts of their own teaching practice. Change in beliefs refers to the teachers own beliefs about teaching math, and lastly, "teaching & learning math" refers what teachers think about how mathematics should be taught. These codes include: visualization needed in teaching math, teaching should be step by step, games are important for teaching math because learning should be fun, teaching mathematics is hard, learning it depends on effort (BLDE) and lastly, mathematics is certain because there is one truth (BTOOT). These codes emerged from the data, including the last two, which were possible to label BLDE and BTOOT, as they matched these two factors from the MOEBS surprisingly well.

The technology dimension included Stages of Concern, which came from the CBAM framework, technology skills & integration, and future technology use, or behavioral intention, to borrow a term from the TAM factors. The Stages included 88 codes out of 151 codes in the technology dimension. The number of codes were high for Stages of Concern, because as the CBAM was used to structure the interviews and analysis, each phrase was analyzed in terms of Stages of Concern, and therefore some of the Stage codes overlapped with other codes. Stage 2, 3 and 4 were the most frequent stages of concern in the data. The technology skills & integration theme included 37 codes. Discovering new tools refers to all applications and websites that teachers newly found. Perceived enjoyment of use, again from TAM, refers to teachers' enjoyment of the use of graphics tablet and pen tablet. Technology skills and positive change in using technology refers to the development of teachers' ability to use online platforms for teaching and learning. For example, P2 said that,

> It has been good in terms of professionalization. For example, I learned screen sharing later, after the 10th or 15th lesson. I asked the students. How do I block the students' messaging during the lesson, how do I turn them off, how do I send a message. I didn't know any of these at first, I learned a lot as I used it. The last lesson I did from Zoom was much better than the first one. (P2)

The last theme was intention for technology usage in the future with 37 codes, which matched the behavioral intention in TAM. There are two codes, balanced technology use in the future and continue using technology in teaching in the future. One of the participants said for balanced technology use as,

> I'm trying to go in a balanced way, let's not be too dependent on technology and let's not get disconnected. Online assignments/projects for students will continue. (P22)

The codes in two of the dimensions, namely, technology integration, and future use emerged from the data, and as in the Epistemological Beliefs theme, matched two of the factors in the scale used during the quantitative phase of the study.

The Emergency Remote Teaching dimension has three themes, advantages, disadvantages, and the "pandemic effect." Advantages are 26 codes and includes codes such as online lessons as comfortable environments for introverted students, education anytime anywhere, accessible content-rich education for everyone, and saving time. Disadvantages were 59 codes out of 100, including learning loss, decrease in literacy skills, decrease in student achievement and engagement, not being in the physical classroom and having social habits, distractibility of technology, inability to teach effectively, students' inability to take notes, inability to perform kinesthetic activities together, lack of eye contact, lack of social learning, lack of monitoring, absenteeism of students, disengagement, which the teachers expressed as not caring about lessons or taking lessons seriously, technical difficulties, and online fatigue. Pandemic effect is the third theme, 15 codes which includes teachers' assessment of changes in their own perspective on the use of teaching with technology due to their ERT experiences. This theme was coded into perceived positive change in attitude towards use, and perceived negative change (as one teacher said her attitude "got worse," because of concerns regarding effectives due to insufficient infrastructure), and no change in attitude towards use of technology. While the participants usually gave only one answer to the question containing this theme, one participant stated that his attitude towards use both changed positively and remained unchanged. He said that,

> I saw that I could show mathematics with more fun and from different perspectives through distance education. I saw that I could be more active and what I could use. In this way, my attitude has changed positively. (P28)

He also added,

> I think distance education has also affected us badly. Previously, I was trying to solve questions by connecting the tablet to the smart board, and I was already using technology actively. As I said, as long as the students are active, face-to-face or distance education, it doesn't matter. I think education will be provided. I used to think like this before ERT and I still think like that. (P28)

According to the participant, his attitude was already positive and continues to be increasingly positive.

Teachers' needs refers to what teachers said they needed before and during their ERT practices. Two main themes emerged in this dimension: in-service training needs, and access to resources and tools. In-service training needs included instructional design of an online lesson, how to plan and create online content before the lessons. Available platforms and tools for distance education includes the need for training both for the applications the teachers were expected to use, and digital resources available online, i.e., web-based and mobile applications for teaching and learning. The code “differentiated teacher training” refers to the need for customized training based on subject (field of teaching) and grade level (elementary/middle/high school). Some applications had limited use and needed subscriptions so teachers mentioned that subscriptions should be given by schools in “access to resources”. The code “need for more content” refers to resources (websites and online applications) made available by the Ministry of Education for all students.

4.2.1 Findings based on epistemological beliefs

Research question 1b: “To what extent do their epistemological beliefs relate to the teachers’ views of mathematics instruction in teaching remotely?”

The participants who underlined the learning loss during the ERT process were mostly the ones who had higher scores of epistemological beliefs. Also, they pointed out having access to education anytime and anywhere as an advantage of ERT. Group 1 and 2 which had more sophisticated beliefs, were concerned more about the learning processes. Learning loss, social needs, lack of kinesthetic activities were examples mentioned. Groups 3 and 4 also talked about these concerns, but these were not the ones that stood out among all the concerns they mentioned. Therefore, these concerns, which could be associated with sophisticated beliefs, did not represent the majority for Groups 3 and 4 (see Table 13).

Table 13. Findings of Interview Data About ERT Based on MOEBS Scores

	Higher scores of MOEBS		Lower scores of MOEBS	
	Group 1 (P1, P6,P7)	Group 2 (P11, P19,P26)	Group 3 (P3, P21, P28)	Group 4 (P2, P8,P22)
Advantages of ERT				
Saving time	+	+	+	+
Rich content	+		+	+
Discovering new tools/applications	+		+	+
Comfortable environment for introverted students		+		
Education at anytime from anywhere		+		
Students are more responsible of their own learning			+	
Disadvantages of ERT				
Absenteeism	+	+	+	+
Lack of monitoring	+	+	+	+
Learning loss	+	+	+	+
Social needs	+	+	+	+
Tiring for teachers	+			
No kinesthetic exercises	+	+	+	
Lack of technical infrastructure		+		+
Students didn't take note		+		+
Not taking online lessons seriously		+		+
Lack of social learning		+		+
Lecturing was not efficient		+		
Mobile phone usage is raised			+	
Distractibility			+	

Additionally, the participants who said that teaching mathematics was hard whether face to face or online, were all from the groups of lower scores of epistemological beliefs (Group 3 and 4). The ones who mentioned about learning as a process and depending on effort, were the ones who had more sophisticated beliefs (Group 1 and 2) (see Table 14).

Table 14. Themes Common Among Groups

Common themes	Epistemological beliefs		Technology acceptance levels	
	higher	lower	higher	lower
	Group1,2	Group3,4	Group1,3	Group 2,4
Importance of social learning				+
Not taking online lessons seriously				+
Lack of technical infrastructure				+
Education at anytime from anywhere	+			
Teaching math is hard		+		
Teaching needs to be fun with games			+	

Members of Group 1 mentioned that teaching mathematics should be step by step and required solving problems. Their explanations about these two codes were indications of beliefs that learning depended on effort which was a factor of epistemological beliefs. BLDE was the factor that showed higher sophisticated beliefs, and the participants in this group were also the ones who had higher MOEBS scores.

Members of Group 2, who scored higher on the epistemological beliefs scale, pointed out that lessons were not efficient without being in the same class, having eye contact, and kinesthetic activities. They believed that middle school students were not old enough to take responsibility for their own learning in remote teaching. P19, a participant from Group 2 pointed out that

> There was not much activity/group-based work in distance education. If I would start group work, they might have connection problems and also, they wouldn't be able to produce concrete products.

And she added:

> Before this experience, I thought that online education could only be done at universities. In fact, I think it is not suitable for the middle school level right now. It may be for those who have awareness, but not every student is at the same level of consciousness, a certain level is required.

Another participant of this group (P11) indicated:

> If you ask whether it is more effective face-to-face or remotely, of course face-to-face is better because we can have eye-contact with student and get their attention more easily.

The participants in this group also underscored the effort needed for learning. Their common concerns were about the difficulties to spend this effort remotely. P11 added:

> For example, the student still hasn't been able to get over the comfort of Zoom or any other platform. Many students don't even take notes right now. Maybe Zoom also made the student a little lazy.

The participants in Group 3, who scored lower in MOEBS, differed in their assessment of teaching math generally from that of the participants in Group 1, who had scored higher in MOEBS. The participants in Group 3 indicated that teaching math was a hard job whether online or face to face, as P21 pointed out:

> In my opinion, teaching math is very difficult. I think we put too much effort on it. Whether face-to-face or remotely.

Similarly, P28 from Group 3 said:

> Mathematics is a very hard subject. Especially in terms of preparing lessons. When we are separated physically, we cannot motivate children much which makes teaching mathematics passive. That's why teaching becomes more difficult.

These findings are consistent with the results from the MOEBS, as they had lower scores among all the participants. Their concerns were more about learning math rather than technology.

Group 4, who scored lower in MOEBS, had similarities with Group 3 regarding epistemological beliefs and differences regarding perspectives/concerns on technology. The participants in Group 3 had pointed out that teaching mathematics was hard, while Group 4 participants pointed out the difficulty of teaching math over video-conferencing, in P22's words: "Mathematics is too abstract to learn remotely." Another participant from Group 4, P2 also mentioned:

> Some students never attended online lessons; others attended but didn't accept that it was a lesson. It seemed like a game to them. Therefore, education was not effective.

Based on these results, concerns of Group 4 participants were both about teaching effectiveness and technology. It can be an expected result since both their MOEBS and T-TAM scores were lower than other groups.

The research question 1c asked "To what extent did their emergency remote teaching experience affect their epistemological beliefs about math, if at all?"

Since the MOEBS was conducted after the ERT and not before it, there was one interview question that asked whether there was a change in the participants' epistemological beliefs after their ERT-related experiences. 33% of the interviewees said yes, there is a change, and 67% of them indicated no change (see Table 15).

Table 15. Perceived Change in Epistemological Beliefs

	Higher scores of MOEBS						Lower scores of MOEBS					
	Group 1			Group 2			Group 3			Group 4		
	P1	P6	P7	P11	P19	P26	P3	P21	P28	P2	P8	P22
No change	+	+		+		+		+	+	+	+	
There is a change			+		+		+					+

4.2.2 Middle school math teachers' ERT experience

Research question 2: "What are the middle school math teachers' thoughts about their emergency remote teaching (ERT) experiences during the Covid-19 pandemic?"

In the Responses from Individual Participants table (see Appendix M), the findings from individual participants are represented, based on their responses during the interviews. Looking at the table, one of the most striking keywords is using enriched e-books that have explanations, interactive math questions, pop-up quizzes etc. Teachers were able to use it on Zoom platform and send some parts to students. Another frequent finding was as a reaction to ERT, 58,33% of interviewees were content with their experiences of ERT in certain ways, while 25% said that it was a bad experience. One of them mentioned that it was hard to adapt as a teacher and also trying to help students to adapt was even harder. Also, as can be seen in the table (see Appendix M), disadvantages of ERT were listed by the teachers more than the advantages.

In the Table 16 below, the teachers' thoughts about the positive aspects of ERT is represented based on their interview responses. The most frequently mentioned advantages were accessible rich content based on topics, saving time during the lessons and discovering new tools. As an example, for those, one of the participants mentioned about the tools she used for different purposes. She said,

> There were Google's drive, Gmail, meet, documents, slides, we actually tried to use them all. Our priority here is easy access, easy to follow by everyone, Google Classroom in the same way. Mathematically, you know, we've already used Geogebra a lot. We used Quizzy, Nearpod, Kahoot, Padlet, Mentimeter a lot. Sometimes we wanted to teach lessons in the form of Flipped Classroom, and then we used to send the information via EdPuzzle beforehand, put a video between them and understand whether the students were watching or not. It was an important tool for us. We even got it licensed later. We always used them as tools, we didn't have time to create something new by ourselves. We also used more available tools for students to understand mathematics better, to visualize it, to get feedback from them, and to evaluate before and after the lesson in the form of quizzes or exitcards. Google form was one of them, good for evaluation. (P21)

For saving time, another participant said,

> When I was teaching on the board, it would take me 2-3 minutes to open the smart board or put the question on the board. When I use pdf or ebook in Zoom, it comes to me by clicking. For example, Zoom helped me a lot in terms of time. (P11)

Table 16. Thoughts About Advantages of ERT

Advantages of ERT	P1	P2	P3	P6	P7	P8	P11	P19	P21	P22	P26	P28
Saving time	+	+			+		+		+	+		
Rich content	+				+	+		+	+		+	+
Discovering new tools/applications	+	+		+					+			
Opportunity for introverted students							+					
Education anytime anywhere								+				
Students are more responsible of their own learning			+									

4.2.3 Epistemological belief and technology acceptance vis-a-vis ERT experience

Research question 2a: “How do the middle school math teachers’ technology acceptance levels relate to their emergency remote teaching (ERT) experiences during the Covid-19 pandemic?”

