

Teachers' Opinions on Conducting Mathematics Education Online and Recommendations on Improving its Quality

Hediye Sarikaya Yetis¹ and Mehmet Salih Yarimsakalli²

¹Near East University, Nicosia, Cyprus, P.O. Box 670, Nicosia, 99138

Cell: +90 392 22 36 464, E-mail: hediye.sarikaya@neu.edu.tr

²Near East University, Nicosia, Cyprus

E-mail: myarimsakalli@gmail.com

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ABSTRACT This research aims to determine lecturers' views on online mathematics education and to get suggestions for its improvement. The participants of the study consist of 15 people who work as instructors in a private university. In the study, the quantitative-qualitative mixed pattern model was used. The data were collected from the participants with the help of an online form containing questions about sex, age, pedagogy status, computer usage levels and ten questions related to research. Participants expressed many positive and negative opinions on the online mathematics education process. Responses were analyzed as the opinions of the lecturers with/without pedagogical formation. According to the data obtained, faculty members with pedagogical formation argue that online mathematics education is appropriate in all aspects; however, those without a pedagogical formation are often against online mathematics education. Recommendations developed as a result of the findings are presented at the end of the study.

INTRODUCTION

Humanity has faced various crises and disasters many times throughout history. One of them is the pandemic. Pandemic is defined as a major epidemic (TDK 2020), in which a disease is prevalent on a continent or several countries at the same time. The new type of coronavirus (COVID-19) epidemic is one of these disasters. The World Health Organization declared the COVID-19 outbreak, which started to spread from Wuhan city of Hubei province of China in December 2019, as a "pandemic" on March 11 (WHO 2020). Since this date, serious changes have occurred in our health, economy, education and social activities. With the rapidly increasing number of COVID-19 cases worldwide, social concerns and anxiety have also started to increase in many world countries (Lin 2020). The COVID-19 pandemic has particularly directly affected our educational activities and brought some concerns with it. Because when this epidemic spreads around the world, the majority of countries announced that schools were temporarily closed, and it was reported that the pandemic, which affected more than 91 percent of students in the world, affected approximately 1.6 billion children and young people (Miks and McIlwaine 2020). Due to the complexity created by the COVID-19 pandemic, most of the states

interested in protecting their economies have started to maintain their education process by launching emergency prevention packages that adopt the use of digital technologies (Agnoletto and Queiroz 2020). To provide effective education and training Turkey and the Turkish Republic of Northern Cyprus (TRNC) has been carrying out this process with distance education with the help of digital technologies like in other countries of the world.

Looking at the literature, among the definitions related to distance education: according to Isman (2008), distance education is a system in which education and training activities are carried out thanks to technology without the need for students and teachers to be in the same environment. While distance education is a form of education where the teacher and learner use different technologies to communicate regardless of time and place, today web-based applications have come to the fore to provide this communication (Kologlu et al. 2016). When looking at web-based distance education applications, the interaction between teacher and learner comes to the fore. In this case, synchronous and asynchronous applications may be used. Generally, the synchronous distance education model is encountered in higher education. Yorganci (2015) defines synchronous education as environments

where students and teachers interact with each other in different places at the same time, where there is bilateral communication. When the literature on distance education is examined, studies on educators are encountered (Baris and Çankaya 2016; Güner et al. 2016; Inan 2013). In the studies examining the views of the lecturers who took an active role in the distance education process, positive and negative opinions about the current process were determined. In line with the results they have obtained, various suggestions have been developed and presented to improve distance education and increase the quality of education and training. In recent studies, the importance of supporting educators in educational and technical aspects in the emergency distance education process is frequently emphasized (Bozkurt et al. 2020; Dolmaci and Dolmaci 2020; Erkut 2020; Huang et al. 2020; Naylor and Nyanjom 2020). Naylor and Nyanjom (2020) reveal that technical problems in distance education cause negative emotions such as stress and anxiety in teachers, and perceived institutional support is important in reducing these emotions. The study conducted by Bozkurt et al. (2020) by synthesizing the experiences and suggestions of 31 countries around the world for transition to emergency distance education during the pandemic process are important in presenting a global perspective. At the end of this study by Bozkurt et al. (2020), the importance of trainers' training is emphasized, and it is recommended to establish an open-access training resource bank for the training of trainers. Findings of the study by Karadag and Yücel (2020), which examined the satisfaction multidimensional of undergraduate students from universities in Turkey relating to the distance education application during the Covid-19 period, reveal that the area with the lowest satisfaction is digital content/teaching materials. As a conclusion of the research, it was stated that the proficiency of the teaching staff in using technology is low. Erkut (2020) emphasizes the need for instructors to undergo a serious education and to restructure their lessons in accordance with online environments in order to provide effective online education in the following period, with the experiences experienced in the emergency distance education process.

Certain concepts and pedagogical approaches are emerging in connection with the technolo-

gy used today. Among these, the ones currently used are Flipped Classroom, Robotic Coding, Online Learning Styles, Animation and Simulations, Technological Assessment Methods and Cloud Computing Systems (Akgündüz 2019). Technology integration can be achieved with technological approaches, methods and learning models in which technology is used efficiently and effectively. Regarding this, Technological Pedagogical Content Knowledge appears first. With the unstoppable development of technology today, it has been necessary to add technology to Pedagogical Content Knowledge. Supporting the methods, techniques, learning approaches and models used by lecturers in the learning-teaching process with appropriate technological tools is expressed as technical knowledge. Mishra and Koehler (2006) have integrated technology into Pedagogical Content Knowledge. Thus, Technological Pedagogical Content Knowledge has emerged (Akgündüz 2019).

