

Instruction of Mathematics in Higher Education in the Covid-19 Pandemic: The Case of Turkey

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Abstract

The purpose of this study is to determine how mathematics instruction is carried out at the higher level of education in Covid-19 pandemic and what are the effects of these teaching activities. In the study, the case study model was used in which 30 lecturers with expertise in mathematics from 20 different universities in Turkey participated. In the study, the opinion form was used as a data collection tool. Descriptive analysis and content analysis methods were used in analyzing the data. It was found that before the pandemic, the use of technology in mathematics education by the lecturers was quite rare and at a basic level. In the pandemic process, it was observed that lecturers conducted their teaching synchronously or asynchronously with the traditional teaching approach, as before the pandemic, with distance education as the teacher-centered approach. It was understood that the main problems encountered during distance education were the difficulties encountered in teacher-student interaction and the inability to carry out assessment and evaluation activities in a healthy manner. It has been observed that the problems encountered especially in assessment and evaluation make it difficult to understand the actual impact of teaching mathematics during the pandemic on student learning. In fact, it was found that at the beginning of the pandemic, universities gave various instructions to their lecturers various trainings on distance education. However, these instructions were usually technical in scope and insufficient to overcome the difficulties encountered in the process, so that mathematics instruction was carried out with an understanding of ‘emergency distance education’ rather than formal distance education. On the other hand, the experience of distance education gained during the pandemic process had a positive influence on the views of a significant proportion of the lecturers on the integration of technology in mathematics education.

Keywords: Covid-19, Mathematics instruction, Distance education.

Introduction

With the emergence of the global Covid19 epidemic in late 2019, it has had a negative impact on educational activities, as it has in many other areas. According to UNESCO (2021), face-to-face education was suspended in 85 countries due to the pandemic. In Turkey, where the research was conducted, face-to-face education, including universities, was suspended right after the WHO declared the Covid-19 outbreak a global pandemic on March 11, 2020. Because of the pandemic, higher educational institutions had to rethink their understanding of education and instructing methods. Due to the pandemic, higher education institutions had to rethink their understanding of education and teaching methods. After a brief pause in education, online education models were used in Turkish higher education from 23 March 2020, making technology more widespread than ever before. This new situation required the integration of technology into the courses of lecturers who play a key role in higher education. In this regard, it is hypothesized that it would be useful to solicit the opinions of lecturers to determine the impact of the pandemic on mathematics instruction in higher education.

Moreover, it is believed that conducting research in Turkey, which is the second largest country in the European Higher Education Area after Russia, with 7.5 million students being trained in 207 universities (Saraç, 2020), will be beneficial to understand the impact of the pandemic from a broad perspective.

According to Telli et al. (2020), distance education is a contemporary and effective learning method that provides individuals with the opportunity to appropriately and flexibly configure, update, and incorporate various technologies into the learning process in the electronic environment regardless of time and place. Although in the past, tools such as letters, radio or television were used for education, nowadays it is mostly conducted as online education through the internet. The said online education can be conducted in two ways, basically asynchronous and synchronous. Asynchronous education is the education of students with previously prepared training content in an environment where no lecturer is present. Synchronous education is when the lecturer is on the same online education platform with the students and conducts the instructional activities simultaneously. Various studies emphasize that the student-centered approach of online learning, where individuals progress according to their individual learning speed, is pedagogically very promising (Grieve et al., 2017; Ituma, 2011).

Yıldız & Erdem (2018) found in their study that knowledge about distance education influences the perception of benefits about this process. In this context, it can be said that at the beginning of the distance education process that started with the pandemic, it is a reasonable approach to organize synchronous or asynchronous training for lecturers about online education in many universities in Turkey. Ak et al. (2021) in their study of 77 lecturers who participated in online lecturer training on distance education concluded that this training had a significant effect on lecturers' self-efficacy perceptions and perceptions of the benefits of distance education. On the other hand, Durak et al. (2020) examined the studies on distance education preparation conducted in 33 universities in Turkey and concluded that lecturer training is the most difficult situation for universities. Moreover, they referred to the educational activities conducted

in universities during the pandemic process as "emergency distance education" and emphasized that not everything could be carried out smoothly in this process because lecturers had no experience in distance education and their knowledge and skills in preparing distance education materials were limited. Kim et al (2013) emphasized that lecturers' knowledge and skills have a significant impact on the way they integrate technology into teaching. In this regard, it can be said that lecturers' knowledge, skills and experience during the pandemic process will contribute to the integration of technology into mathematics instruction when the effects of the pandemic subside and face-to-face teaching resumes.

In addition to the convenience and benefits offered by distance education, various problems and difficulties arose in the teaching processes as it was used urgently and widely during the pandemic process. When examining the research conducted in Turkey, it is found that some problems that occurred in the distance education activities conducted during the pandemic come to the fore. One of the most frequently mentioned problems in the researches is the difficulty of interaction resulting from the fact that students cannot interact with their friends and teachers as effectively as in face-to-face classes (Akıncı & Pişkin, 2021; Altun -Ekiz, 2020; Çakın & Akyavuz, 2020; Er-Türküresin, 2020; Hark-Söylemez, 2020; Karatepe et al, 2020; Kilit & Güner, 2021; Kurnaz & Serçemeli, 2020; Serçemeli & Kurnaz, 2020). However, another common problem in the distance education process is that assessment and evaluation activities cannot be conducted in a healthy way because they are unsupervised (Akıncı & Pişkin, 2021; Ezen & Ceylan, 2020; Tang et al., 2020). Moreover, many studies emphasize that various problems such as limited interaction, technical problems, or the inability to conduct assessment and evaluation activities in distance education negatively affect participants' educational perceptions (Duran, 2020; Hark-S Soylemez, 2020) and motivation (Karakuş et al., 2020; Karatepe et al., 2020).

When examining the national studies on distance education activities conducted during the pandemic process, it is clear that the majority of them are case studies aimed at understanding students' views

(Hark-S Söylemez, 2020) and there are very few studies that focus on lecturers' views. A similar situation is found in studies that specifically focus on instructing mathematics. It is assumed that most studies on mathematics instruction during the pandemic were conducted with the participation of teacher candidates (Ex: Akıncı & Pişkin, 2021) or mathematics teachers (Ex: Kilit & Güner, 2021). In this regard, no study was found in the national literature that addressed the involvement of lecturers in teaching mathematics at the university level during the pandemic process. In this regard, it is believed that the present study will contribute to the literature on mathematics instruction through distance education in the pandemic process in higher education. In addition, it is believed that the study can help policy makers, educational planners, educational researchers and lecturers to plan more effectively the time, money and human resources they will spend on distance education.