Research question 2b: “How are the teachers' technology acceptance levels related to their views of math instruction in remote teaching?”

In Table 17 below, findings based on thoughts and concerns about ERT and what the teachers were doing most during this time are listed. The case groups of the study are used for grouping.

Table 17. Findings Based on Thoughts and Concerns About ERT

Participants	Thoughts about ERT	Concerns	What were they doing most?
Group 1	- Content with the ERT experience and see advantages of online education - Willingness to use technology were always high, ERT was a good experience and will continue to use online tools in classrooms - Discovered many tools/applications and still continue to use in class, nice to experience ERT	- Learning how to use platforms, what kinds of mathematics contents are proper for middle school students - Needed support for payments of applications' premium/pro accounts - Learning how to use platforms, how to handle probable problems	Using enriched e-book and some videos from YouTube, writing with graphic tablet, different websites for different purposes, online games
Group 2	-No usage of technology before ERT but now including to lessons. -ERT was bad experience. Students couldn't take responsibility of learning -ERT was hard both for students and teachers. -lecturing was not efficient	- Concerns about how to teach online without being together, - - how to communicate and get students interest to the lesson, - realized everything depends on willingness to learn whether online or face to face. - Didn't know how to use platforms, - No information about online contents, - Can't reach/find contents for specific needs, - cannot be able to create new content	Using enriched e-books, writing with graphic tablet, different websites for different purposes
Group 3	Fastly adapted to ERT, nice to experience and continue to use online tools in classrooms - Teaching math is hard whether face to face or online, ERT was good experience to see and use different tools for specific topics - Willingness to use technology were always high, ERT was a good opportunity to see new tools and will continue to use online tools in classrooms	- Looking for better tools/applications to use for specific needs of lesson plans - No concern because of IT department's helps and provide differentiated guidance for each subject teacher - Can't reach/find contents for specific needs, - cannot be able to create new content	Writing with graphic tablet, different websites for different purposes Using enriched e-books, online games
Group 4	- Hard to adapt, trying students to adapt was harder -Online tools are good and still continue to use in class but ERT was bad experience. -Distance education cannot be enough for learning, -too many restrictions -No usage of technology before ERT but now including to lessons. -Balanced usage should continue -Hard to be a teacher of ERT	- Unhappy to be not prepared - Can't reach/find contents for specific needs, cannot be able to create new content, - no plan for distance education and no revision of curriculum. - Didn't know how to use platforms, - No information about online contents	Using different websites for different purposes -online games, writing with graphic tablet, -Using enriched e-book and some videos from Eba

There were different concerns about teaching remotely and these concerns are reported here based on the stages of concern in the CBAM model. For example, the participants' comments such as "I didn't know how to use online platforms," or no information about online contents were classified as stage 0. Such a concern was expressed by the participants from Group 4. The participants in this group had lower technology acceptance scores. Their stages of concern were also lower than Group 1 and 3.

Looking for better tools/applications to use for specific needs in lesson plans indicated Stage 4. This concern was indicated by the participants from Group 3, who had higher technology acceptance scores than Group 2 and 4. When data is matched with the stages of concerns, Stage 0 includes 1 interviewee, Stage 1 has 4, Stage 2 has 10, Stage 3 has 10, Stage 4 has 10, Stage 5 has 9 and Stage 6 has 8 interviewees. (See Table 18 below)

Table 18. Number of Interviewees Involved in Stages of Concern

	Interviewee
Stage 0	1
Stage 1	4
Stage 2	10
Stage 3	10
Stage 4	10
Stage 5	9
Stage 6	8

The reason for the high numbers in each stage is because the same people may have different stages of concerns about different issues. In general, Stage 2, 3 and 4 has more data than the other stages. Also, 80% of the codes in Stage 0 and 1 were from Group 2 and 4 interviewees. 60% of the codes in Stage 5 and 6 were from the Group 1 and 3 interviewees. Since the groups were formed based on T-TAM scores, it showed that higher stages of concern may have a relation with higher technology acceptance levels. In addition to these, the data showed that the same teacher might be at a lower stage of concern regarding a specific issue, but at a higher stage of concern regarding another issue. The participant, P7 provides one such example. She said “she would consider researching educational technologies before ERT, but she had never done a detailed search.” (P7) which puts her at Stage 1. However, in response to the question about criticizing used platform with colleagues, she answered:

> I got a chance to talk to a science teacher towards the end of ERT, for example, I didn't know there was a coding game on mathplayground. We learned while we were talking, I said maybe it can be used in the Information Technologies class. He said, "Oh, maybe." I didn't know beforehand, that there was such a coding game. (P7)

This is a quite sophisticated response and it corresponds to Stage 5, as this teacher was leading the discussion and evaluating educational technology tools with her colleague. Another example for the different concern stages of the same teacher is from P2. She said:

> Although I have not found a technology tool myself, if someone who used it would say that they liked it, I am positively affected. I take a more moderate approach because a technology that is never used seems riskier. (P2)

This is an attribute of Stage 2 as she entertained thoughts about starting to use a new technology. However, the same teacher also said,

> The platform we used was Zoom. We were connecting to zoom via eba. I wouldn't even consider switching to anything else because it provided everything I wanted. Students could be assigned to groups; they could take notes on the whiteboard. They could share their own screens. The host had many features to handle the class. I wouldn't have thought of switching to a new platform as more features hadn't occurred to me.

This quotation was about her action to switching to a new technology which referred to Stage 5.

This data showed that, the thoughts and behavioral concerns of the individual may be at different stages of concerns.

In addition to the stages of concerns, the data showed that the ones who mentioned about teaching math with games and having fun were all from the groups of higher technology acceptance levels (Group 1 and 3). Online games or quiz applications with timers used for competition were among the examples given. Also, the participants with higher technology acceptance levels pointed out that their perspective to technology was positive before the ERT experience and helped them during this process. This perspective remained positive and did not turn negative even if problems occurred. The concerns they mentioned were not about technical issues but more about searching for better tools/ways for teaching remotely and how to develop themselves for better usage of technology.

In contrast, the participants with lower technology acceptance levels (Group 2 and 4) commonly pointed out the improvement in their technology usage as a result of their having to teach remotely. In addition to the technical issues, they underlined not being in the same class or physical environment and the lack of social learning as disadvantages. Another most common finding was the lack of monitoring students, mentioned by 75% of the interviewees. They underlined that they could not see what students were doing because cameras were turned off. P19 mentioned that:

> Even if I say let's do it, I cannot follow what is happening on the other side of the screen.

As P11 also pointed out:

> The student attended the class but did they listen, follow to the lesson? Was it effective for them? Is the student really there? They seem to be online but maybe playing on the phone? Are they watching TV at the same time? Or is it their mother or father watching the lesson instead of them?

So, lack of monitoring seems to have triggered many other concerns and assumptions by the teachers.

The participants in Group 1, who had higher scores in both MOEBS and T-TAM scales, called themselves "technology lovers," and reported that they enjoyed teaching remotely. They mentioned people they followed on social media and/or the Web to learn more about new technologies for teaching and also wanted to have premium accounts for the applications they used in lessons. Similar to other three groups, they mentioned saving time, rich content and discovering new tools or applications as the positive aspects of the ERT experience for them. Also, members of Group 1 were the ones who talked about searching for new tools in online forums or from other colleagues. P7, an interviewee in Group 1, explained:

> I saw the websites that can be used at a meeting held by a teacher on Zoom. She was a successful teacher. I heard a website there, and many others. Took a screenshot. Then I looked at their content. Since I don't know English, I was translating first. Then I typed what I search and found out sites like Mathplaygound or Xpmatematik.

Group 2 consisted of the participants who had a higher MOEBS score and lower T-TAM score than those in Group 1 and 3. Participants from Group 2 indicated little experience with technology and could not imagine how to conduct remote teaching by themselves until they did it. They pointed out that lessons were not efficient, not being in the same class, having no eye contact, and no kinesthetic activities. Also, they were the ones who mentioned about the lack of technical infrastructure as a disadvantage of ERT. P19 said that:

> My school is in one of the areas where the internet is not accessible. Students do not have internet access in their village. Most students could not attend, a maximum of 4-5 came from 20 people.

And also, P11 added:

> We couldn't reach Eba several times during the pandemic process. We have already discussed this with our colleagues. It had been quite an agenda. I haven't had any other issues other than the access issue. It was the lack of infrastructure.

Their sophisticated epistemological beliefs and lower technology acceptance levels were compatible with their concerns about teaching and learning math remotely. On the other hand, there was an interviewee who mentioned that ERT was a comfortable environment for introverted students, that it can be advantageous for children who are hesitant to ask for a voice or who have difficulty in adapting in the classroom environment. He stated that those who attended the remote lessons, demanding more right to speak, because they were listening to the lesson with their cameras turned off. He said:

> The student who does not want to make eye contact with the teacher in the classroom or who hesitates to speak may have become a little more comfortable now. In terms of learning, in terms of speaking, in terms of participation in the lesson, it may have given some students such an advantage. (P11)

Group 3 consisted of the participants who have lower scores of MOEBS and higher score of T-TAM. The participants in Group 3 had similar opinions about technology as the participants in Group 1. They enjoyed experiencing remote teaching and wanted to know more about how to create a tool and how to design content by themselves. They were open to learn and use different new technologies like members of Group 1. P26 mentioned that:

> We handled the introductions of the programs among ourselves. How to enter or how to use. But the material on the Eba or Morpa did not satisfy me. I would like to create the material myself. The teacher should be able to design himself, I wish there was training for this.

An interviewee from Group 3 mentioned that students were more responsible for their own learning. She said:

> I'll tell you the most useful thing in this process. This process made children of all levels more responsible. Currently we still use Google Classroom. At the same time, we have a system called Canvas that we also use. I still use it actively in class, I give homework there as well. The child does not have the opportunity to say "I did not see; I did not hear". There are also submission dates. We have now integrated it to face to face. He can't say he forgot my book at home because we have made the announcement. It needs to be adjusted accordingly. We pushed students to take a little more responsibility, it was useful. (P3)

This particular interviewee had higher scores of both MOEBS and T-TAM It can be said that her actions helped raise awareness of students' responsibility for their own learning via using technology in an effective way.

Group 4 consisted of the participants who had a lower score of MOEBS and lower score of T-TAM. Participants from Group 4 were focused on the lack of content for each topic they taught. Also, not being in the same room and the need for eye contact were highlighted in this group, too. P22 said that:

> The children were also constantly looking at the screen, I was not the interlocutor, it was actually the screen. We can't make eye contact.

Another participant said:

> The only difference from face to face is that you cannot touch the child, you are not with her. You cannot look into their eyes unless they turn on the camera. (P2)

The disadvantages they mentioned about ERT were mostly similar with Group 2, where the participants had scored lower on the T-TAM scale. These similarities seem to match T-TAM scores.

The findings regarding positive aspects and disadvantages of the teachers' ERT experience are summarized in terms of groups formed based on MOEBS and T-TAM scores in Table 19 and 20 below.

Table 19. Advantages of ERT Based on Groups

Advantages of ERT	**Group 1**	**Group 2**	**Group 3**	**Group 4**
Saving time	+	+	+	+
Rich content	+		+	+
Discovering new tools/applications	+		+	+
Comfortable environment for introverted students		+		
Education at anytime from anywhere		+		
Students are more responsible of their own learning			+	

When we look at the disadvantages in general, we see that the participants from each group mentioned the disadvantages. It is also seen that the participants in Group 2 and Group 4 mentioned disadvantages more frequently than Groups 1 and 3. Absenteeism, lack of monitoring, learning loss and social needs were common disadvantages addressed by individuals from all groups. Lack of technical infrastructure, students didn't take note, not taking online lessons seriously, lack of social learning and lecturing was not efficient were the ones mentioned only by participants from lower technology acceptance levels (Group 2 and 4). This is an important finding because it is seen that these two groups gave common answers according to their technology acceptance levels. We realize that there are disadvantages that all teachers realize, and that those with higher technology acceptance levels do not see as disadvantages, but those with lower technology acceptance levels see it as a disadvantage (See Table 20 below).