Özden (2002) defined technology-supported education as "a personal or mass practice where everyone can progress according to their own pace of perception and comprehension of information and using course materials that allow them to receive training at the time and place that suits them, accessible via computer and network (LAN, Intranet, Internet), with multimedia features, prepared interactively, having pedagogical features, aiming to transfer knowledge as well as gaining skills, where the performances of the training areas can be automatically evaluated and recorded by the computer". While teachers are teaching technology-supported mathematics, they can have in-depth discussions that would not be possible in environments where there is no computer (Shi 2009). For many years, paper-pencil, blackboard-chalk pairs have been used in mathematics teaching (Ersoy 2003). Today, when we look at research reports, articles and congress papers around the world, a general change and development process regarding the use of technology in mathematics teaching stands out (Ersoy 2005). Mathematics teaching with technology provides a better understanding of the concepts compared to the teacher's mathematics teaching using traditional approaches such as the lecture method. In this way, students are provided to behave more comfortably and flexibly while solving problems (Schreyer-Bennethum and Albright 2011). Utiliz-

ing technology in mathematics education and teaching will increase students' interest and motivation and increase the efficiency and permanence of information in education. It has been suggested that with the use of computers in mathematics education, there will be changes in mathematics teaching and new dimensions will emerge (Baki 2001). Technologies used in mathematics education can be grouped under three main headings (Köse 2008):

1. **General technological tools:** These are tools that cover not only the requirements of mathematics teaching but all technology. For example, web-based communication.
2. **Technological tools for doing mathematics:** It includes technologies developed for doing easier and more accurate mathematics. For example, handheld calculators and computer software applications such as Excel, statistical programs, and graphics programs.
3. **Technological tools for teaching mathematics:** These are software programs developed to improve students' mathematics learning. For example, Cabri 3D, Geometry Sketchpad, Geogebra.

Aydogmus (2010) states that using educational software in mathematics teaching is an element that supports mathematics teaching and complements the system rather than being an alternative way. The use of instructional software in mathematics teaching definitely has an effect on the development of students' problem solving and thinking skills. Using this software, students can achieve permanent learning using mathematical models and graphical and geometric representations of mathematical concepts. Students become aware of the mistakes they have made and have the opportunity to correct them. The software used in mathematics education and teaching is divided into two. These are (1) Computer Algebra Systems and (2) Dynamic Geometry Software. Computer Algebra Systems, such as Derive, Mathematica, Maple or MuPAD, are technological tools suitable for use in mathematics education and teaching. Of course, with the development of technology today, much new mathematical software (Wolfram, MatLab, Desmos etc.) may appear. Computer Algebra Systems strengthen the learning environment, compare it with real situations, establish social interaction and create a discussion environment. In addition to these, it helps to direct the role of mathematics to problem-solving

rather than processing skills and help everyone understand mathematics more easily (Tuluk and Karatas 2007). Dynamic geometry software is the name given to special geometry software created for geometry such as Cabri Geometry, Geometer's Sketchpad, GeoGebra and Cinderella. By entering the field of geometry education, saving geometry from the paper-pencil process and making it dynamic on the computer screen, it enabled students to make assumptions, discover and test theorems and relationships (Güven and Karatas 2003). Especially nowadays, GeoGebra software is used very frequently. Since Geogebra software packages are offered free of charge to users, they are widely used in mathematics learning-teaching processes all over the world. Hence, Geogebra software has been translated into many languages, allowing it to be used in both local and multicultural environments (Hohenwarter and Lavicza 2007). GeoGebra software is a program that includes both computer algebra systems and dynamic geometry software features and is important in terms of ease of use and translation into various languages (Kutluca and Zengin 2011). It is seen how important the use of tools, programs or software in mathematics teaching is to make mathematics education more efficient and effective in the distance education process. Suppose the tools, methods-techniques, programs and software to be used by the instructors in the mathematics education and training process are selected considering the readiness and learning levels of the students. In that case, they can help to get more efficient and positive results from this process. Today, it is clearly seen how important the use of technology is in mathematics education. It is observed that lecturers whose use of technology are poor in mathematics education and teaching have difficulty adapting to the distance education process. In order to prevent this situation, what needs to be done will be to improve themselves by attending courses during the periods when in-service courses are organized.

Instructors need to improve themselves in the distance education process. Otherwise, academics who are insufficient in the use of technology will experience problems in the process. Especially in the process of mathematics education, it is necessary to use different materials, teaching tools, mathematics programs and software. When we look at the literature, we come across many studies on the use of technology: Hebebcı et al. (2020), in their work to reveal the views of teach-

ers and students on distance education applications, show that students and teachers can carry out education in a planned and programmed way even under extraordinary conditions. They found that they had negative opinions such as opinions and interaction limitations, infrastructure problems and lack of hardware. Bakioglu and Çevik (2020) tried to determine the views of science teachers about distance education.

In the study they conducted for as a result of the research, it was revealed that the most important problem experienced by teachers is the problem of technological infrastructure.

Aim of the Study and Research Questions

It is observed that the education and training that has been continuing in the form of distance education for a long time due to the adverse pandemic conditions have negatively affected the students and lecturers. It is observed that instructors have difficulties in adapting to the distance education process. Especially in online mathematics lessons, there are some important consequences such as finding out which method or technique to choose when transferring the subjects to students, creating different materials for students to understand the subjects better, and determining whether students understand the subjects better if different software or programs are used. This study, it is aimed to reveal the opinions of the lecturers about online mathematics education during the pandemic period and to receive suggestions for the development of online mathematics education. The purposes of examining the pedagogical formation part seen in the tables in the findings section of the study in two columns as “Yes / No” for the instructors are as follows:

- 1) To determine whether there is a difference in the views of lecturers who receive pedagogical formation education and those who do not receive education in this field about online mathematics education.
- 2) To reveal whether lecturers with pedagogical formation education and lecturers who do not have pedagogical formation education use similar methods and techniques, similar teaching tools or similar materials in the online mathematics education process.
- 3) To determine the opinions and needs of lecturers who have a pedagogical forma-

tion and who do not have a pedagogical formation for in-service training in the online mathematics education process and to reveal what their differences are.

