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THE VIEWS OF SECONDARY SCHOOL MATHEMETICS TEACHERS ON THEIR DISTANCE EDUCATION EXPERIENCES: THE CASE OF TURKEY

Research article

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Abstract

Distance learning process was initiated by the Ministry of National Education to allow equal opportunity and to improve accessibility, and the teachers provided online courses, exams or material. In the present study, conducted to determine the views of mathematics teachers, who are among the stakeholders in the process, on their experiences in online instruction of the mathematics course in secondary schools, phenomenology approach, a qualitative research method, was employed. The findings of the present study conducted with 105 secondary school mathematics teachers employed in seven regions in Turkey demonstrated that the middle school mathematics teachers considered distance education an obligation to continue mathematics courses and to maintain the communication with their students. It was also observed that the teachers believed that it would be difficult to instruct the mathematics course online due to its nature. It was determined that the predominant view argued that distance education allowed instruction of the course independent of the time and the place, and hence an advantage of the process, but the teachers also stated that distance education had certain cognitive, affective, technical and social disadvantages. The teachers complained that technical problems such as internet access and lack of tablets led to a difficult process.

Keywords: Distance education, mathematics lesson, teacher views, experiences.

1. Introduction

The Covid-19 epidemic, the effects of which increase every day, has adversely affected all lives, especially the health of individuals. While the measures adopted to protect human health led to several developments, the pandemic had a profound impact on education. After the Covid-19 pandemic, all nations quickly suspended face-to-face education and adopted distance education. Turkey was among the nations where distance education was adopted the fastest (Çalık & Altay). All formal public education institutions in Turkey rapidly transitioned to distance education and the EBA (Education Information Network) website (www.eba.gov.tr) and TV channel (TRT EBA TV Primary School, TRT EBA TV Secondary School, TRT EBA TV High School) were established by the Ministry of National Education to ensure equal opportunity in education and to instruct the courses online. Furthermore, teachers participated in online education via supplementary applications such as online classes, material sharing, online exams through the technological infrastructure.

Literature review revealed that there are several definitions of distance education in the literature. According to Zigerell (1984, 10), distance education is a form of instruction characterized by the physical separation of the teacher and the student, except for occasional face-to-face meetings required by certain projects. Similarly, according to King, Young, Drivere-Richmond and Schrader (2001), distance education is a formalized educational learning method employed when time and geographical constraints do not allow face-to-face education between the teacher and student. According to Newby, Stepich, Lehman, and Russell (2000), distance education is an organized instruction program where teachers and students are physically separated. The review of the common characteristics in the above-mentioned definitions demonstrated that distance education entails the physical separation of the teacher and the student. Also, distance education is a planned and organized form of education. Thus,

it was obvious that there was a physical separation between the teachers and students during the pandemic. Furthermore, the pandemic started at a critical time when learning processes were active in all formal education levels. Thus, there was no other option but to quickly transition to distance education globally. In cases where face-to-face education is not possible, distance education is the best alternative. In a study that investigated whether distance education was as effective as face-to-face education, Tucker (2001) did not report a significant difference between the pre-test scores, assignment grades, research paper grades and final course grades of the two classes that were instructed the same course online and face-to-face by the same teacher. This supported the finding that academic learning takes place in distance education. According to Sadeghi (2019), the advantages of distance education include education everywhere and anytime, significant savings in educational expenses, no need for commuting to work, and winning when learning, and the disadvantages include attention deficit, dependence on technology, lack of social interaction, communication problems with educators, and accreditation of the degrees earned in distance education.

When the historical development of the distance education process is examined, it is seen that the first distance education applications started in the United States of America in 1852 through letters. Then, in 1921, for the first time, distance education experiences were made with the radio. This process, which started with the radio, continued in the form of distance education experiences with television for the first time in 1934 with the invention of television. With the development of computers and the internet, distance education has begun to be adopted worldwide (Casey, 2008). Even before the pandemic period, distance education practices from university to pre-school in many countries in the world continued in the form of hybrid, blended or flipped learning.

After the adoption of distance education in formal education institutions in Turkey, the instruction of all courses was redesigned for distance education. A different design was a must due to different requirements in distance and face-to-face education methods. In distance education, instructional design is one of the most important issues (Burns, 2011). The basic elements of instructional design in distance education include paying attention to student views, the determination of the learning tasks and content, providing choices for the students, the determination of instructional strategies adequate for distance education, accurate and active employment of the media, the determination of the adequate learning environment, the assessment of instructional quality and the selection of adequate materials (Zheng & Smaldino, 2009).

The design of distance education courses provides different learning environments and experiences for the students. For instance, a class conducted with asynchronous discussions provides a fundamentally different learning environment and experience when compared to synchronous classes. Similarly, online hybrid or blended learning environments offer different experiences (De Carvalho Borba & Llinares, 2012). In all these methods, teachers should utilize online technological tools and design the courses specifically for distance education. The design of the mathematics course in distance education is of great importance to achieve the goals of the course. According to Beatty and Geiger (2010), teachers could utilize four types of designed technologies that could improve collaboration, communication and student groups in online mathematics education. The technologies designed for and employed in mathematics education include the following:

1. Internet networks that include mathematical objects to provide mathematics education and collaboration,

2. Computer-assisted mathematics education that do not prioritize cooperation but employed in mathematics education and graphical tablets,

3. Online technologies employed to create virtual communities in distance education, where collaboration is prioritized but are not specific to mathematics education,

4. Robotic technologies that do not prioritize mathematics education or cooperation.

Several studies were conducted on online mathematics courses throughout several years in the literature. The teachers who participated in in-service training on distance mathematics education stated positive views that they adapted to the distance education format rapidly, employed their time flexibly, and liked receiving in-service training before appointed in an institution (Santos & Ponte, 2003).

According to a study that investigated the effectiveness of online mathematics education, distance mathematics education at high schools in Iran was not as efficient as face-to-face education. It was suggested that this was due to inadequate distance education planning and the students could not integrate in the educational community (Safavi, Rostamy-Malkhalifeh, Behzadi & Shahvarani, 2013).

According to the study by Mulenga and Marban (2020) where the impact of Covid-19 on the transition to digital learning in mathematics education was investigated, distance education in mathematics education is perceived as a less formal instruction method that is fun and interesting rather than rigid and conventional. It was suggested that a virtual classroom, where students could easily access knowledge, was important, and as the attendance was no longer compulsory, mathematics education should be supported with virtual classrooms.

In another quasi-experimental study where the impact of distance mathematics education instructed during the Covid-19 pandemic was analyzed, it was observed that distance education had positive effects on motivation, autonomy, participation, mathematical concepts, course outcomes, and grades. Thus, it was suggested that distance education was feasible in mathematics courses in high school education (Moreno-Guerrero, Aznar-Díaz, Cáceres-Reche & Alonso-García, 2020).

In a study on the barriers to e-learning during the Covid-19 pandemic based on the views of secondary school mathematics teachers, teacher views were analyzed with respect to the teacher, school, curriculum and student. The most important finding in the study was the fact that the e-learning barrier was at the student level. This demonstrated that students did not have adequate knowledge and skills about the applications employed in distance education before the pandemic (Almanthari, Maulina & Bruce, 2020).