Table 20. Disadvantages of ERT Based on Groups

Disadvantages of ERT	**Group 1**	**Group 2**	**Group 3**	**Group 4**
Absenteeism	+	+	+	+
Lack of monitoring	+	+	+	+
Learning loss	+	+	+	+
Social needs	+	+	+	+
Tiring for teachers	+			
No kinesthetic exercises	+	+	+	
Lack of technical infrastructure		+		+
Students didn't take note		+		+
Not taking online lessons seriously		+		+
Lack of social learning		+		+
Lecturing was not efficient		+		
Mobile phone usage is raised			+	
Distractibility			+	

4.2.4 ERT's influence on technology acceptance

Research question 2c: "To what extent did their emergency remote teaching experience affect the participants' technology acceptance levels, if at all?"

There are several common findings that most of the interviewees mentioned. One of the common findings, mentioned by 83% of the interviewees, was the willingness to continue using technology in their practice, even after ERT was over. Whether they have lower or higher technology acceptance levels before the ERT experiences, participants indicated that their usage of technology will remain constant in different ways. Using the smartboard in class, and continuing to use online homework applications and online content tools even after face-to-face education started were examples in this category. Also, all of the teachers mentioned that their willingness to use technology came from having found new contents during this process. Some of them had newly encountered several applications, found them useful and decided to continue to use them. Some of them knew about or heard of these applications, but had no opportunity to use them before, but they liked using them during their ERT experience. 75% of the interviewees mentioned that using graphics tablet or iPad with pen were essential for teaching math. Writing numbers, operations and symbols were not easy with a mouse or touchpad so these tools were important necessities to conduct their lessons. These tools were the ones the teachers discovered based on the needs they recognized during ERT experiences. One of the interviewees pointed out:

> I feel like I've improved my lessons. I learned to use the EBA and Zoom platforms. After getting a graphic tablet, lessons started to be more effective. (P8)

Similarly, P11 also said;

> The most useful thing for me was the pen-type graphic tablet. I used it much. It's been very effective for me. Teaching over the phone was difficult. It is very comfortable when it is a pen tablet, as if I was giving a normal lecture. Would it be a little more difficult if it wasn't with a pen? Yes. The pen provided a plus feature.

And P3 added;

> We used iPad and pen especially for our branch, it was very necessary for mathematics. I've had no problems with these.

4.2.5 In-service training needs

Research question 3: "What macro design guidelines can be identified for a remotely accessible in-service support program based on the middle school math teachers' experiences of (post)ERT and the needs they have identified?"

In this section, findings based on the in-service training needs are explained. Firstly, introducing the platforms or programs used was the common need that the participants mentioned most frequently. Zoom, Google Meet, Microsoft Teams and Eba platforms were the ones used by the participants to conduct synchronous live lessons online, some of which they had never heard of, and some they had some familiarity with, but had not used before. They underlined that knowing how to use those platforms, text and drawing capabilities of the programs and how to troubleshoot were the main issues at the beginning of the ERT. Also, these tools did not have a Turkish language option, so the participants who did not speak English needed more help.

A second common need was guidance about what can be used in online lessons held over video-conferencing platforms. Participants from all four groups mentioned that they needed guidance about how to conduct an online lesson effectively. Their main concerns during the remote teaching semesters were finding out about which applications were more useful, how to find content for a specific topic, and what kinds of websites or YouTube channels and other video sources were appropriate for students. Another common finding was the need for differentiation of training based on the subject-matter taught, and the student age range they worked with. The participants underlined that the existing trainings were for all branch of teachers and the content was general but they needed more specific information for mathematics. P19 said,

> In-service training seminars/programs are about teaching and education in general. They do not provide separate training for the branches. We cannot access branch-based content. It is as if there is no innovation for mathematics teachers, the most basic information is always taught and the perception begins to form as if it continues. We have to discover it on our own. Branch-based support trainings should be created. I would like an education that shows the answers to questions such as what should a math teacher use, how can a Turkish teacher teach?

Also, one of the participants, P2, added the need of the differentiated trainings based on the student ages they work with. She said,

> …Even if it is divided into branches, middle and high school students want different things. The expectations of these students are not the same. Maybe there is not much gamification requirement for high school students, but it is needed in secondary school. In primary school, perhaps more attention-oriented things should be done, so in-service training appropriate for that age group should have been given. I think that there should be an education program for the age group and cognitive level of the student...

In addition, the need for guidance about instructional design and learning how to create content was mentioned by participants from Group 2 and Group 3. They pointed out that, when the existing contents such as videos, games or other applications available to the teachers are not appropriate for the learning goals or available in another language, the teacher should be able to create his/her own content for that lesson. There can be an optional teacher training for the ones who want to develop their technology skills.

Lastly, the participants from Group 3 and Group 4 pointed out that filling the gap of online contents and informing teachers about these online contents/applications and how to use them were needed. The lesson duration was shortened from 40 minutes to 30 minutes, but the curriculum was not updated, and the teachers had no experience in conducting online lessons, so they needed guidance to redesign lessons with fewer learning goals and for online delivery. They suggested providing educators an emergency pack including materials and recommendations about the new situation, as P8 said,

> …There had to be an appropriate plan for this situation. We would have used it in class if we had prepared an activity package that could come one after the other, such as interactive content suitable for weekly topics and the preparation questions for the high school exam. It would enrich the content. At that time, I felt a lack of it…

CHAPTER 5

DISCUSSION AND CONCLUSION

5.1 Discussion

This study investigated the relationship between middle school mathematics teachers' emergency remote teaching experiences during the Covid-19 pandemic in the 2020-21 school year and their mathematics oriented epistemological beliefs and technology acceptance levels. Epistemological beliefs and technology acceptance levels were examined quantitatively by collecting data via survey instruments. The ERT and post-ERT experience of teachers was examined qualitatively via interview data. The Concerns-Based Adoption Model was used as a lens to study the teachers' technology related experiences and needs through this challenging period of time. The interview questions were designed to identify the Stages of Concern each teacher was at or going through in their practice during this time. The quantitative data was collected and analyzed to plan and inform the qualitative data collection, and the findings from both were brought together to see how the ERT and post ERT experiences might relate to how teachers perceive their practice from the perspective of epistemological beliefs perspective on the one hand, and their technology acceptance, on the other.

The results from the survey showed that there was a positive but not statistically significant correlation between the mathematics-oriented epistemological beliefs and technology acceptance levels of middle school mathematics teachers. Since the sample size was not large enough to attain rigorous correlation results, this can be considered a preliminary finding implying a tendency in the relationship with teaching practice.

The findings also showed that quantitative data from the survey were consistent with the qualitative data in terms of epistemological beliefs. The participants' comments about teaching and learning math were consistent with their scores from relevant factors in the MOEBS scale. For example, those who scored higher on the MOEBS scale referred to how learning math required work and effort, which maps fully on the BLDE (belief that learning depends on effort) factor on the scale. On the other hand, the interviewees who pointed put the difficulty of math as a subject, which corresponded to the BTOOT (belief that there is only one truth) factor, scored lower on the MOEBS scale. Ilhan and Cetin (2013) stated that a higher score on BLDE indicated more sophisticated beliefs, while a BTOOT score indicated less sophisticated beliefs. As Olafson and Schraw (2010) pointed out, more sophisticated beliefs can be an indication of student-centered teaching practice. Similarly, in this study, the teachers who scored higher on MOEBS tended towards a more student-centered approach. As one participant from Group 1, with higher MOEBS scores, put it:

> I think students learn better by playing, especially in younger age levels, including middle school. Otherwise, they get bored, so games are effective. In some topics, we use a constructivist approach, for example decimals are one of such topics. The students can understand very easily (P6).

Since the MOEBS was conducted after the ERT and not before it, there is no information about the participants' MOEBS scores before their ERT experience. However, there was one interview question that asked about whether or not the participants' epistemological beliefs might have changed after their ERT-related experiences. 25% of the interviewees said yes, and 75% of them indicated no change. Even though this finding is based on self-report, it still sheds some light on how experiences may (or may not) change beliefs. It was expected that the interviewees were most likely to report no change, since beliefs are complex and changes are hard (Schommer, 1990), and are resistant to change as they come from early experiences (Kagan, 1992; Pajares 1992). That one fourth of the interviewees perceived a change in their beliefs can be an indication of how radical the ERT experience was for the teachers. It is also possible that while some of the teachers' epistemological beliefs had an influence on their ERT practice, this experience might not have caused changes in their beliefs

Raymond (1997), and later Boehle (2020), argued that teachers' beliefs were shaped by their experiences both as a student and a teacher It was also showed that instructional design decisions were influenced by contextual circumstances (Depaepe et al. 2016), which may have an influence on beliefs. As suggested by Beattie et al. (2022) ERT practices can be expected to be shaped by teachers' epistemological beliefs, but also these experiences might have affected beliefs, as underlined by Boehle (2020).

The ERT and post-ERT conditions provided a unique context to study the teachers' technology acceptance, since the circumstance were such that the teachers were bound to make use of digital technologies regardless of their levels of acceptance (TAM) or stages of concern (CBAM). Due to the pandemic circumstances, all teachers were forced to become technology users whether they felt that they were prepared or had the skills needed during this unusual time. Some researchers who studied teachers' technology integration, pointed out that teachers may not always act on their beliefs and opinions when it comes to integrating technology into their practice. (Belland, 2009; Chen, 2008). However, previous research was conducted under usual circumstances, but in the pandemic circumstances, the teachers had no choice, if they wanted to continue their practice.

Much research in the educational technology has been done about teachers' technology practice, and how they integrate technology into lesson design to make learning more effective (e.g., Loague, 2003; Inan & Lowther, 2010; Ertmer et al., 2012; Kayaduman & Delialioğlu, 2021). The findings of this study showed that the quantitative data from the T-TAM were consistent with the qualitative data from the interviews in terms of technology acceptance. For example, the participants with higher levels of technology acceptance described the ways they found new tools and integrated them into their lessons, as one of the participants pointed out:

> ERT was very good for me in terms of discovering new applications. The lessons I planned started to be different. I learned all of these websites when I started remote teaching (P6).

The focus of these participants was more on the effectiveness of technology. Also, they mentioned more about the advantages (58%) rather than the disadvantages (42%) of ERT. Based on the interview questions, their answers included the disadvantages but the main idea was how to turn an extremely difficult situation into effective remote teaching. As expected, the factors found in the T-TAM scale, such as "perceived ease of use" and "perceived usefulness of technology" were detectable in their phrases during the interviews. This is evident in the following quote from Participant 26:

> I used e-books. It gave the opportunity to write on them and when I clicked it, it shows the answer, it was easy for me. In my regular classes, I had not used these features, but I felt it was necessary for online lessons. So, I used it and saw the benefits (P26).

Another participant said:

> I bought an IPad and its pen. The pen was very sensitive. I was able to draw 3D and geometric shapes very easily (P28).

On the other hand, the teachers who scored lower in technology acceptance mentioned more about the disadvantages (59%) rather than the advantages (41%) of ERT. Similarly, the stages of concern based on CBAM were lower than the participants who had higher technology acceptance levels. Mentioning the disadvantages more than advantages was consistent with their lower stages of concerns that came through in the interview data.

Based on the Stages of Concern, the first two stages of concern (0 and 1) consisted of teachers in groups 2 and 4 (80%) who scored lower on T-TAM. This finding was consistent with findings from Kayaduman and Demirel (2019), who indicated that lower concern stages were more focused on the effects of the implementation on themselves, not the learning outcomes, or other aspects. One of the participants from Group 2 said:

> Probably some teachers used online lessons before the pandemic but it didn't interest me that much. I was thinking about such system, how it would be, how you could conduct a lesson when student is not next to you, and how you could communicate with students, and so on… (P11).

Another participant from Group 4 said:

> I know the simulations are good but I don't have enough technical knowledge to create one myself, and these are processes that take a long time (P2).

Also, they mentioned that technology is for reaching students online, and ERT is a period that will end eventually. Even so, 83,3% of all the interviewee said that they will continue to use technology regardless of their technology acceptance levels.

On the other hand, stages of 4, 5 and 6 consisted of individuals from Group 1 and 3 (68%) who scored higher on T-TAM. It was possible to see that their concerns were more about the learning outcomes rather than the effects of implementation on themselves. The other 32% of participants also had technology related concerns, even if their technology acceptance levels were higher, as was the case with the teachers in Ashrafzadeh and Sayadian (2015)'s study.