This study aims to determine how university mathematics instruction is conducted in the Covid19 pandemic and what the implications of this instructional activity are. To this end, in order to provide a broad and deep perspective in the study, answers were sought to the research questions covering the processes that we can call "pre-pandemic", "pandemic process" and "post-pandemic", which refers to the period when face-to-face instruction resumes.

- How did lecturers benefit from technology in teaching mathematics during pre-pandemic?
- How did lecturers teach mathematics during the pandemic process? What difficulties did they encounter? What are their opinions about the impact of teaching on student learning?
- What are the lecturers' opinions about the impact of their teaching experiences during the pandemic on the post-pandemic period?

Method

In order to present the current situation, the research has taken a deep and detailed perspective. In this regard, the case study model, one of the qualitative research methods, has been used in the research. This is because case studies are a qualitative research design in which one or more events, environments,

or other interconnected systems are studied in depth (McMillan, 2000), and their purpose is to analyze one or more situations holistically within their own boundaries (Yıldırım & Şimşek, 2008).

Participants

In the preliminary research conducted at the beginning of the research, it was found that universities in Turkey conduct their educational activities in different ways in accordance with the framework set by the Higher Education Institution. In order for the study to describe the nationwide situation, care was taken at this stage to ensure that the universities where the participants worked were distributed to cover the seven geographical regions of Turkey (Table 1). While 19 of the universities studied are state universities, one is a foundation university located in the Marmara region. In addition, attention was paid to the fact that the participants had a PhD in mathematics or mathematics education and taught mathematics in different faculties.

Table 1: Distribution of Universities Involved in the Study by Geographical Regions

Regions	University Number
Marmara	4
Aegean	3
Central Anatolia	3
Mediterranean	1
Black Sea	1
Eastern Anatolia	6
Southeastern Anatolia	2
Total	20

In determining the participants, the researcher first reached out to 10 lecturers working in different universities whom he could easily reach out to using the convenience sampling method. Nine of these lecturers volunteered to participate in the research. A written opinion form was emailed to the above participants and they were asked to send these forms to the lecturers they thought would participate in the research. A one-month period was determined for data collection. At the end of this period, 30 participants returned to the researcher via e-mail. Participant numbers were assigned to lecturers

based on turn order. In addition, the study identified information about the participants is presented in participants by naming them “P1, P2 ... P30”. Some Table 2.

Table 2: Demographic Information of Participants

		Participant No.	f	%
Gender	Female	5, 6, 12, 13, 14, 15, 19, 21, 22, 24, 28, 29, 30	13	43
	Male	1, 2, 3, 4, 7, 8, 9, 10, 11, 16, 17, 18, 20, 23, 25, 26, 27,	17	57
Age	31-35	5, 13, 15, 19, 21, 24, 28	7	23
	36-40	1, 3, 8, 10, 11, 12, 14, 17, 18, 20, 22, 27	12	40
	41+	2, 4, 6, 7, 9, 16, 23, 25, 26, 29, 30	11	37
Academic Title	Professor	3, 7, 17, 30	4	13
	Associate Professor	1, 4, 6, 8, 9, 10, 11, 12, 16, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29,	19	63
	Assistant Professor	2, 14, 15, 18,	4	13
	PhD Research Associate	5, 13, 19,	3	10
Faculty Type	Science and Literature	1, 2, 3, 5, 6, 7, 8, 13, 16, 17, 19, 20, 21, 23, 24, 25, 25, 28, 29, 30	20	67
	Education	4, 14, 15, 18, 22, 27	6	20
	Engineering and Architecture	9, 10, 12	3	10
	Junior college	11	1	3

Data Collection Tool

A data collection form consisting of two parts was used in the study. In the first part of the form, there is a consent form stating that the participants were informed about the research and that they participated voluntarily. There is also a section in this part that collects demographic information of the participants. In the second part of the form, there is a written opinion form with 10 open-ended questions (Appendix-1). While creating the written opinion form, the opinion form developed by the researcher in his previous study (Ardıç, 2021) and Cao, Yiming, et al. (2021), interview questions used in their studies were used. A draft form consisting of 12 questions was prepared by the researcher using these sources. An expert with a PhD in mathematics was then consulted to ensure the content validity of the form. In accordance with the expert’s opinion, it was decided that some of the questions were aimed at obtaining opinions on the same topic, necessary corrections were made and a new draft consisting of 10 questions was prepared. Subsequently, the pilot application of the new draft was conducted with the assistance of a lecturer. After reviewing the answers given after the pilot application and obtaining expert

opinions, it was decided that the new draft could be used in the research and the final version of the written opinion form was prepared.

Data Analysis

In the research, the written opinions received from the lecturers via e-mail in MS Word format were analyzed using the methods of descriptive analysis and content analysis. In the first part of the research, descriptive analysis was used to interpret and summarize the data related to the themes “Pre-Pandemic Mathematics Instruction “, “Mathematics Instruction During the Pandemic Process” and “Mathematics Instruction after the pandemic”, which refers to the period when face to face instructing is resumed, considering the framework provided by the research questions. In the second part, content analysis was used to perform an in-depth analysis and identify the categories and codes that could not be noticed in the first part. To do this, first, each participant’s data were examined individually, then the questions were examined separately, and codes, categories, frequencies, and percentages were determined. Then, each participant’s data was re-examined to capture the research leaders’ holistic

view of the topic. After sorting the codes obtained by related categories, they were grouped according to the themes identified by the research questions. The codes obtained in the research are presented in tables within each category along with their frequencies and percentages. In addition, the participant numbers of the lecturers are included in these tables to indicate which participant has which opinion.

To ensure internal reliability and consistency in the research, care was taken to ensure that the data collected and analyzed was consistent within itself as well as with the relevant literature. In doing so, the researcher considered how the study would be understood if assessed from an external perspective. To ensure the external reliability and confirmability of the study, an expert was consulted who had a PhD in mathematics education and had conducted studies on the relevant topic. All the opinions of the participants were also analyzed by the expert according to the three specified themes. As a result of the review by the expert, it was found that there was 87% agreement between them and the researcher. As

a result of the discussions with the expert, necessary improvements were then made and consensus was reached for all the codes and categories presented in the study. In addition, quotes from the participants' point of view were made to explain the codes, subcategories and categories identified in the study. The quotes in question were transcribed using the lecturers' participant numbers. All survey forms used in the study and the data obtained were electronically backed up and can be reused as needed.

Findings

The findings of the research are presented under separate headings according to the themes identified within the research questions.

Pre-Pandemic Mathematics Instruction

The findings of lecturers' opinions on how they used technology in their instructing before the pandemic and whether they had any experience of distance education in doing so are as follows.