The determination of the learning and instruction processes in distance education, which was conducted as the primary education system for the first time in Turkey due to the Covid-19 pandemic, would provide a roadmap for future applications. Thus, it was considered important to report the views of secondary school mathematics teachers on distance education experiences to contribute to future online mathematics instruction. Previous studies indicated that mathematics course has positive impact on student learning when supported with effective and adequate technologies, and low study performance could be improved with technology use (Perienen, 2020; Zelkowski, Gleason, Cox & Bismark, 2013). An effective distance education requires the improvement of the motivation and technological competence of teachers (Ulusoy & Şahin, 2016). However, there is also evidence that online mathematics instruction was more difficult when compared to other courses (Smith & Ferguson, 2005).

Due to the above-mentioned reasons, in this study, the views of the secondary school mathematics teachers, who instructed their courses online in seven regions in Turkey, on the suitability of distance education in the mathematics course, whether they had previous distance education experience before the pandemic, how they instructed their courses in distance education, the advantages and disadvantages of the process, the problems they encountered,

the assistance provided to improve their professional competency, the courses available on EBA, whether they would like to continue online courses after the pandemic, and whether online education could be an alternative to face-to-face education were determined and analyzed with a holistic approach to provide guidelines for future studies on distance education and contribute to the literature.

The present study aimed to determine the views of secondary school mathematics teachers, who are among the stakeholders of distance education, on their experiences.

1.1. Purpose of the Study

The present study aimed to investigate the views of secondary school mathematics teachers on their experiences in distance education.

2. Method

The present study , was used phenomenological design, a qualitative research method. The phenomenology design is a qualitative research method that investigates past experiences (Jasper, 1994; Miller, 2003). In phenomenological studies, data sources are individuals or groups that could reflect on the study phenomenon (Yıldırım & Şimşek, 2008). During the analysis of the study data, individual and past experiences and the personal perceptions of the participants are assessed in-detail (Smith & Eatough, 2007). Phenomenology design focuses on phenomena that we are aware of but do not have a deep and detailed understanding. Facts appear in various forms such as events, experiences, perceptions, orientations, concepts and situations in the world. Within the scope of this study, the thoughts of mathematics teachers in different regions of Turkey about distance education were tried to be revealed.

2.1. Participants

In compliance with the aim of the study, 105 secondary school mathematics teachers employed in seven regions in Turkey and volunteered to participate in the research were assigned to the sample to determine their views on their experiences in distance education. The study sample was determined with the convenience snowball sampling technique. In the technique, the researcher meets with individuals with in-depth knowledge on the research topic and learns about other individuals with the same qualifications from the individuals that she or he meets (Ekiz, 2009, 106). Thus, the authors first collected data from the secondary school mathematics teachers they could reach. Then, the initial interviewees reached other teachers that could be interviewed; and thus, the study data were collected with this method. Data collection was terminated when at least 10 teachers were interviewed in each region. The distribution of the number of participating teachers by regions is shown in Table 1. In this section, the results of two questions in the interview are also given; the distance education experiences of the teachers participating in the study before the pandemic (figure 1) and their status of receiving distance education (figure 2).

Table 1. *The Distribution of the Study Group Participants Based on the Regions*

Region	#of teachers
Mediterranean	14
Aegean	10
Marmara	17
Black Sea	10
Central Anatolia	16
Eastern Anatolia	25
Southeastern Anatolia	13
Total	105

The teachers who formed the working group were asked whether they had experience with distance education before the pandemic period. The results are shown in Figure 1.

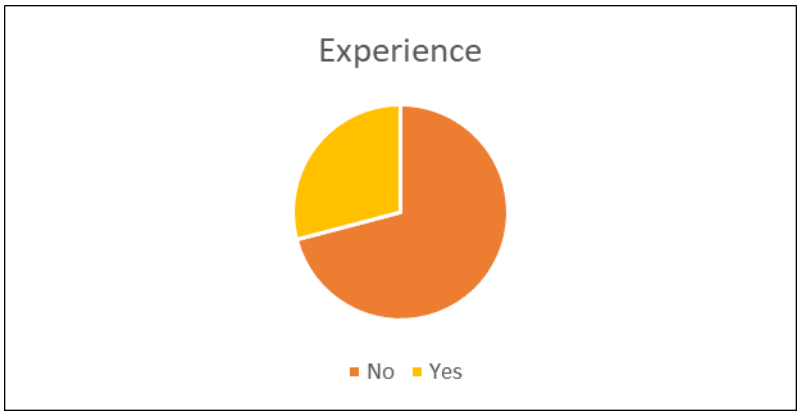

Figure 1. The experience of mathematics teachers on distance education

As seen in Figure 1, the majority of the secondary school mathematics teachers did not have any experience in distance education before the pandemic. It was determined that the mathematics teachers who had distance education experience before the process mostly utilized WhatsApp to send questions or shared EBA assignments. The findings on the participation of other secondary school mathematics teachers in in-service training on distance education are presented in Figure 2.

The teachers who made up the study group were asked whether they had received training to increase distance education skills. The results are shown in Figure 2.

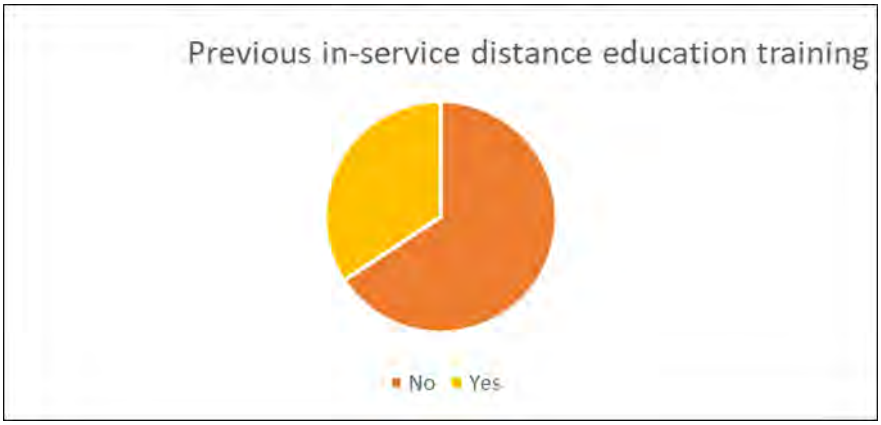

Figure 2. The participation of mathematics teachers in distance education training

As seen in Figure 2, most secondary school mathematics teachers did not take any distance education training before or during the distance education process. It was observed that the mathematics teachers who attended training before the pandemic mentioned the undergraduate courses or the seminars organized by education faculties they attended. Furthermore, it was determined that certain teachers attended training on Web 2 tools or eTwining quality meetings. It was observed that the mathematics teachers followed social media posts on distance education and participated in online courses.

2.2. Data Collection and Analysis

The study data were collected with a semi-structured interview form developed by the authors and finalized based on the expert opinions. In order to ensure the reliability of the interview questions of the research, a total of 3 experts, 1 assessment and evaluation specialist, 1 curriculum development specialist and 1 mathematics education specialist, were consulted. In line with the feedback received, some questions were rearranged and some questions were removed. Then, as a result of the preliminary interview with 5 people, some of the questions were corrected and the form was given its final shape. There are 10 questions in the semi-structured final interview form. The participants completed the semi-structured interview form online. The data were collected at the end of the first semester after the adoption of distance education, on June, 2020. The participant responses were analyzed by the authors. The interview data were analyzed with descriptive and content analysis techniques in the study. Content analysis entails the interpretation of similar data grouped based on certain concepts and themes (Yıldırım & Şimşek, 2008).