The findings showed that the teachers' concerns in this study were not concentrated at a single stage and were distributed across stages, but were more abundant at some stages like 2, 3 and 4. As reported in the Findings chapter that the same individuals were at different stages of concern might be due to the change in their thoughts at the beginning of the long ERT experience and at the end of this experience. It is possible that while concerns at the beginning of the process were mostly about their own use of technology tools, they may have been more learning-oriented towards the end. As it is given in the findings, one example for this situation mentioned by P2, she said:

> At first, I don't think I would have preferred online education, but after I got into online education, I decided that it would actually be more advantageous for mathematics teaching, after I get used to remote teaching. Because children did not have technological tools that they could use individually at school. For example, if everyone had a tablet at school, or even had a device that we could distribute to groups, and if we used it at school and took a step towards mathematics, I would prefer to use these technologies in face-to-face education. Therefore, the ERT process may have shown that the use of technology in mathematics teaching makes things easier and that students can learn more easily. (P2)

Kayaduman and Demirel (2019) who studied the concerns of first-time distance education instructors from different branches. They pointed out in their study that as the courses progressed in an online learning experience, the instructors are more concerned about the effects of distance education courses on their students. The example of P2 was representing the ERT influence on the concerns about a new technology used during remote teaching. Although she said that she would not prefer online education in the past, she expressed that she had a positive approach after the ERT experience. She said that while pre-ERT concerns were based on whether to use it (Stage 0 and 1), now it turned to using and focusing on its content (Stage 3). In fact, it is seen that the same participant evaluated the application she used (Stage 5) in her answer to a different question (pg. 70). Therefore, it is observed that the concerns continued to exist, but were changing. Now she was focusing not on how to use technology, but on its advantages and disadvantages in terms of learning outcomes. This is also an example of how concerns progress by level, from self-concerns to task and then to impact concerns as addressed in the CBAM model (see Figure 2). Acquiring and using graphic tablets/iPad pens was another instance of this. While the teachers were focused on conducting online lessons at the beginning of the process, they bought a new device for the needs they saw and improved their use. This is a step forward both to improve their own use and to improve students' learning. It is an important finding that shows that their concerns have turned into improving the quality of the lesson rather than conducting the lesson.

Some research stated that the low participation of students in distance education course activities may worry the instructors (Berigel, 2013; Thieman, 2008.) As mentioned in the findings chapter, 75% of the interviewees underlined the lack of monitoring, as the process of ERT continued, teachers’ concerns might have triggered by students’ low engagement to remote learning so it can be another point that affects the change of concerns in higher stages.

It is assumed that beliefs seem correlated with effective ways of teaching, and effective ways of teaching tend to be correlated with technology integration practices (Kim et al., 2013). Based on this, it may be expected to see a relation between the participants’ stages of concern, MOEBS, and T-TAM scores. The findings of this study showed a consistency between the concerns that participants mentioned and their scores from the surveys. Group 1 that included participants with higher

MOEBS and higher T-TAM scores, could be expected to have higher stages of concerns. The results showed that 32% of the codes from Stage 4, 5 and 6 were from the participants of Group 1. Since the participants were divided into 4 groups, it is an important rate that this ratio was higher than 25%. This is an important point because the people in Group 1 choose effort-based methods in mathematics teaching because they have more sophisticated epistemological beliefs, and they are also expected to have better relations with technology in teaching because their technology acceptance level is higher. When these two conditions come together, they have higher concern stages in the CBAM model, supporting the consistency of the findings.

From the perspectives discussed above, it is clear that teaching practice is a phenomenon that is affected by many factors. This study examined two of these factors. Priorities of individuals, daily routines or teaching habits can be changed in difficult situations. The needs surfaced based on the current situations. Based on the findings from the interview, it is not surprising that all teachers identified a need for in-service training, regardless of their stage of concern or technology acceptance score. Some of them needed technical support at the beginning while others needed advanced help for integrating technology to their lessons. Each of them had concerns at different stages and these stages could serve as data on which design decisions can be based when making decisions about the scope and content of the in-service training programs. Even if the schools returned to face-to-face classroom education, these needs stay valid for all teachers who participated in this study.

5.2 Implications for further research and practice

In this study, middle school teachers’ ERT practices were examined in terms of their mathematics-oriented epistemological beliefs and technology acceptance levels. As ERT was a practice during pandemic circumstances, further research can be conducted to study how the teachers’ beliefs and technology acceptance evolved as they switched back to teaching face-to-face in the classroom. The preliminary findings from this study may provide a launching pad for designing further research for teachers’ epistemological beliefs and technology acceptance levels to detect possible influences on their teaching practice. The changes in their stages of concern and the effects on their practice can be studied. In further research, epistemological beliefs for subjects other than mathematics can also be considered.

A contribution of this study was bringing together two areas of research, epistemological beliefs and technology acceptance, especially at a critical period of time, when technology was not a choice or a matter of teacher’s approach or skills, but an imperative for education around the world. For this reason, while it might be difficult to examine technology integration experiences of teachers with a weak connection to technology under normal conditions, it was possible to access these teachers’ views as well, since they were obliged to be part a wholesome “technology integration” imposed by the pandemic whether they were willing and able or not. It has been beneficial to study how teachers maintain education when circumstances warrant, and how that education is affected by individual factors, such as epistemological beliefs or technology acceptance

At the same time, it has been recognized that regardless of teachers' epistemological beliefs or technology acceptance levels, each individual teacher needed in-service training. It is necessary to offer support for the needs of each individual teacher at varied levels of concern. As Hall and Hord (2014) stated, training that support teachers before and during the process of adopting new technology can transform their concerns from individual-based to learning-based concern, which means a move from lower to higher stages of concern. For this reason, Ministry of Education, school principals or mentors should contribute to the development of teachers by organizing training that focus on the stage of concern where the teachers currently are. As seen in the findings, teachers made improvements by learning from their colleagues. When teachers are provided a collaborative working environment, they can more readily do this, as suggested by Hall and Hord (2014). The teachers' schedules and work environment should be arranged so that they can introduce the technologies they use to each other and explain how they use them. In a future emergency situation where teachers might be asked to teach remotely from home, it should be ensured that the acquired knowledge is transferred among the teachers and kept up-to-date so that the difficulties experienced at the first moment are not repeated.

For mathematics teachers in particular, it should be aimed to follow new representational tools and disseminate devices such as graphic tablets, which are critical for mathematics lessons. While following new technologies, information should be shared about both the web-based ones and the functions of the new devices which can be used for teaching.

5.3 Limitations of the study

The limitations of the study can be listed as follows.

The sample size was small, which might also have caused the quantitative results to be insignificant. Data collection was conducted right after the schools returned to face-to-face education and ERT came to an end. This also might impact the findings, since the teachers would have to rely on memory, even if still fresh, when they answered the interview questions. The timing of the study might also be a cause of small sample size, as teachers may suffer from online fatigue, and therefore may want to stay away from online meeting platforms, and therefore not respond to calls for participation.

The qualitative data included only interviews, and therefore shedding somewhat limited light on these teachers' experiences. It would help make the conclusions more robust had it been possible to conduct observations. However, since the focus of the study was the teacher's perspective, the two surveys and the interviews still provided relevant data given the research questions.

Lastly, criterion sampling, and not random sampling was used, since the study treated teachers with specific characteristics. However, it has been possible to interview only those teachers who had responded in the positive when calls for interview participation was sent, which may have resulted in the kind of limitations for research posed by self-selected participants.

APPENDIX A

THE MATHEMATICS-ORİENTED EPISTEMOLOGICAL BELIEF SCALE

(MOEBS) (TURKISH)

	Kesinlikle katılmıyorum (1)	Katılmıyorum (2)	Kararsızım (3)	Katılıyorum (4)	Kesinlikle katılıyorum (5)
1. Bir öğrencinin matematiği ne kadar iyi öğrenebileceği ne kadar çaba harcadığına bağlıdır.					
2. Ne kadar yetenekli olursanız olun, çaba harcamadan matematik alanında başarılı olamazsınız.					
3. Yalnızca çok çaba gösteren kişiler iyi bir matematikçi olabilirler.					
4. İnsanların matematik başarılarındaki farklılık gösterdikleri çabanın farklı olmasından kaynaklanmaktadır.					
5. Gerçekten çaba harcarsa her birey matematik öğrenebilir.					
6. Matematik alanındaki zor konuları yalnızca çok çaba sarf eden bireyler öğrenebilir.					
7. Matematik alanındaki bir konuyu hemen anlamayan bir öğrenci anlamak için çabalamayı sürdürmelidir.					
8. Matematik alanında çaba göstermeden bilgi sahibi olunamayacağını bilmek matematik alanında başarılı olabilmenin ilk adımıdır.					
9. Matematik alanındaki en başarılı insanlar en fazla çaba harcayan insanlardır.					
10. Doğru çalışma becerilerini öğrenmek bireyin matematik yeteneğini geliştirebilir.					
11.İnsanlar yeni şeyler öğrenebilirler ancak sahip oldukları matematik yeteneğini değiştiremezler.					
12. Matematik alanında başarılı olan insanlar doğuştan matematik yeteneğiyle dünyaya gelmiş olan kişilerdir.					
13. İnsanların çoğu erken yaşlardan itibaren matematik alanında başarılı olup olamayacaklarını bilirler.					

14. Bir matematik problemini birkaç dakika içinde çözemeyen bir öğrenci ne kadar çaba harcarsa harcasın muhtemelen problemi çözemeyecektir.					
15. Yalnızca matematik alanında yetenekli olan kişiler iyi bir matematikçi olabilirler.					
16. İnsanların matematik başarılarındaki farklılık matematik yeteneklerinin farklı olmasından kaynaklanmaktadır.					
17. Matematik alanındaki zor konuları, yalnızca matematik alanında yetenekli olan insanlar öğrenebilir.					
18. Matematik yeteneği olmayan bir öğrencinin matematik öğrenmek için çaba harcaması vakit kaybıdır.					
19. Ne kadar çabalarsanız çabalayın matematik alanındaki başarınızı bu alandaki yetenekleriniz belirler.					
20. Matematik alanında yetenekli olmayan bir öğrencinin bu alanda başarılı olabilmek için yapacak çok şeyi yoktur.					
21. Matematik alanında kuram (teori) haline gelmiş bir bilginin yanlış olması mümkün değildir.					
22. Matematik alanındaki konular tartışmaya açık değildir.					
23. Matematik alanındaki her konu hakkında yalnızca tek bir doğru vardır.					
24. Matematik alanındaki doğrular değişmezdir.					
25. Matematik alanında, bugün doğru olduğu düşünülen bir bilginin ilerleyen zamanlarda yanlış olduğu anlaşılabilir.					
26. Matematik alanındaki herhangi bir konu farklı bakış açılarıyla ele alınsa da o konuya ilişkin ancak tek bir doğru olabilir.					
27. Matematik alanında hakkında en fazla bilgiye sahip olunan konuların bile doğrulukları sorgulanabilir.					

APPENDIX B

THE MATHEMATICS-ORIENTED EPISTEMOLOGICAL BELIEF SCALE

(MOEBS)

	STRONGLY DISAGREE (1)	DISAGREE (2)	NEOTHER AGREE OR DISAGREE (3)	AGREE (4)	STRONGLY AGREE (5)
1. How well a student can learn math depends on how much effort he puts in.					
2. No matter how talented you are, you cannot succeed in mathematics without effort.					
3. Only people who try hard can become good mathematicians.					
4. The difference in people's math achievement is due to the difference in effort they show.					
5. Every individual can learn mathematics if he really puts in the effort.					
6. Only individuals who put a lot of effort can learn difficult topics in mathematics.					
7. A student who does not immediately understand a subject in the field of mathematics should continue to strive to understand it.					
8. Knowing that one cannot gain knowledge in the field of mathematics without making an effort is the first step to be successful in the field of mathematics.					
9. The most successful people in mathematics are the ones who put the most effort.					
10. Learning correct study skills can improve an individual's math ability.					
11.People can learn new things, but they cannot change their math ability.					
12. People who are successful in the field of mathematics are those who were born with innate mathematical ability.					

13. Most people know from an early age whether they can succeed in mathematics.					
14. A student who cannot solve a math problem in a few minutes will probably not be able to solve the problem no matter how hard he tries.					
15. Only people skilled in mathematics can become good mathematicians.					
16. The difference in people's mathematics achievement is due to their different mathematical abilities.					
17. Only people who are talented in mathematics can learn difficult subjects in mathematics.					
18. It is a waste of time for a student with no mathematical ability to spend effort to learn mathematics.					
19. No matter how hard you try, your success in mathematics is determined by your abilities in this field.					
20. A student who is not talented in mathematics does not have much to do to be successful in this field.					
21. It is not possible for a knowledge that has become a theory (theory) in the field of mathematics to be wrong.					
22. Topics in the field of mathematics are not open to discussion.					
23. There is only one truth about every subject in mathematics.					
24. The truths in the field of mathematics are immutable.					
25. In the field of mathematics, information that is thought to be true today may turn out to be false in the future.					
26. Although any subject in the field of mathematics is handled from different perspectives, there can be only one truth about that subject.					
27. The accuracy of even the subjects about which the most knowledge is available in the field of mathematics can be questioned.					