- 4) To determine the different or common views of lecturers with pedagogical formation and lecturers who do not have pedagogical formation on the reliability of online math exams.

All of the goals determined were examined, applied and compared individually for a total of ten questions in the online interview form.

METHODOLOGY

Due to the Covid-19 pandemic, education and training all over the world have been continuing in the form of distance education since the 2019-2020 Spring semester. In this study, the opinions and thoughts of the lecturers about providing mathematics education in the form of distance education were evaluated. In this context, the “mixed method”, in which quantitative and qualitative methods are used together, was preferred as a research model. The mixed method is a concept used for studies conducted by using more than one qualitative or more than one quantitative method together, collecting and analysing data (Creswell and Plano Clark 2018).

Study Group

Participants of the research consist of 15 lecturers (N = 15) who are in the Department of Mathematics and Mathematics Teaching (Primary Education - Secondary Education) in a private university at TRNC and currently giving mathematics education and training. Distribution according to demographic information is summarized in Table 1.

Table 1: Demographic characteristics of instructors

	N	%
<i>Gender</i>		
Male	9	60
Female	6	40
<i>Age</i>		
Age of 24-34	8	53.3
Age of 35-45	1	6.7
Age of 46-56	4	26.7
Age of 57-67	2	13.3

When Table 1 is examined, it can be seen that a total of 15 lecturers participated in the study. 60 percent of the participants are men and 40 percent are women. The youngest participant is 24 years old, and the oldest participant is 66 years old.

Collection of Data

The interview technique was used to get the opinions and thoughts of the lecturers about providing mathematics education in the form of distance education. The data of the research were obtained with the semi-structured interview form. In order to determine the reliability of the questions, the researcher consulted four field experts. While preparing the interview form, care was taken to ensure that the questions could reveal the situation of Mathematics education and the problems faced by the lecturers during the distance education process. Since face-to-face interviews could not be done with the lecturers due to the adverse pandemic conditions, the forms were delivered to the lecturers online. In the interview form prepared for lecturers; gender, age, pedagogical status, and computer usage levels were asked. The definitions of the words in the questions are included in the online forms so that the instructors fully understand the words in some questions, and they can give more correct answers while answering. The responses of the lecturers who participated in the research were sent to the platform where online forms were prepared. The data were collected in March 2021. The interview form questions directed to the lecturers are shown in Table 2, and the answers given to these questions were examined in detail in the study.

Analysis of Data

The content analysis method was used in the analysis of the data. The main purpose of content analysis is to reach concepts and relationships that can explain the collected data. For this purpose, the data collected must first be conceptualized, then organized logically according to the emerging concepts, and the themes explaining the data must be determined accordingly. The process of content analysis is to gather similar data within the framework of certain concepts and themes and to interpret them in a way that the reader can understand (Yildirim and Simsek 2018). After this analysis method, a framework was created according to the themes, by processing the data, the findings were defined and interpreted. Thus, descriptive analysis has been created. In the descriptive analysis, the aim is to present the findings to the reader in an organized and interpreted form by frequently giving direct quotations (Yildirim and Simsek 2018). Hence, with the help of descriptive analysis, the findings were organized and presented to the reader in an interpreted form.

RESULTS

In this section, the findings obtained from the interview form as a result of the opinions of the lecturers regarding the delivery of mathematics education as online education are presented.

When instructors' computer usage levels, who participated in the study, were examined, it was seen that 5 (33.3%) of the lecturers among 15 had a "Good", and 10 (66.7%) had a "Very Good" computer usage level. Lecturers' pedagogical formation knowledge was also investigated in the

Table 2: Interview form questions created for instructors

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- 1) Is the distance education platform a suitable platform for mathematics education and teaching?
 - 2) What are the conveniences provided by online mathematics education and training to students?
 - 3) What can be done to increase the efficiency of online mathematics education and to ensure the permanence of mathematical knowledge?
 - 4) What are the teaching methods and techniques you use during online mathematics education?
 - 5) What are the teaching materials you use during online math education? Is it sufficient for the students?
 - 6) Do instructors need training on technological formation for online mathematics education?
 - 7) What kind of teaching tools do you use in the mathematics education process? If you use any, what are the advantages for you?
 - 8) Should in-service trainings be given to students and lecturers before mathematics education starts to be given in the form of distance education?
 - 9) How do you think online mathematics education affects students' learning?
 - 10) What is the reliability of online mathematics exams? What measures can be taken to increase its reliability?
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study, and it is seen that 10 (66.7%) lecturers have pedagogical formation while 5 (33.7%) lecturers do not have pedagogical formation.

At the end of the tabulation process of the content analysis made on the data obtained as a result of the interview form sent to the lecturers, the findings given in the tables with-in the paper were obtained and discussed in detail. As can be seen above, separate tables were created for the questions in Table 2 given at the beginning of the study and some results were obtained. The result obtained in each table is as shown below:

When Table 3 is examined, 6 of the answers given by the lecturers with the formation are appropriate, while 5 are not. It is seen that all of the lecturers who do not have a pedagogical formation defend the view that the distance education platform is not suitable for mathematics education and training.