Table 3: Participants' Use of Technology in Mathematics Instruction Pre-Pandemic

Theme	Category	Code	Participants	f	%
Pre-Pandemic Mathematics Instruction	Use of technology in face-to-face education	I was not taking advantage of technological tools	1, 2, 3, 4, 5, 6, 7, 13, 15, 17, 19, 20, 21, 22, 23, 24, 25, 26, 28, 29,	20	66
		I was making use of technological tools	12, 14, 16, 18, 27,	5	17
		I was not taking advantage of technological tools	8, 9, 10, 11, 30	5	17
	Distance education experience	I did not take distance education	1, 2, 3, 4, 5, 6, 7, 9, 11, 12, 13, 14, 15, 16, 17 18, 19, 20, 21, 22, 23, 24, 25, 26, 28, 29, 30	27	90
		I took distance education	8, 10, 27	3	10

Use of Technology in Face-to-Face Education

Upon investigation, it becomes clear that a significant proportion of lecturers (20 participants) did not use technological tools to teach mathematics in their classes before the pandemic. P5 expresses this situation as follows:

“Technological tools have always been and still are a part of our lives to obtain resources and literature, but in the lessons that I conducted face to face, I did not use technological tools at the time

of teaching, that is, at the time of transmitting the lesson.”

Some lecturers indicated that they benefited from technological tools in their face-to-face classes prior to the pandemic (five participants) or at least used them when instructing certain topics (5 participants). The results in Table 4 were obtained as the views of the said lecturers on how they benefited from technology in their instructing.

Table 4: Participants’ Use of Technology in Classes Pre-Pandemic

Type of Use	Participants	f	%
Reflecting lecture notes	12, 18, 27, 30	4	13
Watching a video/animation on the subject	12, 14, 18	3	10
Visualization of geometric shapes	8, 9,	2	7
Homework exchange	10, 11	2	7
Instructioning computer programming	12, 16,	2	7

The views of P12, who stated that she used technology tools in her face-to-face classes, such as history of mathematics and computer programming, to reflect on the notes on the topic and to watch videos in pre-pandemic process are as follows:

“[In my classes] *I used technological tools, although not very often. I used technological tools, although not very often. I used the computer and projection to share the videos and images with students during History of Mathematics classes and to share the screen with students in the Instant class in the programming classes where I taught coding.*”

Distance Education Experience

On the other hand, when it was investigated whether the lecturers had experience with distance education before the pandemic, it was found that only three participants had this experience. P8 expressed this situation as follows:

“[Distance education during the pandemic] *was not my first experience. Previously, I taught distance education as 1 lesson in 1 semester.*

Mathematics Instruction During the Pandemic Process

When the opinions of the lecturers were investigated, it was found that all of them conducted mathematics education through distance education during the pandemic. While two of the participants (P22, P29) conducted distance education during the fall and spring 2020-2021 semesters, all of the remaining lecturers (28 participants) conducted distance education from March or April of the spring 2019-2020 semester to the end of the spring 2020-2021 semester. The results about how the lecturers conducted distance education activities, mathematics instruction and whether they received support from their universities are presented in Table 5.

Table 5: Mathematics Instruction During the Pandemic Process

Theme	Category	Code	Participants	f	%
Mathematics Instruction During the Pandemic Process	Institutional support in distance education	Educational videos about the distance education system were shared	1, 2, 14, 15, 18, 19, 23, 24, 27, 28, 29, 30	12	40
		Online educations were organized about the distance education system.	11, 13, 16, 17, 18	5	17
		I got technical support	8, 9, 11, 27, 30	5	17
		I got hardware support	8, 11, 29	3	10
		I got software support	5, 29,	2	7
		Training meetings were held	30, 22,	2	7
		I have received notification emails	6,	1	3
		Technology class was created	22,	1	3
		I did not receive any support	4, 7, 10, 12, 20, 25, 26,	7	23

Distance education activities carried out	Synchronous education	1, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30,	28	93
	Asynchronous Education	2, 10, 12, 14, 15, 23, 24, 25, 28, 30,	10	33
	Lecture note sharing	4, 8, 12, 22, 23, 24, 30	7	23
Challenges in distance education	I had a hard time maintaining teacher-student interaction	1, 2, 3, 7, 8, 9, 10, 11, 12, 13, 15, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 30,	23	77
	I found it difficult (or not possible) to make sound assessments and evaluations.	1, 5, 7, 10, 11, 12, 14, 20, 21, 22, 23, 24, 27, 28, 30	15	50
	I had trouble explaining (or writing) mathematical operations	1, 5, 12, 13, 14, 15, 19, 20, 23, 25, 26, 30	12	40
	Student attendance (or course follow-up) was very low	1, 4, 11, 13, 14, 18, 24, 25, 27,	9	30
	Difficulty (or inability) of students to attend the class due to technical impossibilities	1, 4, 5, 7, 20, 22, 24,	7	23
	I had technical problems (or difficulties)	2, 6, 11, 16, 17, 19, 22,	7	23
	I had a hard time motivating students to the lesson.	9, 10, 11, 22, 23, 28,	6	20
	Creating distance education materials is time consuming	4, 5, 24,	3	10
	I had difficulty with classroom control	4, 14, 22,	3	10
	I had a hard time because of the high class participation.	11, 22, 27,	3	10
	Students experiencing technical problems (or difficulties)	11, 22,	2	7
	I had a hard time because the lesson times were short (or insufficient)	15, 22,	2	7
	I had difficulty in creating the appropriate environment and materials	24	1	3
	The effects of distance education on students' mathematics learning	Not as helpful (or effective) as face-to-face learning	1, 2, 3, 4, 5, 6, 8, 9, 12, 13, 14, 15, 17, 18, 19, 20, 22, 24, 25, 28, 30	21
It could not be understood (or I have no idea) because a healthy assesment and evaluation could not be made.		7, 11, 21, 23	4	13
Helpful (or more beneficial) for students who follow regular lectures		10, 16, 26, 27, 29	5	17

	Things that should be considered in future distance education processes	Assesment and evaluation process should be healthy	1, 2, 3, 5, 7, 8, 10, 11, 12, 14, 15, 17, 19, 21, 22, 23, 24, 27, 28, 29,	20	67
		Lecturers should be trained	1, 12, 14, 15, 20, 22, 23, 24, 25, 29,	10	33
		Hardware/software support should be given to lecturers	6, 12, 13, 20, 24, 26,	6	20
		Distance education platforms should be made more interactive	12, 14, 17, 27	4	13
		Students should be trained	1, 13, 20, 22,	4	13
		Technical infrastructure of distance education should be improved	12, 24, 28	3	10
		Student attendance should be mandatory (or encouraged)	8, 26, 27	3	10
		Hardware/software support should be given to students	6, 13,	2	7
		Lessons must be synchronized	24, 28	2	7

Institutional Support in Distance Education

In examining the results in Table 5, it is clear that the majority of lecturers (23 participants) receive support from the institution in which they work in a variety of ways related to distance education. When the findings are examined, the technical trainings given to the lecturers, especially on how to perform distance education, come to the fore. It is understood that the said trainings are conducted asynchronously by sharing videos by universities, synchronously in the form of online meetings, and face-to-face, albeit in a small number. In light of this ranking, the following are the opinions of P24, P13, and P22 about the support they received from their institutions.