In the analysis, initially, the interview data were organized to reflect the views of a particular teacher. Teacher responses to the interview questions were included as they were, and attention was paid to ensure data integrity. Then, the interview transcripts were transferred to the MAXQDA qualitative data analysis software and the data were coded separately by the two authors. These codes were combined and discussed until full inter-coder agreement. After the discussions, the codes were grouped under themes. Then, the codes and themes were organized, and the findings were interpreted based on these themes and presented with direct participant quotes. For the convenience of future researchers, the participants were coded based on the region of employment (M, C2, SEA3, etc.). Certain interview questions are presented in categorical graphs due to their nature, while others are presented in hierarchical diagrams and with quotes.

In the qualitative data analysis process, in order to ensure reliability, the percentage of agreement formula was used while calculating the consistency between the encodings that were

determined as a result of the analysis of both researchers. Agreement percentage was calculated with the formula "Confidence=Agreement /(Agreement + Disagreement) x 100" (Miles & Huberman, 1994). According to Yıldırım and Şimşek (2008), when the percentage of agreement in the reliability calculation is 70%, the percentage of reliability is considered to have been reached. According to the results obtained, it is thought that the ratios above 70% are sufficient for the coding reliability of the researchers. In this study, the analysis process continued until the consistency coefficient reached 100%.

3. Findings

In the present study, where the views of secondary school mathematics teachers on their experiences in distance education were determined, they are presented with descriptive and content analysis data. The findings on the experiences of secondary school mathematics teachers before the distance education process and whether they participated in-service training on distance education are presented are presented under the title of participants (see 2.1. participants).

According to the findings obtained from the opinions of teachers regarding the suitability of distance education in mathematics teaching it could be suggested that the participating mathematics teachers had different views on the suitability of distance education in mathematics instruction due to the structure of the latter. The findings on the suitability of distance education in mathematics instruction are presented in Figure 3.

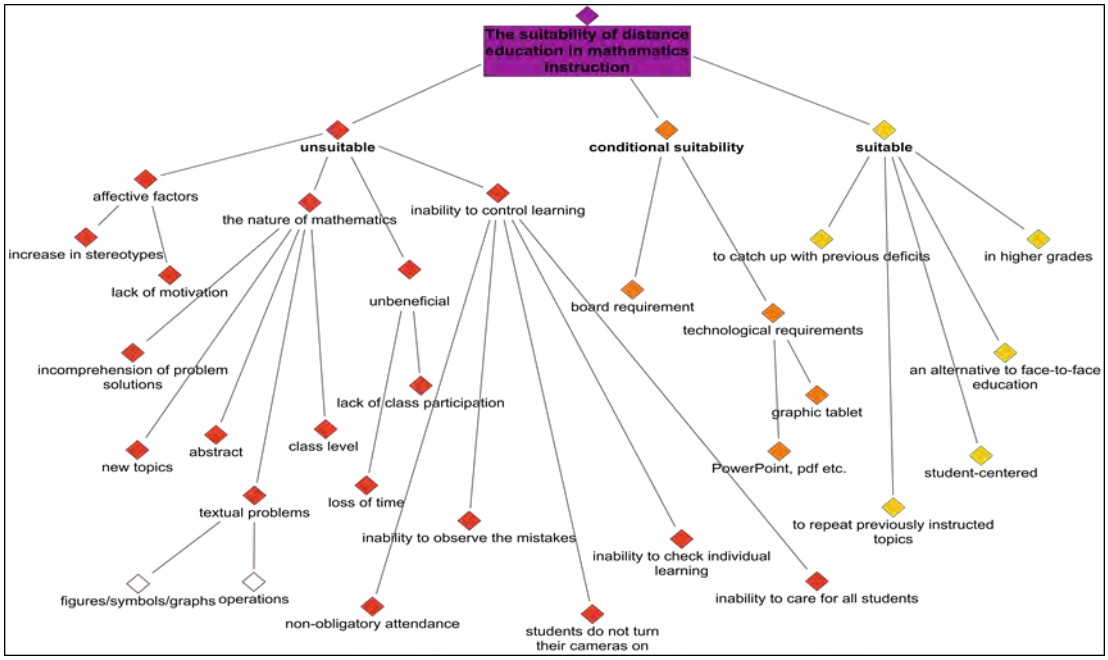

Figure 3. The suitability of distance education in mathematics instruction based on teacher views

As seen in Figure 3, three sub-themes were determined based on teacher views on the suitability of distance education for the mathematics course: unsuitable, conditional suitability, and suitable. Most teachers stated that distance education was not suitable for mathematics instruction due to the nature of mathematics, the inability of the teachers to control learning during distance education, and affective factors such as high anxiety/low motivation. The mathematics teacher C2 emphasized the structure of the course as follows: "*No, I do not think*

it is suitable. Since shapes and numbers are used a lot in math, I had trouble drawing on a computer or phone screen." It was observed that the problem of writing due to the structure of the mathematics course was stated by several participating mathematics teachers. In addition to the difficulty of writing in the mathematics course, it was also noted that it was also difficult to use course materials in distance education. The mathematics teacher BS3 stated the following: *"...I had no trouble explaining the graphs. But I experienced difficulties in geometry. When I was instructing the geometry course to the 5th graders, I had a hard time in these topics because I could not check their drawings, unlike in the classroom, or guide them how to use the ruler, and also because I could not provide feedback on the use of the goniometer when measuring or drawing angles. It was difficult to follow their progress and comprehension.*" The teacher emphasized the problems in the employment of course material that allow the concretization of the topics and providing feedback to the students. Similarly, other mathematics teachers stated that it was difficult to check student comprehension. Several teachers stated that students could not see their mistakes in online mathematics course and teachers could not monitor individual learning. As seen in Figure 3, teachers associated their inability to monitor learning with student unattendance in live classes due to the lack of obligation, and their avoidance to turn the camera on when they do. Thus, they stated that distance learning led to an ineffective mathematics learning-instruction process.

Another reason argued by the teachers for the unsuitability of distance education included the increased impact of affective factors such as concerns, fear, anxiety and motivation in the mathematics course during distance education. Certain mathematics teachers argued that the stereotypes about mathematics increased in the online education process. Furthermore, certain teachers claimed that student motivation was not possible in online mathematics course; and thus, distance education was not suitable for the mathematics course. A notable study finding was the statements of certain teachers that distance education could be suitable for mathematics course when certain conditions are met. These conditions which were included in the sub-theme of conditional suitability included the board requirement and technological requirements according to teacher views. Mathematics teachers stated that eye contact was important as they instructed the class using the board and the board facilitated the instruction of mathematical equations. The mathematics teacher EA19 stated the following: "*In mathematics, the board is used frequently. First, this problem should be resolved. A graphic tablet or a board with a camera should be utilized*." However, this problem was associated with the inequality of opportunity. Certain participating mathematics teachers stated that they experienced difficulties in procuring graphical tablets. The teacher CA4 stated the following: "*Initially we experienced problems in writing, we decided that we should buy a graphical tablet, I am not exaggerating, the prices increased 5-6 times. Thus, we risked it and ordered the tablets from China.*" Furthermore, the teachers argued that the fact that the students did not have internet access, computers or smart phones was another problem associated with inequality of opportunity. They also stated that distance education could be suitable for the mathematics course provided that certain conditions are met, eliminating the inequality of opportunity.