APPENDIX C

TECHNOLOGY ACCEPTANCE MEASURE FOR TEACHERS: T-TAM

(TURKISH)

BT: Bilişim Teknolojileri (bilgisayar, internet siteleri, eğitsel oyunlar, web tabanlı ve mobil uygulamalar, Cabri 3D gibi matematik yazılımları, videolar, podcast, mp3 gibi müzik dosyaları, vs)

	Kesinlikle katılmıyorum (1)	Katılmıyorum (2)	Kararsızım (3)	Katılıyorum (4)	Kesinlikle katılıyorum (5)
1. Derslerimde BT kullanmak performansımı arttırır.					
2. Derslerimde BT kullanmak işlerimi kolaylaştırır.					
3. Derslerimde BT kullanmak verimliliğimi arttırır.					
4. Derslerimde BT kullanmayı yararlı buluyorum.					
5. Derslerimde BT kullanmak benim için kolaydır.					
6. BT kullanımı, benim için kolaydır.					
7. Derslerimde BT kullanabilecek beceriye sahip olmak, benim için kolaydır.					
8. Derslerimde BT'yi kullanmak dersi daha eğlenceli ve ilginç yapıyor.					
9. Mesleğimde BT kullanmak beni mutlu ediyor.					
10. Derslerimde BTy'i kullanmak oldukça iyi bir fikirdir.					
11. BT kullanarak dersimi öğretmek hoşuma gidiyor.					
12. BT'yi sıklıkla kullanacağımı düşünüyorum.					
13. Gelecekte derslerimde BT kullanmayı plânlıyorum.					
14. BT kullanımını, meslektaşlarıma ısrarla tavsiye edeceğim.					

15. Bundan sonra da mesleğimde BT kullanmaya gayret edeceğim.					
16. Derslerimde BT sınıflarını (bilgisayar lab) ve araçlarını kullanırken zorlandığımda okulda rehberlik ve yardım alacağım kişiler vardır.					
17. BT kullanırken bir sorunla karşılaştığım anda kimden yardım alacağımı bilirim.					
18. BT kullanırken bir sorunla karşılaştığımda teknik destek alırım.					
19. İşimin, teknoloji kullanmamı gerektirecek yanlarından zevk alıyorum.					
20. Bilgisayarlarla çalışmak heyecan vericidir.					
21. BT kullanmayı seviyorum.					
22. BT kullanmak eğlencelidir.					
23. BT yi kullanabilecek bilgi ve beceriye sahibim.					
24. Biri bana bir kez nasıl yapıldığını gösterirse, derslerimde BT'yi kullanabilirim.					
25. BT kullanımı konusunda kendime güveniyorum.					
26. Yeni teknolojilerin kullanımını öğrenmeye çok zaman ayırmam gerekir.					
27. Bir işi BT kullanarak yapmak çok zaman alır.					
28. Yeni teknolojileri kullanmak benim için hep karmaşık olmuştur.					
29. BT'nin mesleğim ile ilgili olduğunu düşünüyorum.					
30. Mesleğimde BT'ye ihtiyacım olduğunu düşünüyorum.					
31. BT'nin mesleğim için önemli olduğunu düşünüyorum.					
32. BT kullanırken gergin olurum.					
33. Derslerimde BT kullanırken kendimi zorlanmış hissederim.					
34. BT kullanırken düzeltilemeyecek hatalar yapma ihtimalim beni tedirgin eder.					
35. Benden bilgi teknolojisi ürünlerini kullanmam beklenir.					
36. Düşüncelerine değer verdiğim öğretmenler, benim BT kullanma davranışımı onaylar.					
37. Benim için önemli olan pek çok öğretim elemanı /öğretmen /yönetici, bilgi teknolojisi ürünlerini kullanmam gerektiğini düşünüyor.					

APPENDIX D

TECHNOLOGY ACCEPTANCE MEASURE FOR TEACHERS: T-TAM

IT: Information Technologies (computer, websites, educational games, web-based and mobile applications, mathematics software such as Cabri 3D, videos, podcasts, music files such as mp3, etc.)

	STRONGLY DISAGREE(1)	DISAGREE (2)	NEOTHER AGREE OR DISAGREE (3)	AGREE (4)	STRONGLY AGREE (5)
1. Using IT in my lessons increases my performance.					
2. Using IT in my lessons makes my work easier.					
3. Using IT in my lessons increases my productivity.					
4. I find it useful to use IT in my lessons.					
5. It is easy for me to use IT in my lessons.					
6. IT is easy for me to use.					
7. It is easy for me to have the skills to use IT in my lessons.					
8. Using IT in my lessons makes the lesson more fun and interesting.					
9. Using IT in my job makes me happy.					
10. Using BTy in my lessons is a pretty good idea.					
11. I like to teach my lesson using IT.					
12. I think I will use IT often.					
13. I plan to use IT in my lessons in the future.					

14. I will strongly recommend the use of IT to my colleagues.					
15. From now on, I will try to use IT in my profession.					
16. When I have difficulties in using IT classes (computer lab) and tools in my classes, there are people at school who I can get guidance and help from.					
17. I know who to get help from when I encounter a problem while using IT.					
18. I get technical support when I encounter a problem while using IT.					
19. I enjoy the aspects of my job that require me to use technology.					
20. Working with computers is exciting.					
21. I like to use IT.					
22. IT is fun to use.					
23. I have the knowledge and skills to use IT.					
24. I can use IT in my lessons once someone shows me how it's done.					
25. I am confident in using IT.					
26. I need to spend a lot of time learning how to use new technologies.					
27. It takes a lot of time to do a job using IT.					
28. Using new technologies has always been complicated for me.					
29. I think IT is related to my profession.					
30. I think I need IT in my job.					
31. I think IT is important to my profession.					
32. I get nervous when using IT.					
33. I feel challenged when using IT in my classes.					
34. The possibility of making uncorrectable mistakes when using IT makes me nervous.					
35. I am expected to use information technology products.					
36. Teachers whose opinions I value approve of my ICT use behavior.					
37. Many lecturers / teachers / administrators who are important to me think that I should use information technology products.					

APPENDIX E

SEMI-STRUCTURED INTERVIEW QUESTIONS (TURKISH)

1. Uzaktan eğitim sürecinde Zoom, Eba gibi kullandığınız platformlar dışında başka hangi teknolojileri kullanıyorsunuz? Yararlandığınız bu teknolojileri nasıl seçtiniz? Hangi özelliği sizin için öncelikliydi?

2. Uzaktan eğitim sürecinde sizce hangi teknolojiler en etkili? Neden?

3. Son 3 haftada yaptığınız dersleri düşünün. Teknolojiyi entegre ettiğiniz bir ders oldu mu? Bu ders için yaptığınız hazırlık sürecinden söz eder misiniz?

4. Bu dersi planlarken sizi en çok ilgilendiren (ya da endişelendiren) ne oldu? (Teknolojik bir aksilik ihtimali mi, öğrencilerin nasıl karşılayacağı, vereceği tepkiler mi; harcanacak zaman mı?)

5. Ders nasıl gitti? İyi veya kötü gitmesine sebep olan neydi? Eğer eksikler vardı ise değiştirip dersi tekrar işleme şansınız oldu mu?

6. Uzaktan eğitim platformunu (Eba, vs) ilk kullanmaya başladığınız dersleri hatırlayın. Bu anlattığınız dersten farklı mıydı? Ne açıdan?

7. Uzaktan eğitim platformuyla ilgili bilginiz arttıkça kullanım şekliniz değişti mi? Değiştiyse nasıl bir değişim oldu? Derslerinize etkisi nasıldı?

8. Uzaktan eğitim sürecinde yeni görüp beğendiğiniz bir teknolojiyi en iyi nasıl öğrenirsiniz? (Birinin size detaylıca anlatması veya kendi başınıza incelemeniz, vs?)

9. Yeni bir teknolojiyle tanıştığınızda, o teknolojinin kullanıldığı bir dersi izlemek sizin kullanımınızı etkiler mi? Nasıl bir etkisi olur?

10. Dersleriniz için kullandığınız platformu meslektaşlarınızla değerlendirdiğiniz oldu mu? Olduysa nasıl bir kritik yaptınız, neleri eleştirdiniz?

11. Sizce öğrenciler matematiği en iyi nasıl öğreniyor? Hangi yöntemler daha çok işe yarıyor? Uzaktan eğitimde bu yöntemleri uyguladınız mı? Nasıl?

12. Derslerin yüz yüze değil de uzaktan eğitimle devam etmesi matematik öğretimi açısından nasıl değişti? Hangi açılardan daha avantajlı/dezavantajlı?

13. Kullandığınız platformla aynı işi yapan ama farklı bazı özellikleri olan yeni bir platforma geçiş yapmayı düşünür müsünüz? Neden?

14. Geçtiğimiz dönem ve bu dönem yaşadığınız uzaktan eğitim deneyimleriniz, Matematik branşına veya matematik öğretimine dair düşüncelerinizde bir değişim yarattı mı?

15. Pandemi döneminde yaşadığınız bu deneyimler sonucunda uzaktan eğitim veya eğitim teknolojisiyle ilgili ne düşünüyorsunuz? Bu süreçten önce ne düşünüyordunuz?

16. Uzaktan eğitim deneyiminizi düşündüğünüzde bu süreçte gerçekten size destek olabilecek hizmetiçi bir eğitim programında neler olmalı?

APPENDIX F

SEMI-STRUCTURED INTERVIEW QUESTIONS

1. What other technologies do you use in the ERT process, apart from the platforms you use such as Zoom and Eba? How did you choose these technologies that you use? Which feature was a priority for you?
2. Which technologies do you think are most effective in the ERT process? Why?
3. Think about the lessons you have taken in the last 3 weeks. Have you ever had a course where you integrated technology? Can you tell us about your preparation process for this course?
4. What concerned (or worried) you most when planning this lesson? (Is it the possibility of a technological setback, how students will respond, is it time to be wasted?)
5. How did the lesson go? What made it go good or bad? If there were any deficiencies, did you have the chance to change them and repeat the course?
6. Remember the lessons you first started using the distance education platform (Eba, etc.). Was this different from the lesson you taught? In what respect?
7. Has your usage pattern changed as your knowledge of the distance education platform increased? If so, how did it change? How did it affect your lessons?
8. How do you best learn a technology that you have just seen and liked during the ERT process? (Someone explaining it to you in detail or examining it on your own, etc.)
9. When you meet a new technology, does watching a lesson in which that technology is used affect your use? What effect does it have?
10. Have you ever evaluated the platform you use for your lessons with your colleagues? If so, what kind of criticism did you make, what did you criticize?
11. How do you think students learn mathematics best? Which methods work best? Have you applied these methods in ERT? How?
12. How has it changed in terms of mathematics teaching that the lessons are continued with ERT instead of face to face? In what ways is it more advantageous / disadvantageous?

13. Would you consider switching to a new platform that does the same job as the platform you are using but has some different features? Why?
14. Have your distance education experiences in the past term and this term changed your thinking about the branch of Mathematics or mathematics teaching?
15. What do you think about distance education or education technology as a result of these experiences you had during the pandemic period? What were you thinking before this process?
16. When you think about your ERT experience, what should be an in-service training program that can really support you in this process?

APPENDIX G

DEMOGRAPHIC INFORMATION (TURKISH)

1. **Adınız Soyadınız**

   ....

2. **Mezun olduğunuz fakülte/bölüm?**

   ....

3. **Çalıştığınız okul türü**

   İlkokul Ortaokul İmam Hatip Ortaokulu Özel okul Diğer…

4. **Meslekte kaçıncı yılınız?**

   ....