When Table 4 is examined, the opinions of the majority of the lecturers are as follows; 7 opinions from lecturers with pedagogical formation emphasized that the advantages of online mathematics education and teaching are the advantages of recording the lessons, so that students can listen to their professors by focusing only on the

lecture in online lessons, and also, they can watch the recordings over and over again. The majority of the teachers who do not have pedagogical formation education emphasized that providing mathematics education and training in the form of distance education is not healthy and does not offer any advantage to the student.

When Table 5 is examined, the most common answers given by the instructors are as follows; 7 similar opinions from lecturers with pedagogical formation are that the use of technological materials in the course environment and learning by doing and experiencing with the help of mathematical programs should be added to the lesson plans. Additionally, the other 2 opinions from lecturers with pedagogical formation presented that increasing the evaluation criteria helps to reinforce the learned knowledge and that it is a way to increase the permanence of mathematical knowledge. Four similar views advocated by lecturers without pedagogical formation education who participated in the study are that online mathematics education is not beneficial in any way and that no method can increase the permanence of the education offered.

Table 3: The views of the lecturers regarding the question “Is the distance education platform a suitable platform for mathematics education and teaching?”

<i>Opinions</i>	<i>Pedagogic formation</i>	
	<i>Yes</i>	<i>No</i>
It is possible to provide the classroom environment in the internet environment with the appropriate tools and equipment. If an effective lesson is taught using a tablet, a better and catchy lesson environment can be provided.	1	-
It is appropriate, but the attitude of the instructor is very important.	1	-
Yes, it can be effective in situations where face-to-face education is not possible.	1	-
Generally suitable for lecture presentations. However, we encounter difficulties in using whiteboards in live lessons and using mathematical expressions during exams.	1	-
Yes. Since the visual learning style is the most effective learning, more visual materials (videos and graphics) can be offered to the student thanks to distance education.	1	-
Suitable. Because there are various mathematical tools and applications by which some difficult mathematical concepts can be easily explained to students.	1	-
Our lessons are not suitable as they are practice-based and one-on-one interaction with students is limited.	2	4
No. Although it has several reasons, we can briefly say that it is not practical for mathematics education.	-	1
It is absolutely not suitable. I think it is not suitable for not only mathematics but all other numerical courses. In addition to being a lesson that can be taught by solving mathematics problems, the energy you get from the student while solving the questions step by step in numerical lessons will guide you in the way of expression.	1	-
It is not a suitable platform.	1	-
There is no direct answer to this question. It can be useful in some ways (using applications and programs to plot the chart or show problems better ...) and may not be useful in another way (close contacts with students, ...)	1	-

Table 4: The views of the lecturers regarding the question “What are the conveniences provided by online mathematics education and training to students?”

<i>Opinions</i>	<i>Pedagogic formation</i>	
	<i>Yes</i>	<i>No</i>
Providing the opportunity to follow the lessons independently from time	2	-
Making it possible for students to focus only on the lesson without taking notes	2	-
Teaching the students, the existence of different solution methods with external videos apart from the lecturer	2	-
Changing the evaluation criteria of students and enabling exams and quizzes to be made more frequently and more easily	1	-
They can use the time they spend travelling to school as working at home.	2	-
The student seems to be taking private lessons one on one with his teacher in his / her room	-	1
Its greatest convenience for students is cheating.	1	-
They can watch the course recordings over and over so that they can strengthen their knowledge.	3	-
They can benefit from different materials and therefore have the opportunity to see more examples on a topic.	1	-
They can also ask questions to the instructors thanks to chat environments and live lessons.	1	-
Since I do not think that a healthy education is received, it does not provide any convenience in terms of education.	1	4
There are many websites that help chart functions (desmos.com, ...) found in courses such as analysis and geometry. By using these websites, students can be presented with better visuals and thanks to that the logic of the subjects can be better taught.	1	-

Table 5: The views of the lecturers regarding the question “What can be done to increase the efficiency of online mathematics education and to ensure the permanence of mathematical knowledge?”

<i>Opinions</i>	<i>Pedagogic formation</i>	
	<i>Yes</i>	<i>No</i>
Providing training to lecturers and students about the environment to be used	1	-
To evaluate students more frequently, to push the student to study by quizzes more often, and to get feedback in order to see the state of the information taught	2	-
Using more visual materials, using technological materials in distance education, and even giving students the opportunity to experiment with the help of mathematical programs, it can be ensured that they learn by experience.	2	-
I don't think online math education can increase productivity.	-	4
It would be nice if the lecture is shorter, and students are directed to research about the topics.	-	1
Using a tablet, writing with different coloured pens, watching mathematical films in class	1	-
The only method in the field of mathematics is to create a classroom environment to teach the lesson on the board, and to teach the students by creating a classroom environment through a strong internet network.	3	-
Using technology in mathematics and teaching practices	1	-
Instructors should focus on visual objects. It is necessary to do activities that will remove mathematics from being abstract.	2	-
Teachers should be provided with up-to-date teaching opportunities and workshops for teachers and students on how to use the facilities should be organized.	1	-

When Table 6 is examined, it is observed that the teaching methods and techniques chosen by the majority of the instructors are the methods and techniques which put the teacher in an active position whereas putting the students in a passive position. According to the opinions of the lecturers who do not have pedagogical for-

mation education, it is striking that there are quizzes and homework among the methods and techniques they prefer. On the other hand, teaching methods and techniques preferred by lecturers with pedagogical formation education are methods and techniques such as brainstorming, problem-solving, demonstration and making, and also,

Table 6: The views of the lecturers regarding the question “What are the teaching methods and techniques you use during online mathematics education?”