“Unfortunately, we were not able to receive any technical support from our institution during the initial period of distance education. Unfortunately, no training or provision of technical aids (e.g. graphics tablet) was provided. Some videos (opening a module, creating an exam module, etc.) on the Mergen System, used in the distance education process, were shared only in a WhatsApp group set up by the department. Honestly, I think that since this is a crisis training and this is the first time such a system is being used, we did not get answers that comforted us for our questions and the situations we were worried about.”

“... Online presentations were given on the use of Distance Education and the Moodle program at the university. In the Moodle program, an online presentation was made including the opening of the weekly lessons, uploading the lecture notes and what to do during the exam process, and we were able to access the contents of this presentation in pdf format.

“Our institution created a special technology class for lecturers to maintain live instruction and left the choice of use up to the lecturers. Instructors who wanted and needed to taught their lessons synchronously or asynchronously in this class. Sessions were also held to introduce lecturers to the programme to be used in the distance education process and to present information on its use. It was an in-service training of sorts.”

On the other hand, seven of the lecturers indicated that they did not receive support from their institutions for the distance education activities they conducted during the pandemic process. The views of K10 on this issue are as follows:

“There was a computer provided by the university, I used it. I provided the other materials needed to explain the mathematics myself. Despite the large number of staff, we were unable to get sufficient/ necessary assistance from technical support It was not until days later that we received feedback on the problems that needed to be resolved immediately, with the words ‘there is no problem in the system’.”

Distance Education Activities Carried Out

When the distance education processes conducted by the lecturers during the pandemic were examined, it was found that almost all (28 participants) conducted synchronous applications (Table 5). In addition, it was found that nine of the aforementioned participants also conducted asynchronous education by making the lecture videos they recorded available to students on various platforms in addition to synchronous education. Similarly, six of these lecturers shared their lecture notes with their students. Another point that stands out here is that most of the participants who engaged in both synchronous and asynchronous distance education delivered their lessons mainly asynchronously. P30 expresses this situation as follows:

“The drawing tablet [Graphic] can be used to make necessary marks, explanations, etc. on course presentations. I have made videos as if I were teaching face to face at the blackboard. I shared the links to these videos on my YouTube channel with students and made the lessons accessible. I uploaded the module, consisting of a pdf file and a video link, to the institution’s distance education system for each week. During the semester, I had

two opportunities to deliver live (synchronous) online lessons with students. In these live classes, I delivered my presentations as if I were teaching from a whiteboard using a drawing [Graphic] tablet.”

On the other hand, it was clear that only P2 of the participants taught mathematics with asynchronous distance education, while P4 only shared his lecture notes with his students. The opinions of P2 and P4 are as follows, respectively:

“I taught the mathematics class using the graphics tablet that I bought with my own budget. I edited it by playing back the lecture notes I prepared from the pdf reader and recording it as a video. (...) I shared it with the students through the LMS system that our institution has set up as its own infrastructure.”

“Since these were theoretical courses, I completed the process by uploading the lecture notes as a pdf to the system.”

When examining the opinions of the lecturers, it became clear that some hardware, software, virtual meetings, and classroom applications were prominent in the distance education they conducted. The results of the above components are considered as subcategories of distance education activities and are presented in Table-6.

Table 6: Technological Tools and Software Used in Distance Education

Subcategory		Code	Participants	f	%
Technological Tools Used in Distance Education		Computer	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30	30	100
		Graphic Tablet	2, 9, 11, 12, 19, 20, 24, 26, 27, 28, 30	11	37
		Tablet Computer	7, 13	2	7
Web-based platforms used in distance education	Online course management systems provided by universities	Mergen, LMS, ALMS, Moodle	1, 2, 3, 10, 11, 13, 16, 17, 19, 20, 23, 24, 29, 30	14	47
	Online meeting applications	Zoom	3, 6, 10, 12, 18, 21, 22,	7	23
		Microsoft Teams	5, 6, 7, 9, 21, 26, 29	7	23
		Big blue button	1, 10, 27	3	10
		Google Meeting	14, 15	2	7
		Adobe Connect	18,	1	3

	Virtual classroom applications	Perculus	8, 11, 20, 22, 25,	5	17
		Google Classroom	14, 15, 18	3	10
		Blackboard	9	1	3
	Storage and sharing of contentsc	Youtube	10, 14, 15, 23, 24, 27, 28, 30	8	27
		Google Drive	23, 24, 28,	3	10
Software used in distance education	Word-processing and display etc.	PDF Reader	1, 2, 5, 6, 7, 8, 11, 12, 14, 15, 17, 18, 19, 20, 23, 24, 26, 27, 28, 29, 30	21	70
		MS OneNote	8, 10, 11, 22,	4	13
		MS Word	15	1	3
		Scientific Work Place	21,	1	3
	Presentation	Ms Power point	1, 5, 9, 12, 15, 19, 23, 28, 29, 30	10	33
	Screen recorder	OBS Studio	10, 23, 27,	3	10
		Bandicam	14,	1	3

P10, one of the lecturers, stated that he prepares lecture notes using a word processor, records his lectures on these notes using screen recorder programmes, shares the videos he prepares with his students both through the online course management system provided by his university and through a content sharing platform, and also conducts synchronous instructing through an online meeting application before exams as follows:

“I chose and used the One note programme (free) as a whiteboard to write my lecture notes and present my lectures. I recorded my lectures on One note through screen recording using OBS Studio (free). I created 15-20 minute long lessons. (...) I delivered synchronous lessons using the Big blue button embedded in the UBS system, and I delivered the asynchronous lessons by uploading videos to the system (...) I posted these lessons both on the university system and on my YouTube channel that I had created. (...) Before exams (usually in the evening), I tried to answer my students’ questions by sending them a Zoom link as an extracurricular activity. I did this before every exam.”

Challenges in Distance Education

When the opinions of the lecturers were explored, it became clear that almost all of them (except P29) experienced various difficulties or problems in the distance education process (Table 5).

P11 states that students do not participate in online classes regularly, that he has difficulty in

motivating and participating in class by ensuring interaction between lecturer and students in this process, assessment and evaluation activities cannot be done in a healthy way, on the other hand, distance education will be a more suitable choice for student groups with a smaller number of students.

“I was not able to achieve the efficiency I wanted because of the low online course participation of students and their interaction in the course. (...) Attendance at classes was low or non-existent. (...) Cheating and helping others on exams was very intense. (...) Since no effective method of assessment and evaluation has been found yet, I think students are not getting the education they need and are not motivated. But I think distance learning for small groups will be more effective than face-to-face teaching, for example, in graduate courses where the perception of students will be more open.”