Certain mathematics teachers, on the other hand, believed that distance education could be suitable for the mathematics course, although not as much as the face-to-face instruction. According to the participating mathematics teachers, distance education can be considered as an alternative to face-to-face education so that the students would not fall behind in the curriculum. Furthermore, they believed that distance education was suitable for the mathematics course to prevent the lags in the math curriculum or to repeat the topics that have previously instructed. The mathematics teacher EA10 stated that distance education could serve as an alternative: *"I could instruct the topics and solve the questions easily, especially when I used the screen mirroring. I could point at the related text and questions in the books*

easily. Of course, it may not be as effective as face-to-face education, but I considered distance education suitable for mathematics course at certain intervals in certain topics." Similarly, the teacher EA22 stated the following: "*In the pandemic, extensive use of EBA allowed for individualized education. Thanks to the homework assignment and online education platforms, the students had an environment where they could catch up with the past topics. Undoubtedly, this was very important for the mathematics course…*" Thus, it could be suggested that mathematics teachers believed that the courses in EBA were effective in catching up with the missed topics in the mathematics course. However, the mathematics teachers had contrasting views on the adequacy of the courses in EBA. The findings on the views of the teachers on the adequacy of mathematics courses in EBA are presented in Figure 4.

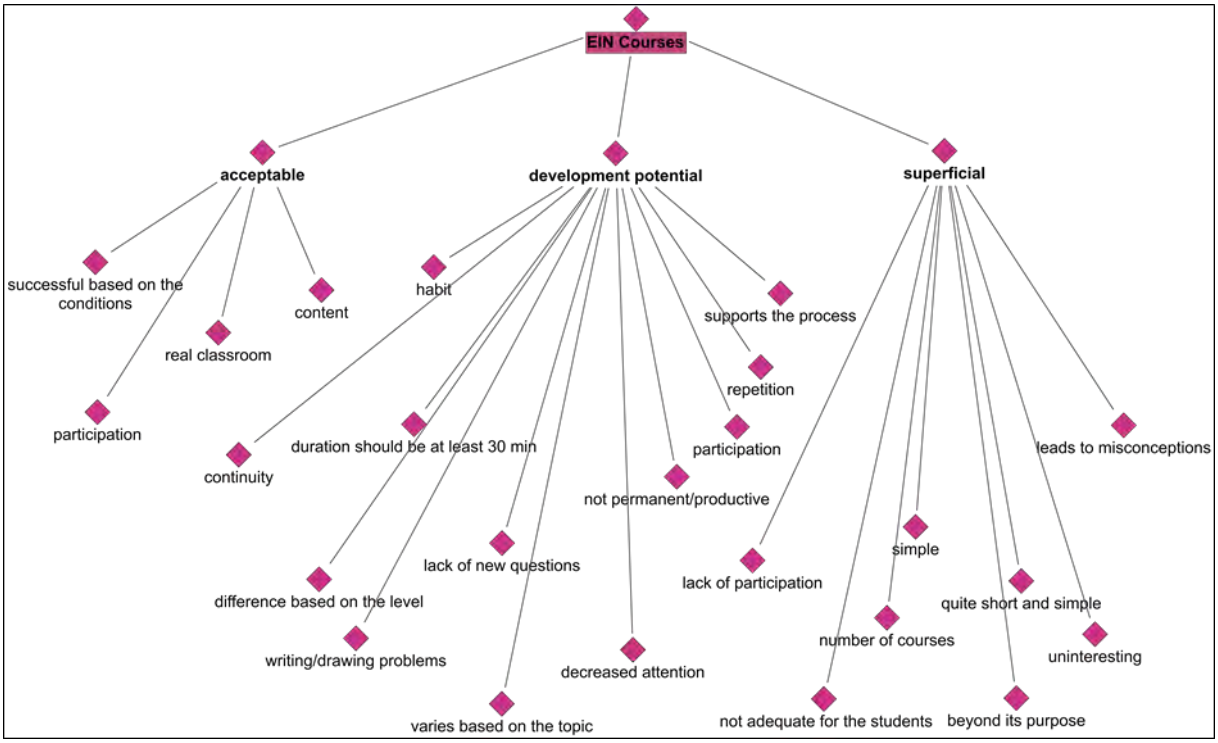

Figure 4. The views of mathematics teachers on EBA courses

The views of the participating teachers on the mathematics courses broadcasted on EBA were classified under the themes of acceptable, development potential, and superficial as presented in Figure 4. It was determined that the teachers who considered the EBA mathematics courses acceptable, stated that the courses would be more effective with student participation and a classroom environment is ensured. Furthermore, the same group of teachers stated that their views were based on the current conditions and the courses were very successful. The mathematics teacher EA16 stated the following: "*The effectiveness was low due to the lack of interaction, but it was not an easy task to organize that many teachers in such a short time and provide instruction for all grades. Because it was not an expected development. Thus, it was quite successful regarding the current conditions.*" Furthermore, it was determined that the mathematics courses in EBA were both sufficient and insufficient. Similarly, other mathematics teachers argued that the EBA mathematics courses should be improved. It was observed that the teachers claimed that the EBA mathematics courses supported the process and ensured the continuation of educational activities; however, the courses did not lead to permanent learning and were not productive. Furthermore, certain mathematics teachers considered the number of skill-based questions in EBA low. Also, it was observed that the differences between the mathematics courses in various grades were not

adequate. The mathematics teacher M14 stated that "*EBA TV primary, secondary and high school course channels should be different.*" Certain mathematics teachers also emphasized that the courses in EBA were different in different topics. Similarly, other mathematics teachers considered the EBA mathematics courses inadequate. It was observed that these mathematics teachers considered the EBA courses very short and simple. Furthermore, they stated that the number of courses were limited. The teacher BS8 stated the following: "*The number of courses was insufficient. We could not instruct half of the number of classes we instructed with face-to-face education.*" Also, the mathematics teachers stated that the mathematics courses in EBA were not interesting, and the students were reluctant to watch the courses. Certain teachers argued that mathematics courses in EBA led to misconceptions among the students; and thus, they were unnecessary. It was determined that several mathematics teachers instructed their courses live to supplement the courses in EBA. The instruction methods adopted by the participating mathematics teachers in distance education are presented in Figure 5.