<i>Teaching methods and techniques</i>	<i>Pedagogic formation</i>	
	<i>Yes</i>	<i>No</i>
Direct instruction	1	-
Problem-solving	4	-
Discussion	1	-
Case study	1	-
Showing and having them do it	2	-
Since I do not do online courses, I do not use any method or technique for online education.	-	2
I use methods such as making quizzes and problem solving with the platforms provided by the school.	2	2
I try to reinforce the subject better and improve the academic level of the student by giving students short research assignments on the topics.	-	1
Teaching by Presentation	2	-
Brainstorming Technique	1	-
I use digital materials (Youtube, Google Search, Powerpoint, Google Classroom... etc.).	1	-
With the help of the internet, I connect live with my students and upload the recorded lecture after the lesson is over.	1	-
My online courses include the discussion dialogue in the Paint app, and I explained its content with the help of many graphic figures. I bought some content from websites and put the shapes and contents in the time to save the materials. During the lecture, I used a graphical sketching program to describe the problems in terms of figures, while I used an integral calculator and many calculators to show the problems for students.	1	-

Table 7: The views of the lecturers regarding the question “What are the teaching materials you use during online math education? Is it sufficient for the students?”

<i>Opinions</i>	<i>Pedagogic formation</i>	
	<i>Yes</i>	<i>No</i>
I pay attention to sharing external videos, lecture videos of reputable schools and various course documents to students. I think it is sufficient for the students because I generally consider the level of the class when choosing their materials.	5	-
Since students attend face-to-face training, I do not use any materials for online math education.	-	2
I think lecture notes and textbooks are sufficient.	1	2
From time to time, finding images related to the subject on the internet helps them understand the subject more quickly	-	1
I try to present the classroom environment to the students by explaining the lesson on the board. I think this is the best and most adequate service in the current conditions.	1	-
Computer, whiteboard and different resource books	1	-
I use tables and graphics.	1	-
I used Google Meet to connect with my students online while using whiteboards and graphics tablets.	1	-
By sharing the page, I tried to create the active classroom as a leader, collaborating with students, helping them tackle problems and researching solutions throughout the lesson.	1	-

it has been observed that they support the participation of students in the educational process.

When Table 7 is examined, according to the 5 opinions expressed by the lecturers with pedagogical formation education, it is seen that they support the students with external videos so that they can be aware of different solution methods and different teaching methods. On the other hand, according to the 5 opinions of the lecturers

who do not have pedagogical formation education, it was seen that they defended the opinion that the lessons in the course environment were sufficient and there was no need for external materials.

When Table 8 is examined, it is seen that 7 of the educators with pedagogical formation training defended the opinion that technological formation training is needed for online mathematics

Table 8: Positive views of the lecturers regarding the question “Do instructors need training on technological formation for online mathematics education?”

<i>Opinions</i>	<i>Pedagogic formation</i>	
	<i>Yes</i>	<i>No</i>
Yes, it is required. There is an ever-evolving e-learning environment, and I think teachers need training to enrich their lessons in these environments.	1	-
Since online education is very new, I think that educators are not aware of many technological developments. Therefore, a well-prepared technological formation is absolutely necessary.	1	1
Yes.	3	-
Such an education will enable the instructors to do their jobs faster.	2	-
No. Because I think the computer usage levels of the instructors are good.	-	4
There is no need for a major training since everyone can achieve this competence with individual touches.	2	-
No.	1	-
No, it is not necessary. Knowing technology is different, having knowledge about education and training activities is another. The lecturer can transfer a subject he knows with his formation knowledge by using teaching tools.	1	-

Table 9: The views of the lecturers regarding the question “What kind of teaching tools do you use in the mathematics education process? If you use any, what are the advantages for you?”

<i>Teaching tools and their advantages</i>	<i>Pedagogic formation</i>	
	<i>Yes</i>	<i>No</i>
While lecturing, I use a tablet and try to offer students an education like in a classroom environment. Apart from these, we solve the questions by experimenting with students with the help of mathematical programs such as Desmos, Wolfram Alpha, scientific calculator and excel. In such an environment, students can both defend their ideas freely and observe the right and wrong things they do, and more permanent learning is provided because more sensory organs appeal to the student.	1	-
Uzebim, EasyTeach. The application is advantageous as it provides a whiteboard facility.	-	2
Laptop	1	1
Graphics tablet, LM. We can easily teach with a graphic tablet on the whiteboard used in the system.	1	-
I use the camera of smartphones due to the current conditions. I can say that this is the most important tool that helps me to provide classroom service to students.	1	-
I use lecture notes, lecture recordings, Youtube videos. However, I think it would be beneficial for them to watch the videos of different teachers, watch the lesson and repeat the points they missed so that they can see different examples.	2	-
Visual, Audio and Educational Tools	2	-
I can take screen recordings and write with Windows Ink Workspace. I meet with students and make a presentation with Google Meet Kapila M.	1	-
I use my laptop, digital graphics tablet and also the whiteboard. The digital tablet makes it easy to simplify the explanation of various concepts such as 3D, graphic drawing and so on.	1	-
I use the distance education platform.	1	2

education, whereas 4 lecturers stated that such training was not needed. While 4 lecturers who do not have pedagogical formation education defended that such training is not necessary, 1 lecturer emphasized that online education is new and that trainings should definitely be done in order to be aware of new educational technologies.

When Table 9 is examined, it is concluded that most of the lecturers use laptops, and it is emphasized that the lecturers with pedagogical formation education include different technological devices (graphic tablet, etc.) and software (Windows Ink Workspace, EasyTeach, etc.) in the mathematics education process. It has been

Table 10: The views of the lecturers regarding the question “Should in-service training be given to students and lecturers before mathematics education starts to be given in the form of distance education?”