P22 states that in distance education, there may be various technical problems and therefore there are difficulties in controlling the instructing and attracting students’ attention and motivating them to attend the class, and this situation also has a negative impact on the interaction between lecturer and students:

“Systemic problems may occur; power outage, Internet outage, [student] unable to see clearly because he/she is connected from the phone, etc. Kids have trouble turning on both the camera and the sound. In this case, we, the teachers, find it difficult to concentrate and motivate them. We cannot stop them

from engaging in different tasks. The question that the child asks during the lecture comes a little too late, or you notice it too late. In that case, you can not give effective feedback because you have already passed that point. You give the student the right to speak, he says he cannot turn the sound up, there's a system problem, or the computer microphone is broken. In this case, unfortunately, the interactive lesson cannot be processed."

P15 stated that she had difficulty solving questions in geometry class and that due to the short duration of the class in the distance education process, there might be difficulties in the future, as follows:

"I had a hard time teaching geometry. In one class, I wrote the solution to the questions on the board beforehand, recorded a video, and shared it that way. Sometimes this took the form of a live lesson, sometimes it took the form of writing the solution on the board and then recording it. This process leads to serious problems in the long run, for example, in a normal class period of 4 hours, we gave a half-hour lesson and were able to convey very sparse information. Even if our students get good grades, they will have a hard time when the normal conditions start."

P24 stated that she had difficulty in creating a suitable working environment at home and preparing materials for distance education, and that she had difficulty in establishing student-teacher interaction in the lessons she held with the freshmen

because she had not had the opportunity to teach face-to-face before, and that some of her students could not participate in the lesson due to technical impossibilities in the process:

"Since we continue our work remotely due to the pandemic and most people spend time at home in this process, it was difficult for me to find a suitable environment. Frankly speaking, even if we did not prepare the original materials ourselves, it took a long time to prepare the course materials. Moreover, the most worrying situation for me was the issue of copyright and how effective the courses would be on the students. (...) Unfortunately, not every student has the same resources. Therefore, I have students who cannot follow the course and fail the course. (...) Since I was teaching Analysis I- II [Calculus], most of my students were people I had never met in person. No matter how hard I tried to communicate with my students, they were generally shy. In the Analysis, I live class, only one of my students answered a question I asked. (...) In this case, of course, it is very difficult to interact with the student."

On the other hand, when examining the views of the lecturers, it became clear that some of them have carried out various activities to overcome the problems they encountered in distance education. The results of the said activities are presented as a sub-category of the category "Difficulties in Distance Education" and are reflected in Table-7.

Table 7: Methods of Coping with Difficulties in Distance Education

Sub-Category	Code	Participants	f	%
Methods used to cope with the difficulties in distance education	I tried to interact with students by asking questions (or giving them a voice)	1, 3, 9, 16, 18, 21, 22, 23, 25, 27,	10	33
	I tried to take measures to prevent cheating	14, 20, 24, 28, 30,	5	17
	I used a graphics tablet	24, 26, 30	3	10
	I gave homework	18, 23,	2	7
	I prepared detailed lecture notes	5, 24	2	7
	I got technical support	6, 24	2	7
	I asked students to keep a lesson diary.	18,	1	3
	I lectured in front of the blackboard	15	1	3

The views of P12, who stated that she asked questions to her students to make her instructing interactive, are as follows:

"Keeping students in class was one of the biggest challenges for me. (...) I tried to make the lesson interactive and get the students involved. Instead of explaining the topic or solving the question, I tried

to teach the lesson together by giving them the right to talk.”

P18 states that he tries to find solutions by doing in-class performance assessment, giving homework, and asking students to keep a class diary to ensure student participation in the lesson:

“When I noticed that some students were not listening to the lecture, I tried to get them to listen to the lecture or at least look at the lecture notes asynchronously after the lecture by giving performance assessments or giving homework in each lecture or requiring weekly diary of what was explained in the lecture.”

P30 states that she used a graphics tablet to explain the mathematics lessons in the usual way in the distance education process and prepared several exam sheets consisting of different questions for healthy assessment and evaluation, but this did not work:

“When we started the distance education process, it was very challenging for me not to teach a course like mathematics in writing. With the help of the Drawing [Graphic] tablet, I solved this problem and was able to make the instructional videos more useful for me and, I believe, for the students as well (...) Unfortunately, I could not avoid “cheating” on the exams I took during the distance education process. To solve this problem, I prepared the exams by grouping the exam questions with a lot of effort and time, but this was not the solution either.”

The Effects of Distance Education on Students’ Mathematics Learning

When the views of the lecturers on the effects of distance education conducted during the pandemic on students’ mathematics learning of undergraduate students were explored, it was found that the vast majority (21 participants) felt that the said education was not as effective as face-to-face education. The views of P19 on this issue are as follows:

“I think face-to-face education improves students both socially and in terms of teaching. In face-to-face education, communication skills are stronger, they become active and social. Distance education may be beneficial for developing skills in using technology. However, I do not believe that distance education contributes to students’ learning of mathematics.”

In addition, four of the lecturers indicated that they do not have a clear idea of the impact of the process on mathematics learning because the assessment and evaluation activities in the distance education process cannot be carried out in a healthy manner. P23 expressed this situation as follows:

“I believe that it is not possible to accurately determine how students learn mathematics because there is no adequate and reliable assessment and evaluation system.”

On the other hand, only five of the participants stated that the activities of distance education in mathematics are mainly beneficial to the students who attend the classes regularly. The views of P27 on this issue are as follows:

“(...)This process cannot be used effectively because the majority do not bother to get information such as ‘can the class be done remotely’, ‘even if you open the course online and leave the computer, nothing happens’. However, considering the productive aspects of distance education and the need for individuals to develop their own learning style, it can be said that distance education is quite productive for some conscious students who use the process effectively.”

Things that Should be Considered in Future Distance Education Processes

When asked about the lecturers’ opinions on what should be considered in the distance education activities that can be conducted in the future after the distance education experiences gained, the findings that lecturers should be trained (10 participants) and that the assessment and evaluation processes should be conducted in a healthy way (20 participants) are the most prominent. P12 expressed this situation as follows:

“I think that the people who will be conducting the courses should be technologically supported and trained at the time of training the trainers. In the assessment and evaluation process, the results in assigning homework for mathematics courses were not healthy, I think online exams should be conducted, but adding too many questions to the question bank in the exams must prevent students from seeing the same questions. The fact that the distance education systems used do not allow students to open their

microphones or even the lecturers' cameras has made this distance communication much less effective. I think that, in such processes, necessary precautions and infrastructure improvements should be made for such situations."