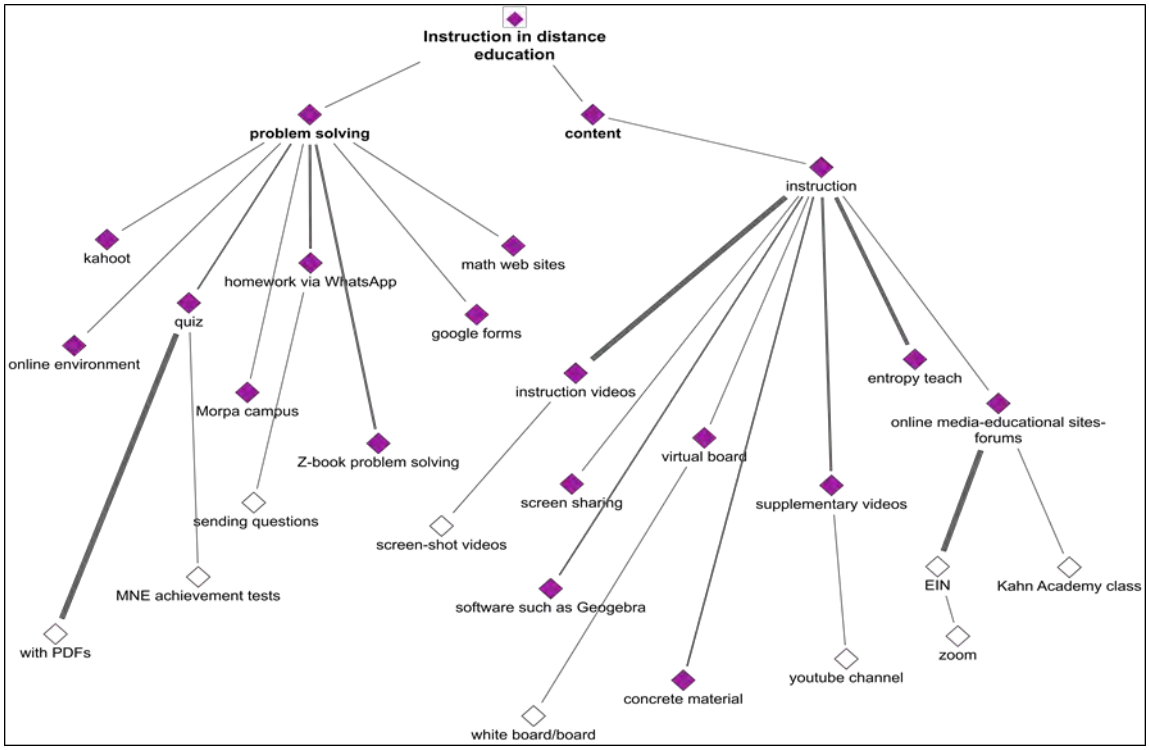

Figure 5. The course content adopted by the mathematics teachers in distance education

The analysis of the views of the mathematics teachers who participated in the study demonstrated that teacher instructions in distance education were classified under problem solving and instruction categories. It was determined that the teachers mostly prioritized problem solving in their mathematics syllabi during the process. Furthermore, it could be observed that mathematics teachers preferred the WhatsApp application in problem solving activities. The mathematics teacher M8 stated the following on the preference of this application: "*We did question and answer sessions on WhatsApp. I instructed the 8th grade during the pandemic, so I used WhatsApp to help children with the problems they could not solve*." As seen in Figure 5, teachers employed various sources simultaneously when solving mathematical problems. In this process, Z books was the most preferred resource that mathematics teachers employed. Furthermore, it was determined that mathematics teachers investigated the Z book application in different publishers. Also, it was observed that problems in MNE achievement tests or practice exams were solved in the classes using PDF files. In addition, it was determined that mathematics teachers employed various online media such as different mathematics web sites. The teacher SEA5 stated the following: "*I tried to diversify*

the process by sharing the screens of the smart board applications of publishing houses, educational sites and internet forums, by writing, drawing and instructing on these platforms, and by providing the students with an opportunity to solve problems on shared screens." On the other hand, it was determined that the Google form was employed to check the learning levels of the students rather than diversifying the process. Similarly, it was determined that online media and educational sites/forums were employed during instruction. It was observed that the most frequently employed site was khanacademy.org.tr for student activities.

It was observed that mathematics teachers instructed the course in the distance education process with various methods. As seen in Figure 5, the mathematics teachers predominantly employed prerecorded videos in instruction. It was determined that mathematics teachers employed YouTube videos as well as screen-shot videos. Similarly, it was determined that mathematics teachers also used virtual boards during instruction. Furthermore, they stated that they employed Entropy teach, an interactive board software, in instruction. They claimed that the Entropy teach software was convenient for the instruction of the mathematics course. The mathematics teacher M9 stated the following: "*When I did my first class on my mobile phone, I saw that it limited me. But then I realized that I could instruct the topic very easily (with screen sharing) with the Entropy files I develop on the computer before the class. The instruction is quite easy with software where one can draw several mathematical shapes.*" Furthermore, mathematics teachers stated that they diversified the instruction with GeoGebra and Cabri 3D software.

It was observed that the participating mathematics teachers diversified both instruction and problem-solving in distance education. The weekly course hours were different as well as the instruction methods in distance education. The variations in the weekly course hours of mathematics teachers during the distance education process are presented in Figure 6. However, it was observed that the course hours of certain mathematics teachers were undetermined. The mathematics teacher CA9 stated the following on this fact: "*The process was determined based on the program assigned by the administrators…*". Furthermore, it was determined that the course hours were not consistent. The mathematics teacher A6 stated that the course hours differed based on the grade: "*I instructed online every day, 3 classes a week with 8th graders, 1 or 2 hours per week with the others*." As seen in Figure 6, most mathematics teachers instructed online between 1 and 5 hours. It was determined that mathematics teachers who instructed for 6-10 hours per week instructed 2-3 days per week. On the other hand, it was found that the mathematics teachers who instructed for 21 hours or more instructed every day. Thus, the high number of mathematics teachers who instructed every day was a significant finding in the study. The mathematics teacher A2 was active online every day: "*Almost every day of the week, re-instruction of the topics, tests, sample MNE problems…*" Most teachers identified that they instructed every day on WhatsApp and EBA.

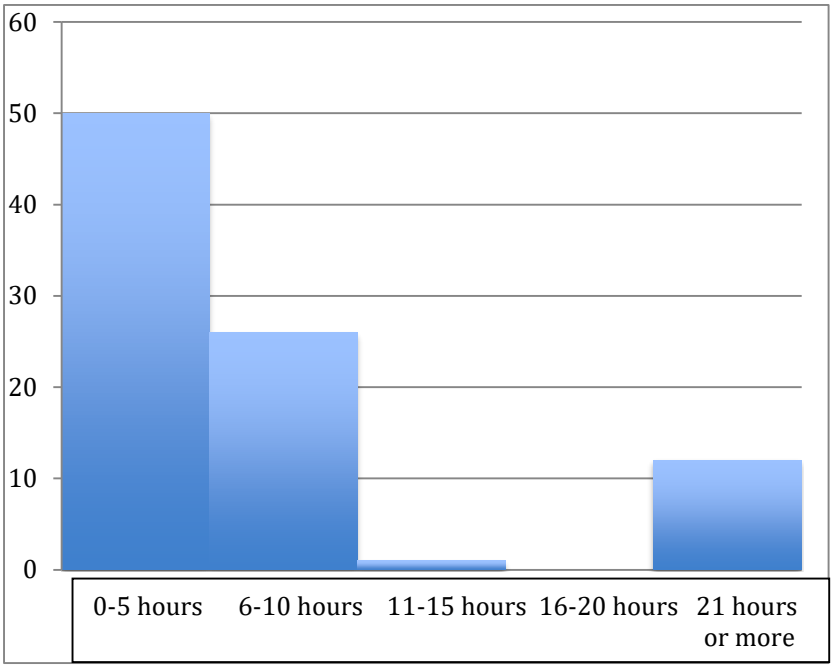

Figure 6. The weekly course hours in distance education

Based on the experiences of mathematics teachers in the process, the advantages and disadvantages of distance education in the mathematics course and the difficulties experienced by the teachers are discussed respectively. The advantages of distance education for the instruction of the mathematics course are presented in Figure 7.