<i>Opinions</i>	<i>Pedagogic formation</i>	
	<i>Yes</i>	<i>No</i>
It should definitely be given. The inability of some of the students to use the computer well can cause problems in the course entrance and they experience the biggest problem in online exams.	1	-
Yes.	1	-
As always, it would be better to give a preliminary training.	-	1
Yes. Because I think that everyone should not have the discipline to manage their own education, and every institution should have training on distance education.	1	-
It should definitely be given. We have to determine the terms of use and the adequacy of the website we use. If we do this, the quality of the service we will provide to the students and the ability to make fast transactions will increase.	2	-
Yes, it should. It should especially be given to educators. The person who plays a key role in ensuring the participation of students in the lesson is also the lecturer.	1	-
It must be given. The lecturers and students who learn many things technically will use this platform faster and more effectively.	1	-
If they do not know how to use distance teaching technologies, in-service training can be given.	1	-
It should be given. In-service training should be provided to the instructors about how to do online lessons or how to do an online exam or how to upload online course materials.	1	-
It is clear that the teaching method has to be changed in the new form of online teaching. Education is a part of life for every teacher and researcher. These trainings must be done on their own or may be offered by the institute. Since older teachers are not as attached to modern life as the new generation, a compulsory short training course can be given.	1	-

observed that lecturers with pedagogical formation education carry out the online education process beneficially, and it is seen that they provide the continuity of the education offered in the

classroom environment, thanks to the teaching tools they use, in the online process.

When Table 10 is examined it is seen that while all lecturers (10 people) with pedagogical forma-

Table 11: The views of the lecturers regarding the question “How do you think online mathematics education affects students’ learning?”

<i>Opinions</i>	<i>Pedagogic formation</i>	
	<i>Yes</i>	<i>No</i>
Like teachers, students are at the top of this journey. They should adopt online teaching method, assignments and exams.	1	-
The fact that students can cheat more on online platforms raises problems in adaptation.	1	-
Since students do not take online education seriously and do not participate regularly, it affects their learning negatively.	1	4
Especially when online mathematics education is not given with face-to-face education model and principles, it has a negative effect on students. I am of the opinion that they almost did not learn anything because they could not get the information completely and could not put the information they received in their brains.	1	1
It affects negatively. Not only in terms of mathematics, but a mass that adopts the principle of passing lessons without studying is rapidly progressing.	1	-
A student in face-to-face education is academically the same in distance education.	2	-
This situation varies according to the student and the lecturer. If the student is sufficiently interested in the lesson, he / she will acquire the required learning outcomes. It is very difficult to win unrelated students on this platform. In addition, the extent to which the lecturer uses the online platform will affect this result.	1	-
It affects positively.	1	-
I think it has a positive effect. Students are accessing materials that appeal to more visual memory.	1	-
It gives students the ability to follow the recorded lecture so that they have more clarity about the concept they do not understand correctly.	1	-

tion education answered the question “Should in-service training be given to students and lecturers before mathematics education starts to be given in the form of distance education?” as required, four lecturers who do not have pedagogical formation education stated that it is not necessary, and one lecturer defended the opinion that it is correct to provide education.

When Table 11 is analysed, most of the answers given to the question of how online mathematics education affects students’ learning was negative. While those who do not have pedagogical formation education defend the opinion that students have adaptation problems in this process and do not take the lessons seriously by not paying attention to course participation, 3 lecturers with pedagogical formation education advocated the opinion that students are positively affected, and that it is a more useful education because they have more material.

When Table 12 is examined, it is seen that all of the instructors who participated in the study stated that the exams were not reliable when asked about the reliability of online math exams. Among the views advocated by lecturers, it was shown that it is not possible to control the students during the exam. The opinions offered by the lecturers to increase the safety of the online exam include suggestions such as presenting the questions in a mixed way, asking different (individual) questions to the students, preventing the transition between questions and keeping the time-limit.

DISCUSSION

With the impact of the COVID-19 pandemic all over the world, distance education platforms have started to be created in order to minimize the losses in education. Distance education platforms have

Table 12: The views of the lecturers regarding the question “What is the reliability of online mathematics exams? What measures can be taken to increase its reliability?”

<i>Opinions</i>	<i>Pedagogic formation</i>	
	<i>Yes</i>	<i>No</i>
It is very difficult to trust the results of their exams. There are many websites and supporting programs that help them answer questions. I’m still working on a reliable method for online math exams. I have reviewed many methods, but each of these methods has weak spots and I think we are at the beginning of this road and there is still a lot to be discovered.	1	-
It has no credibility; exams must be done face to face.	-	4
I do not think it is reliable. Individual exams can be done to increase reliability. In test exams, a pool of questions can be created as much as possible, and questions can be chosen randomly. Generally, students can cheat less frequently in open-ended questions rather than test questions.	1	-
Unfortunately, online math exams are not absolutely reliable in terms of assessment and knowledge measurement.	2	1
Reliability is a very important problem in distance education platforms. Because abusive students usually have others do the exams. For this, it is important that the system is open source and has periodic updates.	1	-
It would be funny to talk about reliability until a system in which cheating can be prevented. Using techniques such as providing short time and difficult questions will cause the loss of successful students. The safest method that can be provided is to transfer the course to the student in the best quality and to keep the students who want to benefit from it as long as possible.	2	-
Its reliability is low. Now, teachers as well as students know this job very well. When it comes to technology, I don’t think too many measures can be taken.	1	-
I think it’s not safe enough. The averages obtained in many courses for years have exceeded the normal in online education. Technical support is needed to increase security. You need a camera that will show the student exactly (his hands and his desk). Asking different questions to each student can reduce the likelihood of cheating and taking classical exams and not accepting similar mistakes will increase security.	1	-
As with all tests, reliability methods can be used. Giving the questions mixed, not being able to go back to the questions and the time limitation will also increase the reliability.	1	-
The main disadvantage of the online exam is that it is very difficult to question.	1	-

been established in all universities in the TRNC as well as in universities in all countries. It took some time for educators to adapt to distance education platforms. In particular, educators who were weak in terms of technology usage had to attend different training while adapting to the distance education platform. During online education, educators encounter many problems and these problems affect their motivation negatively. It can cause not only lecturers but also students to stay away from teaching and stop attending classes (Lee and Choi 2011).