P28 stated that the technical infrastructure in which the instructing can be conducted synchronously and the measurement and evaluation activities in the distance education process are conducted in a healthy way should be created by universities as follows:

"I think that the distance education process should be taught in a synchronous way, on a weekly basis, in environments where the university creates its technical infrastructure. I think that creating

a system that prevents students from cheating on the exam will allow for healthier assessment and grading."

Instructing Mathematics after the Pandemic

The results regarding the changes in lecturers' thoughts and skills regarding instructing mathematics after the distance education activities they engaged in during the pandemic and whether they will benefit from the technology in their personal instructing after the experiences they had are presented in Table 8.

Table 8: The Effects of Distance Education During the Pandemic Process

Theme	Category	Sub-Category	Code	Participants	f	%
Instructing Mathematics After the Pandemic	The effects of the pandemic on mathematics instructing	Belief in instructing mathematics	There was no change in my perspective of instructing mathematics.	1, 2, 4, 5, 7, 8, 9, 16, 18, 19, 21, 23, 25, 26, 28, 29, 30	17	57
			There has been a change in my perspective of instructing mathematics.	3, 6, 10, 11,12, 13, 14, 15, 17, 20, 22, 24, 27	13	43
		Mathematical pedagogical knowledge and teaching skills	It did not contribute to my pedagogical knowledge and teaching skills.	1, 2, 4, 7, 8, 9, 15, 16, 17, 18, 19, 21, 23, 25, 26, 28, 29,	17	57
			It contributed to my pedagogical knowledge and teaching skills.	3, 5, 10, 11, 12, 13, 14, 20, 22, 24, 27,	11	37
			It partially contributed to my pedagogical knowledge and teaching skills.	6, 30	2	7
		Gained mathematical belief, knowledge and skills	My awareness of the use of technology in education has increased	3, 5, 6, 10, 11, 13, 15, 17, 20, 22, 24, 27, 30	13	43
			My technology knowledge/skill has improved	6, 10, 14, 17, 18, 20, 24, 28	8	27
			My beliefs towards distance education have changed positively	11, 12, 20, 27	4	13

The effects of the pandemic on face-to-face education	The use of technology in mathematics instructing	I intend to use technology in my lessons.	3, 5, 8, 10, 11, 12, 13, 14, 15, 17, 19, 20, 22, 24, 27, 29,	16	53
		I don't want to benefit from technology in my lessons.	2, 4, 7, 9, 16, 21, 25, 26	8	27
		I intend to partially benefit from technology in my lessons.	1, 6, 18, 23, 28, 30	6	20
	Innovations thought to be made using technology in lessons	Sharing lecture notes and assignments	1, 11, 18, 19, 20, 23, 30	7	23
		Benefiting from the technology on subjects involving three-dimensional shapes	6, 12, 17, 22, 24,	5	17
		Doing the appropriate courses (Practice, practice solution, etc.) with distance education	5, 11, 12 19,	4	13
		Benefiting from videos and animations	10, 12 ,24, 28	3	10
		Visualization/embodiment with math software	13, 24	2	7
		Taking compensation class with distance education	8, 11,	2	7
		Conducting verbal courses with distance education	15,	1	3
		Using a graphics tablet instead of a board	27, 29	1	3

The Effects of the Pandemic on Mathematics Instruction

When the lecturers' views on mathematics instruction were examined after their experience with distance education, it was found that the majority of them did not experience any change in their beliefs (17 participants) or pedagogical knowledge and skills (17 participants) (Table 8). In this regard, P7 who stated that he did not gain anything other than the experience of distance education in mathematics instruction is as follows:

"There was no change in mathematics education. I only gained experience in distance education."

Similarly, P28 who indicated that there was no positive change in her beliefs or pedagogical approaches to instructing mathematics indicated that there were improvements in her technological skills as follows.

"I used to believe that instructing mathematics remotely would not be successful. The pandemic process reinforced this thought even more. (...) Since we are instructing the lesson without getting feedback from the students during the distance education process, I cannot do it in a healthy way."

The views of P15, who stated that her views on instructing mathematics changed after the experience she had and that her awareness of the use of technology in education increased in the process, but there was no pedagogical difference, are as follows:

"I realized that we were inadequate because I saw how big the gap was between my beliefs, theory and practice. Thousands of publications are made every year, but we still did not know any program outside the Google classroom. (...) I struggled to communicate my pedagogical knowledge in a constrained environment. My pedagogical skills did

not improve or regress, I just felt inadequate. I found it very difficult to upload my knowledge.”

Following the distance education experience of the lecturers, it was found that a significant number had positive changes in their beliefs (13 participants) or pedagogical knowledge and skills (11 participants). In this regard, P20's beliefs about realizing mathematics education through distance education have changed positively and their awareness has increased, as follows:

“Thanks to distance education, I have seen that studies can be done by eliminating the problem of distance, especially at the graduate level, with the help of the technological tools we use. I think there are positive change in instructing skills. I can say that we are especially encouraged to use more technology.”

On the other hand, P30 states that although her awareness of using technology in instructing mathematics has increased, she still has concerns about this issue:

“In fact, I did not realize that I could make instructing more enjoyable with some technological tools along with writing on the board in my traditional face-to-face instructing. However, I still think that traditional mathematics instruction (where the student follows the lesson by taking notes while I teach in writing in the classroom) is the most useful method.”

The Effects of the Pandemic on Face-to-Face Education

When the participants' views were explored, it was found that after experiencing distance education during the pandemic, 16 of them believed they benefited from technological tools in various ways in face-to-face instructing, and seven of them believed they used them to some extent (Table 8).

P5, who expressed that she had not benefited from technological tools in mathematics instruction prior to the pandemic, indicated that she plans to use technology in her classroom after her distance education experience and that she may rely on distance education in this process if necessary:

“When face-to-face education is introduced, I plan to make some changes in the way I teach by adding the use of technology to the lectures. In other

words, the courses can be delivered as a blend of distance and face-to-face instructing. In the next period, I plan to transfer the habits I have acquired in distance education to the classroom environment and explain the necessary part of the lesson on the blackboard and the part where technological tools are needed.”

The opinion of P18, who is undecided about the use of technology in face-to-face instructing that he can get help from virtual classroom applications for homework, is as follows:

“I do not think my instructing will change much. Maybe I can use the Google classroom platform, which we also use in distance education, in situations like homework. I think it will provide convenience in terms of delivery, scheduling, and archiving of assignments.”

P24 expresses that she can benefit from the dynamic features of computer algebra system software in her face-to-face classroom because of her experience in distance education:

“(…) Before the Covid 19 epidemic, I took the Mathematica classes in our department to benefit my lessons. However, I never had the opportunity to benefit from the technology in my face-to-face courses. I think we should integrate technology into our face-to-face classes with the distance education process. For example, although it is easy to imagine the rotated area when dealing with volume in integral applications, I tried to explain the object to be formed after rotation to my students using known objects because I had difficulty drawing them. (...) I think I can benefit from visualisations using the technique. If I succeed, I plan to explain some topics with the help of Mathematica programme. Integral implementations, sequences, etc.”