As seen in Figure 7, the themes on the advantages of distance education in mathematics course were determined as flexibility, contribution to development, learning-instruction process, sustenance of education and awareness of values. The teachers mostly emphasized time and space flexibility in their views classified under the theme of flexibility. The mathematics teachers considered the time and place independent instruction from home an advantage of distance education. The mathematics teacher CA8 emphasized the comfort of instruction from home: "*The only advantage for both parties (teacher and students) was saving time. If we are prepared for the class, it is great to sit in front of the computer 5 minutes before the class*." Furthermore, mathematics teachers underlined the sustainance of education, even if it was distance education, to maintain their bond with the students, and stated that distance education prevented the expansion of the gap between the teacher and the class. The mathematics teacher A3 stated the following: "*During events such as the pandemic, it was possible to prevent students from staying away from the class*." Another theme under the category of the advantages of distance education based on teacher views was contribution to development. The related sub-themes included the improvement in technology and computer use, personal, professional and social development. Since mathematics teachers had the opportunity of personal and professional self-development during distance education, they considered this an advantage of the process. The mathematics teacher ME7 stated the following: "*As a teacher, I acquired experiences in a field that I had no previous experience, researched and improved my technological skills.. For example, I tried to use the blank spaces in the test I downloaded, or the board displayed via the camera in my first classes, later on, I discovered that the whiteboard (in EBA) was more adequate for instruction, and I started using it.*"

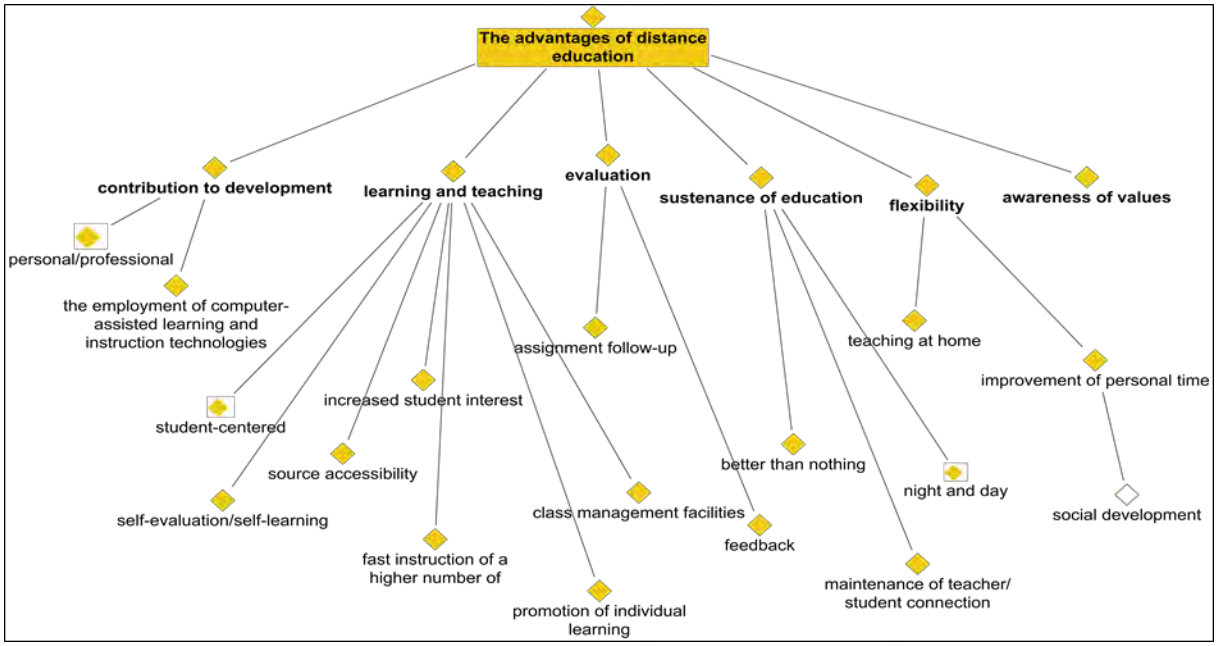

Figure 7. The advantages of distance education according to mathematics teachers

The mathematics teacher ME6 stated that distance education increased personal time: "*I spared enough time for my own child and spouse. Also, I had the chance to read about 25 novels in 3 months for my personal development…*" It was determined that there were several advantages of distance education in the learning-instruction processes in mathematics according to mathematics teachers. Certain teachers observed that the interest of certain students in mathematics increased in the process. However, the most significant finding was the view that distance education was not suitable for every student, but an advantage for active, diligent, hardworking, and successful students with parental awareness, and who are interested in the course and could study on their own. The mathematics teacher BS3 stated the following: "*Interested students attended the classes and controlled self-learning. Schooling was voluntary, not compulsory. So, they became aware of their efforts*." Similarly, the teachers emphasized that the distance education process contributed to the development of self-regulation/self-learning strategies among the students. Furthermore, it was determined that distance education in mathematics course promoted individual learning. It was stated that this was more beneficial for the students who will take the LGS (High School Entrance Examination). Furthermore, it was observed that according to the teachers, the process improved value awareness and contributed to the appreciation of the school and the teachers.

Thus, distance education has certain advantages for the mathematics course. However, it was determined that the process also had certain disadvantages. The disadvantages of distance education are presented in Figure 8. The disadvantages of distance education in the mathematics course were categorized in sub-groups. For example, it was suggested that the limitation of affective learning during distance education was a disadvantage. Among these factors, the increased disinterest in the mathematics course among the students was considered as a disadvantage by several teachers. The mathematics teacher A2 stated the following: "*There were only 1-2 people who took the floor and answered questions. It was very difficult to conduct operations, and we had to write them very slowly. Participation was low among the students…*" Also, the teachers stated that the disadvantages were not the same for every student, similar to the findings on the advantages of distance education. The mathematics teacher SEA7 emphasized that disenfranchised students were affected more by the process: "*Distance education is difficult for students who need support*." Furthermore, it was suggested that the

process may present disadvantages for students with negative beliefs about distance education. The mathematics teacher EA22 stated that "*The most important difficulty was the disbelief about the effectiveness of distance education among students and parents and only a small number of students participated in the process…*" Also teachers stated that the learning environment was not effective in distance education since the students did not participate in the mathematics course even though they seemed to be interested. Thus, certain mathematics teachers argued that they could not touch the souls of the children in distance education and could not provide adequate guidance. It could be suggested that affective and cognitive factors alleviated each other, becoming a disadvantage in distance education. Thus, most mathematics teachers claimed that the process was not efficient. Also, they thought that the students were not mentally active in mathematics classes. The teachers stated that the mathematics learning-instruction process was not as efficient as face-to-face education. Furthermore, the teachers argued that the mathematics learning-instruction process was not effective and permanent in distance education. On the other hand, the teachers could not monitor student comprehension in the mathematics classes.