5. **Yaşınız**

   20-30 30-40 40-50 50-60 60 ve üzeri

6. **Uzaktan eğitim sürecinden önce hangi teknolojileri/uygulamaları kullanıyordunuz?**

   EBA Power Point Sunumları Kahoot Internetteki (ücretsiz) oyunlar

   Yayınevlerinin etkileşimli içerikleri Matematik yazılımları Diğer…

7. **Uzaktan eğitim sürecinde hangi uygulama ve platformları kullandınız?**

   EBA ZOOM WhatsApp grupları Teams Skype Kahoot Internetteki (ücretsiz) oyunlar

   Matematik yazılımları Diğer…

8. **Kullandığınız platformların güncel olmasına dikkat ediyor musunuz?**

   Evet Hayır

9. **Uzaktan eğitim sürecinde kullandığınız platformlar/ veya uygulamalarla ilgili size eğitim verildi mi?**

   Evet Hayır

10. Cevabınız Evet ise bu eğitimi kim(ler) düzenledi?

Okul müdürü/idaresi İl/İlçe Milli Eğitim Müdürlüğü Eğitim alanında çalışan vakıflar

Diğer vakıflar Özel sektör Üniversiteden öğretim üyeleri Diğer…

11. Uzaktan eğitim sürecinde teknoloji araçlarını kullanırken yardım gerektiğinde nereye başvurdunuz?

Okul müdürü/idaresi İl/İlçe Milli Eğitim Müdürlüğü Eğitim alanında çalışan vakıflar

Diğer vakıflar Özel sektör Meslektaşlar Okulun BT/Bilgisayar öğretmeni

Aile üyeleri veya yakın arkadaşlar Diğer…

12. Uzaktan eğitim deneyiminizi tek sözcükle anlatın deseler ne derdiniz?

....

13. Uzaktan eğitim sürecinde size mesleki açıdan gerçekten destek olabilecek bir hizmetiçi eğitim neleri barındırmalı?

Teknoloji becerilerinin gösterilmesi

Teknoloji becerilerinin bizzat deneyimlenmesi

Teknolojiye pedagojik yaklaşımlarla ilgili sunumlar

Teknolojiye pedagojik yaklaşımlar üzerine grup çalışmaları

Kuramsal çerçevelerle ilgili sunumlar

Etkili ders örnekleri

Etkili ders planları deposuna uzaktan erişim

Meslektaşlarla deneyim paylaşımı

Meslektaşlarla grup çalışması

Meslektaşlarla birlikte derslere hazırlık

Diğer…

APPENDIX H

DEMOGRAPHIC INFORMATION

1. Name and Surname?
....

2.Faculty/department you graduated from?
....

3.The type of school you study at?

Primary School   Secondary School   Imam Hatip Secondary School

Private School   Other…

4. What year are you in the profession?
....

5. Your age

20-30   30-40   40-50   50-60   60 and above

6. Which technologies/applications did you use before the ERT process?

EBA   Power Point Presentations   Kahoot   Online (free) games

Interactive contents of publishers   Mathematics software   More…

7. Which applications and platforms did you use during the ERT process?

EBA   ZOOM   WhatsApp groups   Teams   Skype   Kahoot

Games on the Internet (free)   Math software More…

8. Do you make sure that the platforms you use are up-to-date?
Yes   No

9. Have you been given training on the platforms/or applications you use during the ERT process?
Yes   No

10. If yes, who(s) organized this training?

School principal/administration
Provincial/District Directorate of National Education
Foundations working in the field of education Other foundations
Private sector Faculty members from the University Other…

11. Where did you apply when you needed help while using technology tools during the ERT process?

School principal/administration
Provincial/District Directorate of National Education
Foundations working in the field of education
Other foundations
Private sector
Colleagues
School IT/Computer teacher
Family members or close friends
More…

12. If you were asked to describe your distance education experience in one word, what would you say?
....

13. What should be included in an in-service training that can really support you professionally in the ERT process?

Demonstrating technology skills
Personal experience of technology skills
Presentations on pedagogical approaches to technology
Group work on pedagogical approaches to technology
Presentations on theoretical frameworks
Effective lesson examples
Remote access to effective lesson plans repository
Experience sharing with colleagues
Group work with colleagues
Preparation for lessons with colleagues
Other…

APPENDIX I

CONSENT FORM I - FOR SCALES (TURKISH)

Araştırmayı destekleyen kurum: Boğaziçi Üniversitesi

Araştırmanın adı: Matematik Öğretmenlerinin Epistemolojik İnançları ve Covid-19 Pandemisi Sırasında Acil Uzaktan Öğretim için Teknoloji Kabul Düzeyleri

Proje Yürütücüsü: Günizi Kartal **E-posta adresi:**

Telefonu:

Araştırmacının adı: Rumeysa Erol **E-posta adresi:**

Telefonu:

Sayın Öğretmenler,

Matematikle ilgili yaklaşımlar ve teknoloji kabul düzeyini Covid-19 küresel salgını sürecinde yaşadığımız uzaktan eğitim deneyimleri çerçevesinde yeniden incelemek amacıyla bilimsel bir araştırma yapıyorum. Bir Matematik öğretmeni olarak yürüttüğüm bu çalışmaya katılmayı kabul ederseniz çok memnun olurum.

Proje konusu: Bu araştırmada öğretmenlerin matematiğe dair epistemolojik inançlarının ve teknoloji kabul düzeylerinin pandemi sürecindeki uzaktan eğitim deneyimleriyle ilişkisini görmek ve bunun gibi zorlu süreçlerde öğretmenlerin ihtiyaç duyduğu mesleki desteği sağlayabilecek bir öğrenme platformu için model oluşturmak istiyorum.

Onam: Araştırmaya katılmayı kabul ettiğiniz takdirde matematiğe dair epistemolojik inançlarınız ve teknoloji kabul düzeylerinize ilişkin iki ankete cevap vermeniz istenecektir. Her bir anket yaklaşık 10 dk sürecektir. Anketler aracılığıyla elde edilen veriler istatistiksel olarak incelenecektir. Verileriniz araştırmacı tarafından gizli tutulacaktır. Katıldığınız takdirde çalışmanın herhangi bir aşamasında sebep göstermeden onayınızı çekebilirsiniz.

Araştırmanın size herhangi bir risk getirmesi kesinlikle beklenmiyor. Araştırma sonunda elde edilecek bilgilerin öğretmenlere verilecek hizmetiçi eğitimlere yön gösterici olması bekleniyor. Araştırma çerçevesinde ulaşılan sonuçlar eğitimle ilgili bilimsel konferanslarda sunulabilir, yayınlanabilir.

Araştırma projesi hakkında ek bilgi almak istediğiniz takdirde lütfen benimle ya da tez danışmanım Bilgisayar ve Öğretim Teknolojileri Bölümü Öğr. Üyesi Dr. Günizi

Kartal ile temasa geçiniz (e-posta: gunizi.kartal@boun.edu.tr, Adres: Boğaziçi Üniversitesi, ETA-B binası, Kuzey Kampüsü, 34342 Bebek, İstanbul).

Araştırmayla ilgili haklarınız konusunda Boğaziçi Üniversitesi Sosyal ve Beşeri Bilimler Yüksek Lisans ve Doktora Tezleri Etik İnceleme Komisyonu'na (SOBETİK) (sbe-ethics@boun.edu.tr) danışabilirsiniz.

Yukarıdaki açıklamaları okudum ve anladım. Çalışmaya katılmayı **kabul ediyorum**.

Katılımcı Adı-Soyadı: …………………………………..

İmzası:……………………………………………......

Tarih: ..../.........../............

APPENDIX J

CONSENT FORM I - FOR SCALES

Institution supporting the research: Boğaziçi University

Name of the Study: Mathematics Teachers' Epistemological Beliefs and Technology Acceptance in Emergency Remote Teaching during the Covid-19 Pandemic

Project Coordinator: Günizi Kartal E-mail address:

Telephone:

Researcher's name: Rumeysa Erol E-mail address:

Phone:

Dear Teachers,

I am conducting a scientific research in order to re-examine the approaches to mathematics and the level of technology acceptance within the framework of the ERT experiences we have experienced during the Covid-19 global epidemic. I would be very grateful if you would agree to participate in this study that I am conducting as a Mathematics teacher.

Project topic: In this research, I want to see the relationship between teachers' epistemological beliefs about mathematics and their level of technology acceptance with their experience of ERT during the pandemic process, and to create a model for a learning platform that can provide the professional support that teachers need in such challenging processes.

Consent: If you agree to participate in the research, you will be asked to answer two questionnaires about your epistemological beliefs about mathematics and your level of technology acceptance. Each survey will take approximately 10 minutes. The data obtained through surveys will be analyzed statistically. Your data will be kept confidential by the researcher. If you participate, you can withdraw your consent at any stage of the study without giving any reason.

The research is certainly not expected to pose any risks to you. It is expected that the information to be obtained at the end of the research will guide the in-service trainings to be given to the teachers. The results reached within the framework of the research can be presented and published in scientific conferences related to education.

If you would like to receive additional information about the research project, please contact me or my thesis advisor, Department of Computer and Instructional Technologies Lecturer. Member Please contact Gunizi Kartal (e-mail:

gunizi.kartal@boun.edu.tr, Address: Boğaziçi University, ETA-B building, North Campus, 34342 Bebek, Istanbul).

You can consult Boğaziçi University Social and Human Sciences Master's and Doctoral Thesis Ethics Review Committee (SOBETİK) (sbe-ethics@boun.edu.tr) regarding your rights regarding research.

I have read and understood the above explanations. I agree to participate in the study.

Participant Name-Surname: …………………………………..

Signature: ………………………………………………………..

Date: ..../.........../.............

APPENDIX K

CONSENT FORM II - FOR INTERVIEWS (TURKISH)

Araştırmayı destekleyen kurum: Boğaziçi Üniversitesi

Araştırmanın adı: Matematik Öğretmenlerinin Epistemolojik İnançları ve Covid-19 Pandemisi Sırasında Acil Uzaktan Öğretim için Teknoloji Kabul Düzeyleri

Proje Yürütücüsü: Günizi Kartal **E-posta adresi:**

Telefonu:

Araştırmacının adı: Rumeysa Erol **E-posta adresi:**

Telefonu:

Sayın Öğretmenler,

Matematikle ilgili yaklaşımlar ve teknoloji kabul düzeyini Covid-19 küresel salgını sürecinde yaşadığımız uzaktan eğitim deneyimleri çerçevesinde yeniden incelemek amacıyla bilimsel bir araştırma yapıyorum. Bir Matematik öğretmeni olarak yürüttüğüm bu çalışmaya katılmayı kabul ederseniz çok memnun olurum.

Proje konusu: Bu araştırmada öğretmenlerin matematiğe dair epistemolojik inançlarının ve teknoloji kabul düzeylerinin pandemi sürecindeki uzaktan eğitim deneyimleriyle ilişkisini görmek ve bunun gibi zorlu süreçlerde öğretmenlerin ihtiyaç duyduğu mesleki desteği sağlayabilecek bir öğrenme platformu için model oluşturmak istiyorum.

Onam: Araştırmanın bu bölümüne katılmayı kabul ettiğiniz takdirde, sizinle açık uçlu sorulardan oluşan bir görüşme yapacağım. Görüşme yaklaşık 20 dakika sürecek. Ayrıca veri analizi için gerekli olan demografik bilgiler içeren bir form doldurmanız istenecektir. Görüşme sırasında paylaştığınız bilgileri analiz edebilmem için görüşmeyi kayıt altına alacağım ve arzu ettiğiniz takdirde teyit için görüşme metnini size e-posta ile göndereceğim. Görüşme kaydı sadece benim erişimimde olacak ve araştırma bittiğinde tüm kayıtlar tamamen silinecek.

Çalışmaya katılmanız tamamen isteğe bağlıdır. Katılımcı bilgilerinin gizliliği esastır ve isminiz gizli tutulacaktır. Katıldığınız takdirde çalışmanın herhangi bir aşamasında sebep göstermeden onayınızı çekebilirsiniz. Araştırmanın size herhangi bir risk getirmesi kesinlikle beklenmiyor. Araştırma sonunda elde edilecek bilgilerin öğretmenlere verilecek hizmetiçi eğitimlere yön gösterici olması bekleniyor. Araştırma çerçevesinde ulaşılan sonuçlar eğitimle ilgili bilimsel konferanslarda sunulabilir, yayınlanabilir.

Araştırma projesi hakkında ek bilgi almak istediğiniz takdirde lütfen benimle ya da tez danışmanım Bilgisayar ve Öğretim Teknolojileri Bölümü Öğr. Üyesi Dr. Günizi Kartal ile temasa geçiniz (e-posta: gunizi.kartal@boun.edu.tr, Adres: Boğaziçi Üniversitesi, ETA-B binası, Kuzey Kampüsü, 34342 Bebek, İstanbul). Araştırmayla ilgili haklarınız konusunda Boğaziçi Üniversitesi Sosyal ve Beşeri Bilimler Yüksek Lisans ve Doktora Tezleri Etik İnceleme Komisyonu'na (SOBETİK) (sbe-ethics@boun.edu.tr) danışabilirsiniz.