On the other hand, contrary to the presented opinions, it became clear that eight of the lecturers did not think of using technological tools in their face-to-face classes. P26 expressed this situation as follows:

“Since I am a mathematician I think it makes more sense to explain in writing.”

Discussion, Conclusion and Recommendations

When examining the findings from the lecturers' views on the use of technology in

teaching mathematics in pre-pandemic process, it is clear that the vast majority (66%) did not use technological tools in their teaching. It was found that the participants who stated that they benefited from technological aids in their teaching mainly taught by reflecting with technological aids rather than writing lecture notes on the board (13%) or drawing geometric shapes (10%). It can be said that this type of use does not radically change the usual teaching routines, but only changes the environment through the use of technology so that participants do not move away from the traditional teacher-based teaching approach. In this context, it can be concluded that the use of technology in mathematics instruction process, which took place at the undergraduate level in the pre-pandemic period was quite limited and at a basic level. In fact, this level of technology use, referred to as “replacement” in the relevant literature, is considered the lowest level of technology integration in education (Hughes, 2005). Furthermore, it was found that almost all participants (90%) had no experience with distance education prior to the pandemic. In this regard, when the pre-pandemic results are evaluated together, it can be said that the commitment to using technology that came with the pandemic was a major challenge for the majority of the participants. In fact, the findings on teaching mathematics during the pandemic also support this finding.

When examining the findings from the opinions of the lecturers, it can be seen that the instruction was done with distance education by showing a quick reflex when the pandemic hit the entire country. It was understood that majority of the participants (93%) conducted their mathematics classes with synchronous instructing. It is understood that the participants who have done the distance education for about three semesters have various difficulties in adapting to the distance education, especially in the spring of 2019-2021, which is the first periods of the pandemic. Although universities have tried to support lecturers in this regard, it can be said that this has not had the desired effect. In fact, when examining the support that participants received from their institutions, it is understood that it was almost exclusively synchronous (17%) or asynchronous (40%) training or technical support (17%) on the

technical features of the distance education platforms to be used. On the other hand, it was understood that a significant proportion (23%) of lecturers could not obtain support from their universities. When the university supports remaining in the technical dimension and the technology use habits of the lecturers in the pre-pandemic courses are evaluated together, it can be said that mathematics instruction at the undergraduate level is conducted with the understanding of “emergency distance education” rather than formal distance education. Similarly, Durak et al. (2020) found that faculty training in the preparation process for distance education is the most difficult situation for universities. Moreover, they described the conducted activities as “emergency distance education” by expressing that in this process, not everything could be conducted smoothly because the lecturers of the educational activities conducted in universities during the pandemic were inexperienced in distance education and their knowledge and skills in preparing distance education materials were limited. In fact, Ak et al. (2021) concluded that training activities for online lecturers via distance education had a significant effect on lecturers’ self-efficacy perceptions and benefits perceptions of distance education. However, it would be wrong to expect lecturers to have an advanced level of technology integration in this regard for which they do not have sufficient knowledge and experience. In fact, when examining participants’ opportunities to teach mathematics through distance education, results were obtained that support this conclusion.

The vast majority of the lecturers delivered synchronous lectures (93%) or video-based asynchronous lectures (33%) via the lecture notes they had prepared in the computer environment using various word processors (77%) or presentation programs (33%). On the other hand, some of them preferred to write lectures instead of presenting the lecture notes they prepared using graphics tablets (37%) or tablet computers (7%) to overcome the difficulties they often encountered (40%), especially in explaining mathematical operations. However, in none of these processes, it was found in various studies that students did not use computer algebra systems or dynamic geometry software that increased

their interest in the course, provided opportunities for students to try things out by interacting with dynamic materials, and contributed to their individual learning (Ardıç & İşlenen, 2017; 2018). In other words, it can be said that during the pandemic process, lecturers conducted their instruction remotely using technology with the traditional instructional approach as before the pandemic. In fact, features such as instant video and audio communication, screen sharing, or creating learning groups offered by online meeting or virtual classroom applications used by almost all lecturers are very appropriate platforms for using dynamic mathematics software to interact with students in class. In fact, several studies emphasize that the student-centered approach of online learning, where individuals progress according to their individual learning speed, is quite promising in terms of pedagogy (Grieve et al., 2017; Ituma, 2011). However, despite this positive atmosphere, the fact that the software used in class are PDF readers or presentation programs that lecturers interact with may have caused students to remain passive in distance education. Findings about the difficulties encountered in distance education activities conducted during the pandemic also support this finding.

When the findings regarding the difficulties faced by lecturers in the distance education activities conducted are examined, it is clear that the majority of them (77%) experienced difficulties in providing teacher-student interaction. In fact, similar difficulties are frequently highlighted in the literature (Akıncı & Pişkin, 2021; Altun -Ekiz, 2020; Çakın & Akyavuz, 2020; Er-Türküresin, 2020; Hark-Söylemez, 2020; Karatepe et al., 2020; Kilit & Güner, 2021; Kurnaz & Serçemeli, 2020; Serçemeli & Kurnaz, 2020). Similarly, it can be seen that a certain proportion of participants (20%) have difficulties in motivating their students to attend classes, as highlighted in various studies (Karakuş et al., 2020; Karatepe et al., 2020). In addition, all said lecturers are considered to have difficulties in providing teacher-student interaction. Some participants (33%) tried to overcome this problem by asking students various questions or giving them the right to speak in synchronous classes. However, it can be concluded that these efforts did not have the desired effect and

that one of the main problems in distance education is difficulty in teacher-student interaction. Indeed, Cao et al. (2021) emphasized that one of the main difficulties that lecturers face in online mathematics instruction during the pandemic period is the inadequacies in teacher-student interaction, which supports this result.