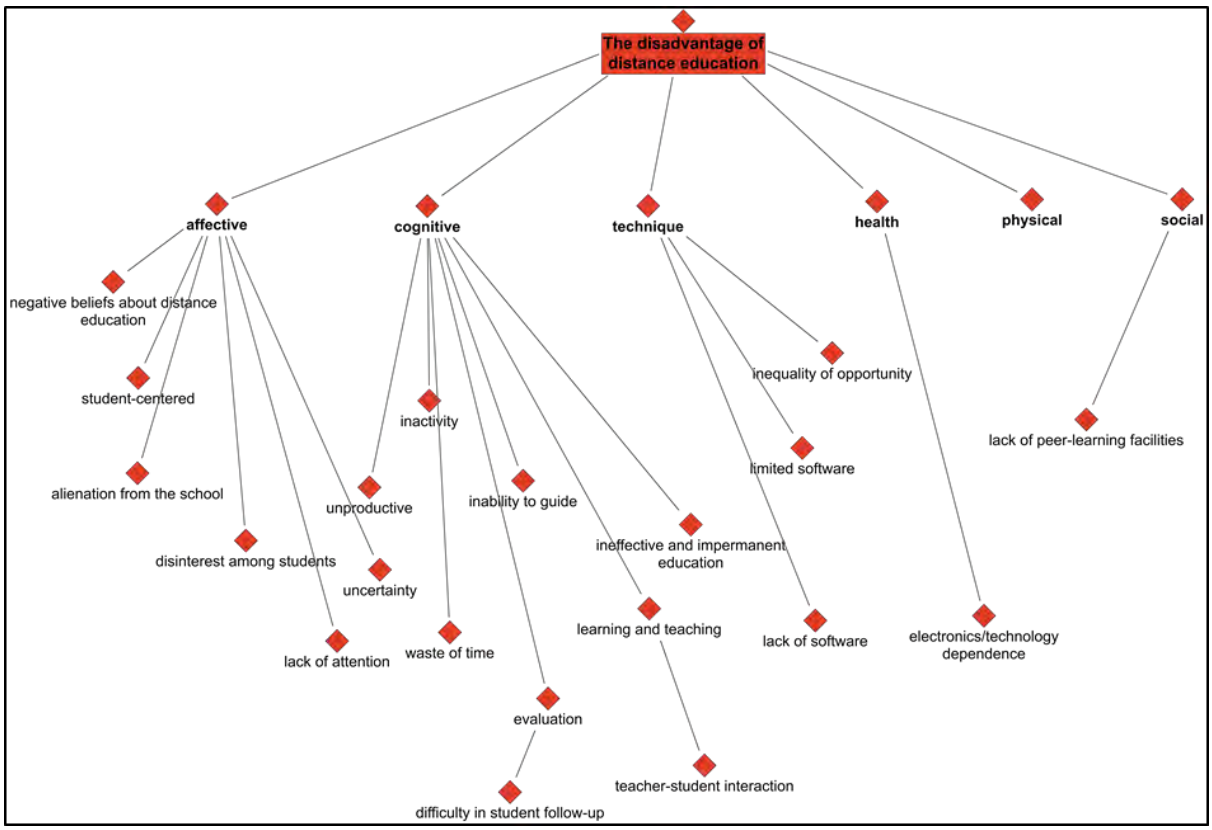

Figure 8. The disadvantages of distance education according to mathematics teachers

The lack of technical facilities for distance education was constantly mentioned by most mathematics teachers. They considered this fact as a disadvantage of distance education. They argued that teachers or students could not write mathematical equations. M2 coded The mathematics teacher M2 stated that "*Student participation was very low in live classes due to GB quotas in internet connections. It was not possible to write on the screen without a graphic tablet. I wasted time until I bought a graphic tablet. Since the students did not own that equipment, they could write on the screen, so the instruction was one-sided …*" On the other hand, it was determined that mathematics teachers experienced physical and health problems in technology use. The mathematics teacher CA4 stated the following: "*We could not even come close to the productivity of one class hour in 5 hours of online live classes. My neck hurt*

from looking at the PC screen :) Soon, I also expect further physical problems". Thus, the disadvantages of distance education in the mathematics course were several. Along with these disadvantages, certain difficulties were experienced during the online mathematics classes. These difficulties are presented in Figure 9.

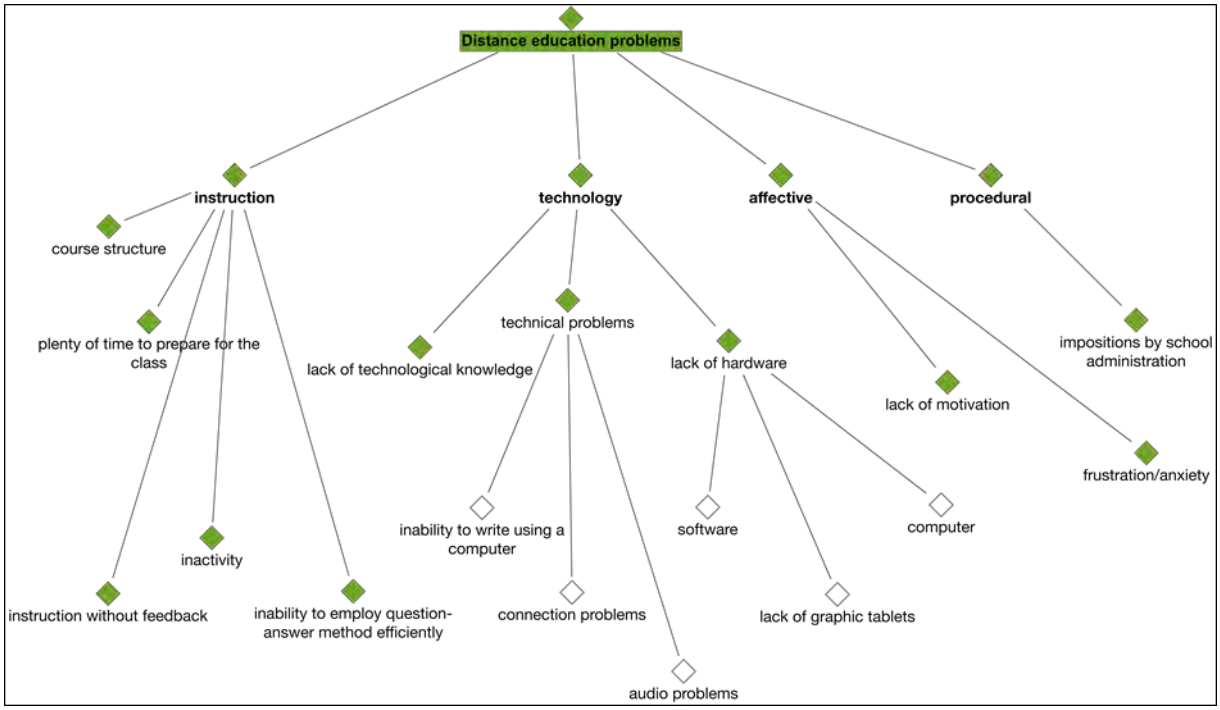

Figure 9. The problems experienced by mathematics teachers in distance education

These difficulties were basically grouped into four categories: mathematics instruction, technology, affective and procedural problems. The structure of the mathematics course itself was a challenge in the mathematics instruction in distance education. Furthermore, the time that was allowed for the preparation for the course was plenty and that was considered a problem by the mathematics teachers. Teachers also stated that they could not use the question-answer method effectively in distance education in the mathematics course. And the mathematics teachers argued that it was difficult to instruct without any feedback. The mathematics teacher EA16 stated the following: "*Myself, I could not achieve the dynamism in the classroom environment. I could not use the question-and-answer method effectively."* One of the difficulties experienced in distance education was about technology use. It suggested that almost all participating teachers agreed on that. Technological difficulties were discussed in three categories: the incompetent technological knowledge of mathematics teachers, technical problems and lack of equipment. The teachers lacked technological knowledge for the employment of EBA and Zoom software. On the other hand, according to mathematics teachers, technical problems included inability to write using the computer, connection problems and audio problems. Also lack of hardware was another technological problem. According to mathematics teachers, the lack of software, computer and graphic tablet required for distance education was in this category. Another challenge experienced in distance education was the affective factors. Mathematics teachers argued that distance education led to low motivation and communication barriers among the students. Furthermore, they stated that the anxiety of students for mathematics increased during the distance education process. Finally, it was observed that the pressure of the school administration, which was among the procedural problems, was another problem experienced in distance education. Thus, it was determined that several problems were experienced in the instruction of the mathematics course in distance education. However, certain participating mathematics teachers also stated that

distance education could be an alternative to face-to-face education when necessary. The data on the views of mathematics teachers that whether distance education could be a conditional alternative are presented in Figure 10.