This process shows how important it is for lecturers to choose the methods and techniques, teaching tools and materials they use during online training, taking into account the readiness of the students. It is seen that a wrongly chosen method and technique or teaching tools and materials harm students' learning and the retention of information.

It is observed that especially educators who teach numerical courses have more difficulty in the distance education platform. The methods and techniques that lecturers will choose during online math education should engage students more in the lesson. The reason for this is that students' general perspectives on numerical courses are different compared to other courses and incorrectly chosen method and technique will affect students' understanding and application of the subject negatively. When different studies are examined, it is shown that providing numerical courses in the form of distance education provides some advantages to students. The fact that with distance education lessons can be recorded and these records permanently included in the system created for the distance education platform so that the students can repeat subjects by listening again whenever they want, can be shown among the advantages (Sarıkaya and Yarımşaklı 2020).

In line with the purposes of examining the pedagogical formations of lecturers as "Yes/No" stated in the introduction, many positive or negative opinions about online mathematics education have emerged after comparing the opinions of teachers. In this context, the results obtained from the ten questions in the interview form are as follows:

The results obtained regarding the question "Is the distance education platform a suitable platform for mathematics education and teaching?" can be summarized as follows: Those who take

pedagogical formation from mathematics lecturers generally argue that the distance education platform is suitable for online mathematics education. Lecturers without pedagogical formation argue that the distance education platform is not suitable for online mathematics education. Özgöl et al. (2017), in line with the findings of the study, found distance education advantageous for students in terms of ease of access to content and flexibility; yet, they state that they see distance education at a disadvantage in terms of not being able to communicate face to face and not being able to ask questions.

The results obtained regarding the question "What are the conveniences provided by online mathematics education and training to students?"; All of the lecturers with pedagogical formation argue that online mathematics education provides convenience to students. According to Ilgaz (2014), since one of the most preferred features by learners in simultaneous learning systems is course recordings and being able to rewatch recordings of lessons, it is important that this feature is always actively accessible. Most of the lecturers who do not have pedagogical formation education stated that they do not provide any convenience. These results are consistent with the studies conducted by Isman (2008) and Çabi and Erhan (2016).

All of the lecturers who receive pedagogical formation training have revealed positive opinions about what can be done to increase the efficiency of online mathematics education and ensure the permanence of mathematical knowledge, and all of these views can be seen in Table.5. Lecturers who do not have pedagogical formation education generally argued that there is no situation that can increase the efficiency of online mathematics education and the permanence of information.

It is seen that the vast majority of the lecturers with or without pedagogical formation training use different methods and techniques during their online mathematics education. Among the methods and techniques, the most used ones are problem-solving, teaching through demonstration and presentation. This result is parallel to the study by Burke and Dempsey (2020). Similarly, Yılmaz and Aktug (2011) concluded in their study that lecturers generally use the presentation method in their teaching process in the distance education system.

It is seen that lecturers use different teaching materials for online mathematics education and they generally think that the teaching materials they use are sufficient. When Table 7 is examined, the view “*I pay attention to sharing external videos, lecture videos of reputable schools and various course documents to students. I think it is sufficient for the students because I generally consider the level of the class when choosing their materials.*” is the view with the highest frequency ($f = 5$). These results are similar to the studies conducted by Mulenga and Marban (2020) and Roy (2020). Chao et al. (2006) state that one of the factors affecting the quality of online education is the richness and quality of learning-teaching resources and materials. According to Seaman (2009), one of the most important reasons for negative thoughts about online teaching is the low quality of course materials.

The majority of educators with pedagogical formation argued that educators should receive technological formation training. Among the opinions offered by the lecturers on this subject are that there is a constantly developing online learning environment, the lecturers need training in order to continue the lessons more efficiently in these environments, and training is required for the work to be carried out faster. Kayaduman and Demirel’s (2019) study also reveals the importance of technological, pedagogical and content training to be given in reducing the concerns of lecturers about distance education. Among the opinions of the lecturers who have a pedagogical formation, who view this issue negatively, it can be shown that everyone can develop themselves by researching and that the lecturers can use their knowledge. Lecturers who do not have pedagogical formation education generally stated that lecturers’ computer usage level is good and that such training is not needed.

All of the teaching tools used by the lecturers during their online mathematics education are discussed in detail in Table 9, and as a result, it has been obtained that all of them use different teaching tools. It has been observed that all educators argue that the teaching tools they use provide them with an advantage and that these tools do not have any disadvantages. According to Enriquez (2010) and Nie et al. (2011), tablet computers are among the technologies preferred in educational environments because of their features. The posi-

tive effects of the use of this technology in the education process on students are emphasized.

The results obtained regarding the question “Should in-service training be given to students and lecturers before mathematics education starts to be given in the form of distance education?” can be summarized as follows: All lecturers with pedagogical formation training argued that it is necessary to give training to students and lecturers before starting to teach on the distance education platform, and these views are shown in detail in Table 10. Lecturers without pedagogical formation argued that in-service training is not necessary. These results are consistent with the findings of studies that emphasize the importance of educating instructors in terms of the adoption and effectiveness of distance education (Bilgiç et al. 2011; Düzakin and Yalçinkaya 2008; Gürer et al. 2016; Kayaduman and Demirel 2019; Yildiz 2015; Yilmaz and Aktug 2011).