Yukarıdaki açıklamaları okudum ve anladım. Çalışmaya katılmayı **kabul ediyorum**.

Görüşme sırasında **ses** kaydı yapılmasını onaylıyorum. □ Evet □ Hayır

Görüşme sırasında **video** kaydı yapılmasını onaylıyorum. □ Evet □ Hayır

Katılımcı Adı-Soyadı:…………………………………..

İmzası:…………………………………………….....

Tarih:........./.........../.............

APPENDIX L

CONSENT FORM II - FOR INTERVIEWS

Institution supporting the research: Boğaziçi University

Name of the Study: Mathematics Teachers' Epistemological Beliefs and Technology Acceptance in Emergency Remote Teaching during the Covid-19 Pandemic

Project Coordinator: Günizi Kartal E-mail address:

Telephone:

Researcher's name: Rumeysa Erol E-mail address:

Phone:

Dear Teachers,

I am conducting a scientific research in order to re-examine the approaches to mathematics and the level of technology acceptance within the framework of the ERT experiences we have experienced during the Covid-19 global epidemic. I would be very grateful if you would agree to participate in this study that I am conducting as a Mathematics teacher.

Project topic: In this research, I want to see the relationship between teachers' epistemological beliefs about mathematics and their level of technology acceptance with their experience of ERT during the pandemic process, and to create a model for a learning platform that can provide the professional support that teachers need in such challenging processes.

Consent: If you agree to participate in this part of the research, I will interview you with open-ended questions. The interview will take approximately 20 minutes. You will also be asked to fill out a form containing demographic information required for data analysis. I will record the interview so that I can analyze the information you shared during the interview and, if you wish, I will send you the interview text by e-mail for confirmation. The interview recording will only be available to me and all recordings will be completely deleted when the research is finished.

Your participation in the study is completely optional. Confidentiality of participant information is essential and your name will be kept confidential. If you participate, you can withdraw your consent at any stage of the study without giving any reason. The research is certainly not expected to pose any risks to you. It is expected that the information to be obtained at the end of the research will guide the in-service trainings to be given to the teachers. The results reached within the framework of the research can be presented and published in scientific conferences related to education.

If you would like to receive additional information about the research project, please contact me or my thesis advisor, Department of Computer and Instructional Technologies Lecturer. Member Please contact Gunizi Kartal (e-mail: gunizi.kartal@boun.edu.tr, Address: Boğaziçi University, ETA-B building, North Campus, 34342 Bebek, Istanbul).

You can consult Boğaziçi University Social and Human Sciences Master's and Doctoral Thesis Ethics Review Committee (SOBETİK) (sbe-ethics@boun.edu.tr) regarding your rights regarding research.

I have read and understood the above explanations. I agree to participate in the study.

I consent to audio recording during the call. □ Yes □ No

I consent to video recording during the call. □ Yes □ No

Participant Name-Surname:…………………………………..

Signature: ……………………………………………………..

Date:........./.........../............

APPENDIX M

RESPONSES FROM INDIVIDUAL PARTICIPANTS

Participants	Reaction to ERT	Concerns / Problems?	Advantages	Disadvantages	What were they doing most?
P1	Content with the ERT experience as an opportunity to see advantages of online education	how to use platforms, contents for middle school students	Rich content, saving time, discovering new tools/applications	Absenteeism, lack of monitoring, learning loss	Using enriched e-book and some videos from YouTube
P2	Hard to adapt, helping students to adapt was harder	Unhappy to be not prepared	saving time, discovering new tools/applications	Lack of technical infrastructure, absenteeism, not taking online lessons seriously, social needs (eye contact etc.)	Using enriched e-books, different websites for different purposes
P3	Fastly adapted to ERT, happy to experience, continue to use online tools in classrooms	Looking for better tools/applications for specific needs of lesson plans	Students are more responsible of their own learning,	lack of monitoring, social needs (eye contact, being together in the same class etc.), learning loss, mobile phone usage is raised,	Writing with graphic tablet, different websites for different purposes
P6	Content with the ERT experience, continue to use online tools in classrooms	Needed of applications' premium/pro accounts	discovering new tools/applications	social needs (being together in the same class etc.), lack of monitoring, learning loss	Writing with graphic tablet, different websites for different purposes, online games
P7	Content with the ERT experience Discovered many tools/applications, continue to use in classrooms	how to use platforms, how to handle problems	saving time, rich content	learning loss, tiring for teachers, no kinesthetic exercises	Writing with graphic tablet, Using enriched e-books, different websites for different purposes, online games
P8	Online tools are good and still continue to use in class but ERT was bad experience. Distance education cannot be enough for learning, too many restrictions, Hard to be a teacher during ERT	Can't reach/find contents that I specifically need and cannot be able to create myself, no plan for distance education and no revision of curriculum.	rich content	social needs (being together in the same class etc.), Lack of technical infrastructure, students didn't take note	Using enriched e-books, online games, writing with graphic tablet

Participants	Reaction to ERT	Concerns / Problems?	Advantages	Disadvantages	What were they doing most?
P11	No information before, Content with the ERT experience, liked to learn	Concerns about how to teach online without being together, how to communicate and get students interest to the lesson, realized everything depends on willingness to learn whether online or face to face.	saving time, Comfortable environment for introverted students	lack of monitoring, Lack of technical infrastructure, social needs (eye contact, being together in the same class etc.), learning loss, students didn't take note	Using enriched e-books, writing with graphic tablet
P19	ERT was bad experience both for students and teachers, students couldn't take responsibility of learning, they are too young for that consciousness.	Hard to learn features of platforms, no classification for teachers of different subjects, no guidance what can be used for lessons.	rich content, education at any time anywhere	Lack of technical infrastructure, absenteeism, lack of monitoring, no kinesthetic exercises, learning loss, not taking online lessons seriously, lack of social learning	writing with graphic tablet, different websites for different purposes
P21	Teaching math is hard whether face to face or online, ERT was good experience to see and use different tools for specific topics	No concern because of IT department's helps and provide differentiated guidance for each subject teacher	discovering new tools/applications, rich content, saving time	Distractibility, no kinesthetic exercises, learning loss	Using enriched e-books, different websites for different purposes, online games
P22	No usage of technology before ERT but it needs to be included to lessons. Balanced usage should continue	Didn't know how to use platforms, No information about online contents	saving time	Lack of technical infrastructure, social needs (eye contact, being together in the same class), lack of social learning, lack of monitoring, learning loss	Using enriched e-book and some videos from Eba, writing with graphic tablet
P26	No usage of technology before ERT but now including to lessons.	Lecturing was not efficient, can't find contents that specifically needed, cannot be able to create new content	Rich content	Absenteeism, lack of monitoring, lecturing was not efficient	Using enriched e-books, different websites for different purposes
P28	Content with the ERT experience, good opportunity to see new tools, continue to use online tools in classrooms	Can't reach/find contents for specific needs, cannot be able to create new content	Rich content	lack of monitoring, Absenteeism, social needs (eye contact)	writing with graphic tablet, different websites for different purposes, online games

REFERENCES

Aldunate, R. & Nussbaum, M. (2013). Teacher adoption of technology. *Computers in Human Behavior, 29*(3), 519-524. https://doi.org/10.1016/j.chb.2012.10.017

Artigue, M. (2002). Learning mathematics in a CAS environment: The genesis of a reflection about instrumentation and the dialectics between technical and conceptual work. *International Journal of Computers for Mathematical Learning, 7,* 245–274. https://doi.org/10.1023/A:1022103903080

Ashrafzadeh, A. & Sayadian, S. (2015). University instructors' concerns and perceptions of technology integration. *Computers in Human Behavior, 49*, 62–73. https://doi.org/10.1016/j.chb.2015.01.071

Avargil, S., Shwartz, G., Herscovitz, O., & Dori, Y. J. (2017). The case of middle and high school chemistry teachers implementing technology: Using the concerns-based adoption model to assess change processes. *Chemistry Education Research and Practice (CERP), 18*, 214–232. https://doi.org/10.1039/C6RP00193A

Beattie M., Wilson C. & Hendry G. (2022). Learning from lockdown: Examining Scottish primary teachers' experiences of emergency remote teaching. *British Journal of Educational Studies*, *70*(2), 217-234. https://doi.org/10.1080/00071005.2021.1915958

Berigel, M. (2013). *Öğretim elemanlarının uzaktan eğitim ortamlarına uyum süreçlerinin incelenmesi [Investigating adoption of instructors to distance education environment]* (Doctoral dissertation). Retrieved from YÖK TEZ. (Order No. 344510).

Blömeke, S., Felbrich, A., Müller, C., Kaiser, G., & Lehmann, R. (2008). Effectiveness of teacher education. *ZDM, 40*(5), 719-734.

Boehle, M. (2020). *Personal epistemological beliefs and teaching practices: a case study of history teachers.* (UMI No. 27831460) [Doctoral Dissertation, Northern Illinois University]. Available from ProQuest Dissertations & Theses Global database.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*, 77-101.

Braun, V., & Clarke, V. (2019). Reflecting on reflexive thematic analysis. *Qualitative Research in Sport, Exercise and Health, 11,* 589-597. https://doi.org/10.1080/2159676X.2019.1628806

Braun, V., & Clarke, V. (2021). Can I use TA? Should I use TA? Should I not use TA? Comparing reflexive thematic analysis and other pattern-based qualitative analytic approaches. *Counseling and Psycho-therapy Research, 21*(1), 37–47. https://doi.org/10.1002/capr.12360

Brevik, L.M., Gunnulfsen, A.E. & Renzulli, J.S. (2018). Student teachers' practice and experience with differentiated instruction for students with higher learning potential. *Teaching and Teacher Education: An International Journal of Research and Studies, 71*(1), 34-45. Elsevier Ltd. Retrieved November 11, 2022 from https://www.learntechlib.org/p/201934/.

Bromme, R., Kienhues, D., & Stahl, E. (2008). Knowledge and epistemological beliefs: An intimate but complicate relationship. In M. S. Khine (Ed.), *Knowing, knowledge and beliefs: Epistemological studies across diverse cultures* (pp. 423–441). Springer Science + Business Media. https://doi.org/10.1007/978-1-4020-6596-5_20

Brousseau G. (1997). *Theory of didactical situations in mathematics. Didactique des mathématiques*, 1970 - 1990. Kluwer Academic Publishers: Dordrecht / Boston / London.

Brown, C. A., & Borko, H. (1992). Becoming a mathematics teacher. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning: A project of the National Council of Teachers of Mathematics* (pp. 209–239). Macmillan Publishing Co, Inc.

Buehl, M.M., Alexander, P.A., & Murphy, P. (2002). Beliefs about schooled knowledge: Domain specific or domain general. *Contemporary Educational Psychology, 27*, 415-449. https://doi.org/10.1006/ceps.2001.1103

Cicchetti, D. V. (1994). Guidelines, criteria, and rules of thumb for evaluating normed and standardized assessment instruments in psychology. *Psychological Assessment, 6*(4), 284–290. https://doi.org/10.1037/1040-3590.6.4.284

Changsri, N., Inprasitha, M., Pattanajak, A., & Changtong, K. (2012). A study of teachers' perceived beliefs regarding teaching practice. *Psychology, 3*, 346-351.

Chen, V., Sandford, A., LaGrone, M., Charbonneau, K., Kong, J., & Ragavaloo, S. (2022). An exploration of instructors' and students' perspectives on remote delivery of courses during the covid-19 pandemic. *British journal of educational technology: journal of the Council for Educational Technology, 53*(3), 512–533. https://doi.org/10.1111/bjet.13205

Cobo-Rendon, R., Lobos Peña, K., Mella-Norambuena, J., Cisternas San Martin, N., & Peña, F. (2021). Longitudinal analysis of teacher technology acceptance and its relationship to resource viewing and academic performance of college students during the covid-19 pandemic. *Sustainability, 13*(21), 12167. https://doi.org/10.3390/su132112167

Cooney, T. J., & Shealy, B. E. (1997). On understanding the structure of teachers_ beliefs and their relationship to change. In E. Fennema & B. S. Nelson (Eds.), *Mathematics teachers in transition* (pp.87–109). Mahwah, NJ: Erlbaum.

Creswell, J. W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (4th ed.). Boston, MA: Pearson.

Creswell, J.W. & Plano Clark, V.L. (2011) *Designing and Conducting Mixed Methods Research* (2nd ed.). Sage Publications, Los Angeles.