Another difficulty that is noticeable in distance education is that assessment and evaluation activities in this process cannot be conducted in a reliable and objective manner (50%). In fact, similar problems are highlighted in different studies (Akıncı & Pişkin, 2021; Ezen & Ceylan, 2020). Although some of the lecturers (17%) who participated in the research tried to take measures to overcome this difficulty, it can be said that it had no effect at the expected level. This difficulty may also have had an impact on other difficulties encountered in distance education. For the fact that the assessment process, which is an important part of instructing, could not be done effectively and that some students could get high marks due to wrong practices, such as cheating or getting help from others, may have negatively affected the interest and motivation of other students. In addition, the fact that the assessment results obtained did not reflect the real situation at the students' learning level may have resulted in lecturers' failure to receive healthy feedback on their teaching and self-assessment. Tang et al.'s (2020) studies with undergraduates' participation also came up with results that support the current conclusions. In the above study, it was found that undergraduates were largely dissatisfied with their course participation, assessment and evaluation, and learning levels in distance education delivered using the traditional teaching approach. Furthermore, the findings obtained from the lecturers' views on the impact of distance education on students' learning of mathematics also support these conclusions. It was found that some of the lecturers (13%) do not have a clear idea about the impact of this process on students' mathematics learning because the assessment and evaluation activities in the distance education process cannot be carried out in a healthy manner. Similarly, the vast majority of the participants (67%) stated that "[students] *will have a hard time when the normal conditions start, even*

if they get good grades” (P15) and that distance education mathematics instruction is not as effective as face-to-face instructing. On the other hand, some lecturers (17%) believe that distance education is beneficial for students who attend classes regularly. However, considering the present results, it should be taken into account that students’ regular attendance in classes is influenced by teacher-student interaction and objective evaluation processes. In this context, it can be said that it is very difficult to understand the actual impact of distance education activities conducted during the pandemic process on students’ mathematics learning. Also, the fact that majority of the lecturers (67%) suggested that assessment and evaluation activities should be conducted in a healthy manner in the future distance education courses based on their experiences supports this finding.

It can be seen that the beliefs (57%) or the pedagogical knowledge and skills (57%) of the majority of the lecturers regarding mathematics education did not change after the distance education they conducted during the pandemic. On the other hand, it was understood that a significant proportion of them had positive changes in their beliefs (43%) or pedagogical knowledge and skills (37%). Similarly, a significant majority of lecturer indicated that their awareness of the use of technology in education increased as a result of the distance education process (47%), in parallel, there were positive changes in their beliefs about distance education (13%), and their technological knowledge and skills improved (27%). In addition, unlike before the pandemic, the majority of participants indicated that they will benefit from different levels and forms of technological tools in their face-to-face classes from now on (73%). In fact, the fact that Yıldız and Erdem (2018) revealed in their studies that knowledge about distance education influences the perception of benefits about this process supports the current findings. In this context, it can be concluded that distance education experiences gained during the pandemic process have a positive effect on a significant proportion of lecturers’ opinions about technology integration in mathematics education. However, considering that lecturers’ knowledge and skills have a significant impact on how they implement technology integration in the classroom

(Kim et al., 2013), it can be said at this point that the technology integration to be implemented will be at the basic level as it was before the pandemic. In fact, quite a few of the participants (7%) indicated that they would use mathematical software such as computer algebra systems that students can interact with in their courses. On the other hand, a large proportion of them indicated that they could use technology to make “appropriate” courses such as compensation classes (7%) or practice courses (13%) through distance education or to facilitate issues such as course grades and homework exchange (23%).

In the traditional understanding of mathematics education, mathematical information is divided into different skill parts and presented by the teacher to students in the position of passive receiver. Here, students are expected to be able to repeat the acquired knowledge and skills. In such an educational process, all control lies with the teacher, who is the sole authority. Therefore, all factors in the instructional process, including teacher-student interaction or a sound assessment and evaluation process are under the control and responsibility of the teacher. However, in the process of distance education experienced with the pandemic, the technology component between the teacher, who is an authority figure, and the student, who is a passive recipient, was integrated. In the process of technology integration in education, the authority is not only with the teacher. Authority is distributed among all participants in the process, including students and even technological tools (Koehler, et al., 2007). In the research, it was understood that this division of authority emerged as a new situation for lecturers and undergraduates with the pandemic. In this regard, it can be said that factors such as lecturers’ inexperience in technology integration in mathematics education, their inability to use computer programs such as dynamic mathematics software with which their students can interact, and the fact that students in many universities do not have to open their cameras or microphones in synchronous classes negatively affect the interaction between lecturers and students. Moreover, it can be said that some students for the first time abuse the initiative they have as authority figures and prevent healthy assessment and evaluation in homework and exams.

In view of the research findings, it can be suggested to organize training for academic staff of universities on technology integration in mathematics education. It should be noted that in the trainings to be organized here, it is not enough to train only the use of technological tools or distance education platforms. It is assumed that lecturers do not have problems with the use of hardware such as computers or web-based platforms such as online meeting applications, even at a basic level. In these trainings, lecturers may be trained by individuals who specialize in technology integration in mathematics education in dynamic geometry software (e.g., GeoGebra) or computer algebra systems (e.g., Mathematica) that allow them to facilitate student-computer interaction and create dynamic materials. In addition, the content of these trainings can consider technopedagogical competencies determined by theoretical frameworks, such as Technological Pedagogical Content Knowledge, that theoretically define the process of technology integration in the classroom.

Research findings indicate that students' skills to learn mathematics independently should be considered. Studying the way students use the authority acquired with the pandemic in the classroom and their individual learning skills will be useful to understand the impact of the training provided in this process. In this regard, various studies can be conducted that include undergraduates. On the other hand, in terms of equity, especially in teaching environments where technology integration is offered, it can be recommended to support students who need hardware, software and access to the Internet.

The results of the study are limited to the data of 30 lecturers working in 20 different universities in Turkey. For this reason, similar studies can be conducted with larger samples in different countries to obtain more generalizable results.

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Appendix–Opinion Form

1. Prior to the pandemic, we are living in; did you use technological tools for teaching mathematics in your face-to-face classes? If so, could you tell us how often and in what ways you benefited from them?
2. Did you do distance education (synchronous or asynchronous) during the pandemic? If yes, was this your first experience with distance education experience? How long did it last? From when to when?
3. Did you receive support (provision of technological tools, technical support, training, etc.) from your institution regarding distance education? If yes, can you talk about it?
4. Can you explain with an example how you teach your lessons in the distance education process? Can you also explain what technological tools, digital platforms (Zoom, YouTube, etc.), and computer programs (PowerPoint, PDF reader, etc.) you have used in this process?
5. What do you think about teaching mathematics with distance education when you compare it to the face-to-face instruction you are used to? Have you encountered any difficulties or problems in this process? Can you explain with an example?
6. If you have encountered any difficulties, how did you deal with them? Can you explain with examples?
7. Has your view of mathematics teaching changed as a result of distance education process? Did you learn anything new? Did your mathematics pedagogical knowledge, beliefs, or teaching skills change? If so, can you explain with an example?
8. Do you think your teaching will change (use of technology, different teaching methods, etc.) if you switch to face-to-face teaching after your experience in distance education? If yes, can you explain with an example?
9. What do you think about the impact of distance education on student learning of mathematics compared to the face-to-face teaching activities you did before the pandemic?
10. In your experience, what should be considered in distance education (student learning, pedagogical practices, assessment and evaluation, trainer's training, etc.)?

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