The results obtained regarding the question “How do you think online mathematics education affects students’ learning?” can be summarized as follows: 50 percent of all lecturers with pedagogical formation education stated that it affects positively and the remaining 50 percent stated that it affects negatively. All opinions are discussed in detail in Table 11. Mathematics lecturers who do not have pedagogy education stated that students affected negatively as they do not take online education seriously and they do not participate in lessons and they do not approach interaction. According to Hara and Kling (2000) and Rasheed (2007), the inefficiency of the lesson can lead to low motivation for the learners and not being able to properly coordinating the lesson.

Among the lecturers, all mathematics educators with or without pedagogical formation stated that the mathematics evaluations made at the end of online mathematics education were not reliable in any way. When all the opinions given in Table 12 are examined, it can be seen that the lecturers’ suggestions on what measures can be taken to increase the reliability in the exams. When the UNIQUE Standards (2011) used by the European Foundation for Quality in e-Learning (EFQUEL) for establishments and institutes are examined, it is seen that institutions should use both formative and summative assessment, in order to reflect their learning experiences, stu-

dents should be given continuous self-assessment and encouragement of self-improvement initiatives, the institution should have appropriate tools and procedures to secure the evaluation process and ensure the confidentiality of the results, that justice and transparency should be ensured in the evaluation process, the use of methods to detect theft and other illegal acts and their need to be reported to students, the importance of timely, comprehensive and constructive feedback to students, an effective and fair system should be in place for complaints about the evaluation results and it is important to support peer assessment methods and encourage students to work in groups.

Seren et al. (2020) it has been seen that the views of the instructors on the disadvantages of the teaching-learning process in distance education in terms of measurement-evaluation are more than their views on the advantages, they use various methods to solve their problems and make constructive suggestions to make the process more efficient.

In the study conducted by Erzen and Ceylan (2020), it was stated that the possibility of cheating in unsupervised exams in online exams is an injustice against working students. Can (2020), on the other hand, states that there is a need for alternative searches for assessment and evaluation in the distance education system.

CONCLUSION

In general, one of the most important results obtained from the study is that the 24-34 age group lecturers who participated in our study, compared to the lecturers of other age groups, use different teaching tools and different materials (Youtube video, etc.) in online math education, and also they use programs and software in a way that they can explain the subjects more easily and the students could review the subject. Thus, it was concluded that the use of technology of the lecturers in the 24-34 age group was at a better level than the lecturers in the other age group. The scarcity of technological tools, programs and software used by lecturers in other age groups indicates that lecturers in the 35-45, 46-56 and 57-67 age groups need to improve themselves in technology. In addition, when the findings obtained in the study are examined, it can be said that the

lecturers need to improve themselves by participating in in-service training.

Another important result obtained is that pedagogical formation education affects the opinions of the lecturers about online mathematics education. When all the results obtained in this context were examined, it was observed that the lecturers with pedagogical formation generally approach online mathematics education positively, strive to increase the quality of online education and try to adapt to the process. It has been observed that lecturers with pedagogical formation education try to add various software and programs to the education process to be beneficial to students in the online education process and to make students more active in lessons. It was concluded that lecturers without pedagogical formation education approached online mathematics education negatively and managed the process with traditional methods as before. Additionally, they argued that online mathematics education does not provide any advantage for students.

RECOMMENDATIONS

Considering the opinions of the lecturers who conduct online mathematics lessons regarding the online lessons and the problems they encounter at this process, some suggestions are presented below to use the online learning platform more efficiently for educators and to progress the online education process more comfortably;

- 1) As a result of the COVID-19 pandemic in education, the positive or negative effects on students and lecturers actively involved in the distance education process should be examined in more detail.
- 2) Instructors should be trained about teaching methods they can use in web-based simultaneous distance education systems.
- 3) When planning the in-service training for educators, it will be beneficial for universities to first conduct a needs analysis study and to create these training by considering current needs. In-service training on technology literacy and computer-aided education should be provided for lecturers.
- 4) Lecturers are required to refer to different methods techniques, teaching tools and materials in the lessons held on the distance

education platform. The use of these different methods-techniques, teaching tools and materials can attract more attention of students and increase their motivation to the lesson.

- 5) Instructors should take care not to teach in a way that they are active but students are passive during live lessons on different programs (Google Meet, Zoom, Microsoft Teams, etc.), in the distance education platform.
- 6) If students are wanted to be successful in mathematics lessons, care can be taken to provide opportunities for them to use their critical thinking skills.
- 7) A mathematics educator who is not aware of programs and software related to mathematics should definitely participate in training and improve herself/himself in order to learn programs and software. Otherwise, s/he may experience difficulties while doing online mathematics education during the distance education process.
- 8) In the online mathematics evaluations, more efficient results can be obtained from measurement and evaluation if points such as students' readiness, students' levels and problems related to time are taken into account.
- 9) Evaluations made at the end of online training can cause fear and anxiety in students. While making evaluations, it is necessary to create a plan that will improve learning and contribute to lifelong learning. Instructors should take care to make process-oriented evaluations instead of monotonous exams and ensure that students stay away from the uniform exam system.
- 10) On the distance education platform, while mathematics educators with pedagogical formation education approach online education more positively, lecturers without pedagogical formation approach more negatively. The necessity of taking pedagogical formation training in order for lecturers to teach more easily on the distance education platform may be of great importance in this process.

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