Creswell, J.W. & Poth, C.N. (2018) *Qualitative inquiry and research design choosing among five approaches* (4th ed.). Sage Publications, Inc., Thousand Oaks.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319–340. https://doi.org/10.2307/249008

Dele-Ajayi O., Fasae O.D. & Okoli, A. (2021). Teachers' concerns about integrating information and communication technologies in the classrooms. *PLoS one, 16*(5), e0249703. https://doi.org/10.1371/journal.pone.0249703

Deng, F., Chai, C. S., Tsai, C. C., & Lee, M. H. (2014). The relationships among Chinese practicing teachers' epistemic beliefs, pedagogical beliefs and their beliefs about the use of ICT. *Journal of Educational Technology & Society, 17*(2), 245-256.

Deryakulu, D. (2006). Epistemolojik inançlar. Y. Kuzgun & D. Deryakulu (Ed.) içinde, *Eğitimde bireysel farklılıklar* (ss. 261-289). Ankara: Nobel Yayın Dağıtım.

Depaepe, F., De Corte, E., Verschaffel, L. (2016). Mathematical epistemological beliefs: A review of the research literature. In Greene, J. A., Sandoval, W. A., Bråten, I. (Eds.), *Handbook of epistemic cognition* (pp. 147–164). New York, NY: Routledge.

Erdogan, A. (2010). Variables that affect math teacher candidates' intentions to integrate computer-assisted mathematics education (CAME). *Education, 131*(2), 295-305.

Ertmer, P. A., Ottenbreit-Leftwich, A. T., Sadik, O., Sendurur, E., & Sendurur, P. (2012). Teacher beliefs and technology integration practices: A critical relationship. *Computers & Education, 59*, 423–435. https://doi.org/10.1016/j.compedu.2012.02.001

Garaika, Helisia Margahana, (2020). Adoption of educational technology: Study on higher education. *International Journal of Management (IJM), 11*(1), 61–71. Available at SSRN: https://ssrn.com/abstract=3526805

George, A. A., Hall, G. E. & Stiegelbauer, S. M. (2006). *Measuring implementation in schools: The stages of concern questionnaire.* Austin, TX: Southwest Educational Development Laboratory.

Hall, G. E., & Hord, S. M. (2014). *Implementing change: Patterns, principles, and potholes* (4th ed.). Upper Saddle River, NJ: Pearson.

Hammarberg, K., Kirkman, M. & de Lacey, S. (2016). Qualitative research methods: When to use them and how to judge them. *Human Reproduction, 31*, 498-501. https://doi.org/10.1093/humrep/dev334

Haney, J., Czerniak, C., Lumpe, A., & Egan, V. (2002). From beliefs to actions: The beliefs and actions of teachers implementing change. *Journal of Science Teacher Education, 13*, 171- 187. https://doi.org/10.1023/A:1016565016116

Hao, Y. & Lee, KS. (2015). Teachers' concern about integrating Web 2.0 technologies and its relationship with teacher characteristics. *Computers in Human Behavior, 48,* 1–8. https://doi.org/10.1016/j.chb.2015.01.028

Hodges, C., Moore, S., Lockee, B., Trust, T, & Bond, A. (2020). The difference between emergency remote teaching and online learning. *Educause Review, 27.* https://er.educause.edu/articles/2020/3/the-difference-between-emergency-remote-teaching-and-online-learning

Hofer, B. & Pintrich, P. (1997). The development of epistemological theories: Beliefs about knowledge and knowing and their relation to learning. *Review of Educational Research, 67,* 88–140. https://doi.org/10.3102/00346543067001088

Huang, H. M., & Liaw, S. S. (2005). Exploring users' attitudes and intentions toward the web as a survey tool. *Computers in Human Behavior, 21,* 729–743.

Hughes, M. C., Henry, B. & Kushnick, M. (2020). Teaching during the pandemic? An opportunity to enhance curriculum. *Pedagogy in Health Promotion, 6*(4), 235–238. https://doi.org/10.1177/237337992095017

İlhan, M. & Çetin, B. (2013). Matematik odaklı epistemolojik inanç ölçeği (MOEİÖ): Geçerlik ve güvenirlik çalışması. *Kuramsal Eğitimbilim Dergisi, 6*(3), 359-388. doi: http://dx.doi.org/10.5578/keg.5952

Inan, F. A., & Lowther, D. L. (2010). Factors affecting technology integration in K-12 classrooms: A path model. *Educational Technology Research and Development, 58*(2), 137–154. https://doi.org/10.1007/s11423-009-9132-y

Joo, Y. J., Park, S., & Lim, E. (2018). Factors influencing preservice teachers' intention to use technology: TPACK, teacher self-efficacy, and technology acceptance model. *Journal of Educational Technology & Society, 21*(3), 48–59. http://www.jstor.org/stable/26458506

Kayaduman, H. & Delialioğlu, Ö. (2021). English language preservice teachers' stages of concern for Web 2.0 technology integration. *İnönü Üniversitesi Eğitim Fakültesi Dergisi, 22*(2), 1083-1114. https://doi.org/10.17679/inuefd.837412

Kayaduman, H., & Demirel, T. (2019). Investigating the concerns of first-time distance education instructors. *The International Review of Research in Open and Distributed Learning, 20*(5), 85-103. https://doi.org/10.19173/irrodl.v20i5.4467

Kim, C., Kim, M.K., Lee, C., Spector, J.M., & DeMeester, K. (2013). Teacher beliefs and technology integration. *Teaching and Teacher Education, 29*, 76-85. https://doi.org/10.1016/j.tate.2012.08.005

Koruyan, K., Meri-Yilan, S., & Karakaş, A. (2022). English teachers' beliefs and practices: A mixed methods study of 25 countries in the covid-19 pandemic. *Asian Journal of Distance Education, 17*(1), 182-204.

Lee, Y.-H., Hsieh, Y.-C., & Chen, Y.-H. (2013). An investigation of employees' use of e-learning systems: Applying the technology acceptance model. *Behavior & Information Technology, 32*(2), 173-189. https://doi.org/10.1080/0144929X.2011.577190

Leinhardt, G. (1989). Math lessons: A contrast of novice and expert competence. *Journal for Research in Mathematics Education, 20*(1), 52–75. https://doi.org/10.2307/749098

Li, B. (2021). Ready for online? Exploring EFL teachers' ICT acceptance and ICT literacy during covid-19 in Mainland China. *Journal of Educational Computing Research, 60*(1), 196–219. https://doi.org/10.1177/07356331211028934

Loague, A. (2003). *Beliefs and practices regarding technology: Influences on professional instructional practices*. The University of Alabama.

Meriam, S. B. (1998). *Qualitative research and case study applications in education. Revised and Expanded from "Case Study Research in Education."*. Jossey-Bass Publishers. Jossey-Bass Publishers, 350 Sansome St, San Francisco, CA 94104.

Merriam, S. B. (2002). *Qualitative research in practice: Examples for discussion and analysis*. San Francisco, CA: Jossey-Bass Publishers.

Milman, N. (2020, March 30). This is emergency remote teaching, not just online teaching [Web log post]. https://www.edweek.org/leadership/opinion-this-is-emergency-remote-teaching-not-just-online-teaching/2020/03?cmp=SOC-SHR-FB

Mishra, P. & Koehler, M.J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, *108*(6), 1017-1054. http://dx.doi.org/10.1111/j.1467-9620.2006.00684.x

Mitchener, C. P., & Anderson, R. D. (1989). Teachers' perspectives: Developing and implementing an STS curriculum. *Journal of Research in Science Teaching*, *26*(4), 351-369. https://doi.org/10.1002/tea.3660260407

Muis, K. R., Bendixen, L. D., & Haerle, F. C. (2006). Domain-generality and domain-specificity in personal epistemology research: Philosophical and empirical reflections in the development of a theoretical framework. *Educational Psychology Review, 18*(1), 3–54. https://doi.org/10.1007/s10648-006-9003-6

Muis, K. R., & Foy, M. J. (2010). The effects of teachers' beliefs on elementary students' beliefs, motivation, and achievement in mathematics. In L. D. Bendixen & F. C. Feucht (Eds.), *Personal epistemology in the classroom: Theory, research, and implications for practice* (pp. 435–469). Cambridge University Press. https://doi.org/10.1017/CBO9780511691904.014

Olafson, L., Schraw, G., & Vander Veldt, M. (2010). Consistency and development of teachers' epistemological and ontological world views. *Learning Environments Research*, *13*(3), 243–266. https://doi.org/10.1007/s10984-010-9078-3

Perry, W. G., Jr. (1968). *Patterns of development in thought and values of students in a liberal arts college: A validation of a scheme.* Cambridge, MA: Bureau of Study Counsel, Harvard University. (ERIC Document Reproduction Service No. ED 024315)

Peterson, E.G. & Cohen, J. (2019). A case for domain-specific curiosity in mathematics. *Educational Psychology Review, 31*, 807–832. https://doi.org/10.1007/s10648-019-09501-4

Rahmadı, I. F. (2021). Teachers' technology integration and distance learning adoption amidst the covid-19 crisis: A reflection for the optimistic future. *Online Journal of Distance Education, 22*(2), 26-41.

Raymond, A.M. (1997). Inconsistency between a beginning elementary school teacher's mathematics beliefs and teaching practice. *Journal for Research in Mathematics Education, 28*, 550-576. https://doi.org/10.2307/749691

Schoenfeld, A. H. (1992). Learning to think mathematically: Problem solving, metacognition, and sense making in mathematics. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 334–370). New York: Macmillan.

Schommer, M. (1990). Effects of beliefs about the nature of knowledge on comprehension. *Journal of Educational Psychology, 82*(3), 498–504. https://doi.org/10.1037/0022-0663.82.3.498

Schommer, M. (1993). Epistemological development and academic performance among secondary students. *Journal of Educational Psychology, 85*(3), 406–411. https://doi.org/10.1037/0022-0663.85.3.406

Schommer, M. (1998). The influence of age and education on epistemological beliefs. *British Journal of Educational Psychology, 68*(4), 551-562. https://doi.org/10.1111/j.2044-8279.1998.tb01311.x

Schommer-Aikins, M., Duell, O. K., & Hutter, R. (2005). Epistemological beliefs, mathematical problem-solving beliefs, and academic performance of middle school students. *The Elementary School Journal, 105*(3), 289–304. https://doi.org/10.1086/428745

Mumtaz, S. (2000). Factors affecting teachers' use of information and communications technology: A review of the literature. *Journal of Information Technology for Teacher Education, 9*(3), 319-342. https://doi.org/10.1080/14759390000200096

Shwartz, G., Avargil, S., Herscovitz, O. & Dori, Y. (2016). The case of middle and high school chemistry teachers implementing technology: Using the concerns-based adoption model to assess change processes. *Chemistry Education Research and Practice, 18.* https://doi.org/10.1039/C6RP00193A

Teo, T., Chai, C. S., Hung, D., & Lee, C. B. (2008). Beliefs about teaching and uses of technology among preservice teachers. *Asia-Pacific Journal of Teacher Education*, *36*(2), 163–174. https://doi.org/10.1080/13598660801971641

Teo, T. (2009). Modelling technology acceptance in education: A study of pre-service teachers. *Computers & Education, 52*(2), 302–312. https://doi.org/10.1016/j.compedu.2008.08.006

Thomas, M. O., & Hong, Y. Y. (2013). Teacher integration of technology into mathematics learning. *International Journal for Technology in Mathematics Education, 20*(2), 69–84.

Thompson, A. G. (1984). The relationship of teachers' conceptions of mathematics and mathematics teaching to instructional practice. *Educational Studies in Mathematics*, *15*(2), 105–127. http://www.jstor.org/stable/3482244

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), 555–577. http://www.jstor.org/stable/45018567

Ursavaş, Ö., Şahin, S. & Mcılroy, D. (2014). Technology acceptance measure for teachers: T-TAM / Öğretmenler için teknoloji kabul ölçeği: Ö-TKÖ. *Eğitimde Kuram ve Uygulama, 10*(4), 885-917. https://dergipark.org.tr/tr/pub/eku/issue/5462/74152

Xu, Y., Jin, L., Deifell, E. & Angus, K. (2021). Chinese character instruction online: A technology acceptance perspective in emergency remote teaching. *System, 100*. https://aquila.usm.edu/fac_pubs/18819

Vedenpää, I. & Lonka, K. (2014) Teachers' and teacher students' conceptions of learning and creativity. *Creative Education, 5,* 1821-1833. doi: 10.4236/ce.2014.520203.

Venkatesh, V. & Davis, F.D. (1996). A model of the antecedents of perceived ease of use: Development and test. *Decision Sciences, 27,* 451-481. https://doi.org/10.1111/j.1540-5915.1996.tb00860.x

Zellweger, F. (2007). Faculty adoption of educational technology. *EDUCAUSE quarterly*, *30*(1), 66-69.