Figure 10. Whether distance education could be an alternative based on the views of the mathematics teachers

In Figure 10, it could be observed that more teachers considered distance education as a conditional alternative to face-to-face education. The teachers considered distance education a supportive/assistive/complementary alternative in mathematics education. It was a significant finding that mathematics teachers, who more frequently expressed the disadvantages and difficulties of distance education in the mathematics course, considered distance education an alternative. On the other hand, it was determined that certain teachers were definitive in their views that distance education could not be an alternative to face-to-face education. Most mathematics teachers employed statements such as "*absolutely not*," and "*it could never be...*". It was determined that mathematics teachers with positive views emphasized the distance education could be an alternative only based on certain conditions. The teachers emphasized that it could be an alternative when there is no other solution, when communication facilities are not available, in groupwork of 3-4 students, and for the reinforcement of the topic. Also, most mathematics teachers stated that distance education could be an alternative when necessary and adequate technological tools and equipment are provided in mathematics course.

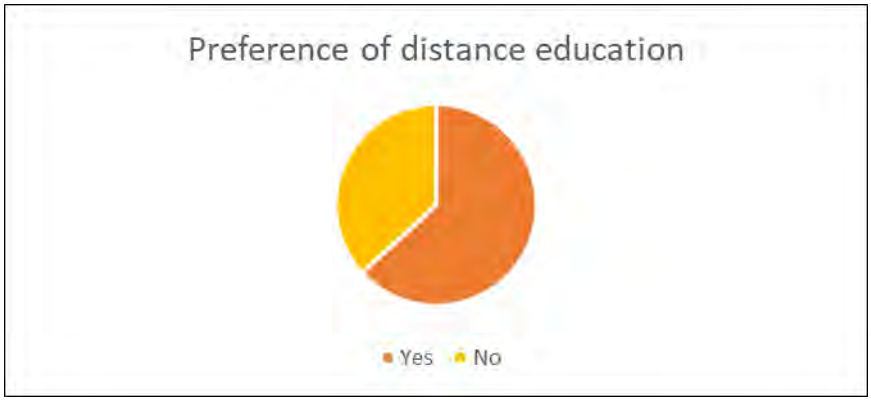

Figure 11. The preference of distance education by the mathematics teachers

Thus, distance education could be an alternative in the mathematics course based on the conditions. Similarly, the preference of distance education in the mathematics course varied based on the aim of the teachers in distance education. It could be observed in Figure 11 that the distance education process was preferred by mathematics teachers. Similar to the preference of distance education as an alternative, the views of the teachers who did not prefer

distance education were precise and clear. However, it was determined that the aim of using distance education was effective on the views of the teachers who preferred distance education in mathematics course. It was also observed that distance education could be preferred to provide easy access for the interested student in the mathematics course. The mathematics teacher CA11 stated the following: "*I plan to continue, not for all students, but for interested and productive students with*." However, another mathematics teacher stated that she/he may prefer distance education to improve student readiness. It was also observed that most mathematics teachers preferred distance education when they are on leave or when they fall behind in the curriculum (holidays etc.). Furthermore, it was determined that mathematics teachers could prefer distance education in weekend courses or summer school. The mathematics teacher EA1 stated that he may employ distance education maybe occasionally: "*I can solve the problems that the students could not solve in the classroom during the summer vacation and semester break when we cannot meet face to face. After all, I believe that it is much more effective than writing the solution of a problem on paper and mailing it*." Also, it was observed that teachers preferred distance education in cases where the mathematics curriculum is not adequate.

4. Discussions and Conclusion

After the Covid 19 epidemic, various measures were implemented in Turkey, similar to other nations, and face-to-face education was suspended. During this period, the sustainability of education was ensured with TRT EBA-TV channels, online courses, EBA internet platform, printed and digital supplementary material. Thus, distance education, which was employed in several countries and institutions before the pandemic (Gökbulut, 2021), was adopted as an alternative to face-to-face education. It could be suggested that it was appropriate to adopt distance education (Allean & Seaman, 2017) as an alternative to face-to-face education, where regular education could be conducted synchronously or asynchronously based on one or several technologies to support the regular interactions between the teacher and the student located at different places.

It was observed that the majority of the participating mathematics teachers did not have distance education experience before the pandemic, and the experiences of the few teachers who stated that they had prior experience were limited to questions sent via instant messaging applications for measurement purposes or assignments on EBA. Thus, it was determined that most secondary school mathematics teachers did not have any distance education experience before the pandemic, and they did not attend any in-service distance education training before or during the process. It was determined that the teachers, who attended seminars on distance education during the pandemic, took initiative to attend courses on social media and EBA, and participated in webinars organized by national education directorates. Thus, it could be suggested that mathematics teachers were caught unprepared in the pandemic, several teachers learned about distance education in the process, implemented the method for the first time, and learned how to manage the process in practice. It was determined that teachers tended to improve their experiences with Web 2.0 learning tools. Especially since the 2000s, advances in Web technologies created new opportunities for individuals to learn by sharing and experiencing in social learning media. Web 2.0 technologies (O'Reilly, 2007), which led to a new era in the internet world, allowed educational activities such as exchanging ideas, sharing knowledge, adopting different approaches and interpretations, and acquiring learning experiences in discussion environments (Alexander, 2006; Thompson, 2007; Vaughan, 2010). It could be suggested that teachers were aware of the contributions of the Web 2.0 tools to distance education, and they tried to improve in this field.

It was expected that mathematics teachers, inexperienced in distance education, would agree that distance education was not suitable for the mathematics course. For quality learning, the resources suitable for the course should be included in the distance education system (Başaran, Doğan, Karaoğlu & Şahin, 2020). However, the limitations associated with the materials and resources used in mathematics, which has its own language that includes numbers, shapes and symbols, may have led to this view among the teachers. Mathematics teachers, who did not use various materials in the distance education process and stated that it was difficult to present mathematical symbols, operations and figures on the screen, believed that distance education was not suitable for this course. However, certain teachers argued that mathematics course could be instructed online if certain tools or software that would allow presentation of mathematical figures and symbols on the screen such as graphic tablets, are available. This view was also clearly reflected in the findings on whether distance education could be an alternative to face-to-face education. Mathematics teachers were united around the idea that it could only be considered as an alternative to face-to-face education when the necessary technological infrastructure is available. Even the teachers who claimed that distance education was suitable for the mathematics course associated this view with the employment of distance education to repeat the topics, catch up with the curriculum, and only for senior students; thus, even these teachers were not sure about the suitability of distance education.

In Turkey, distance education was adopted one week after face-to-face education was suspended on March 12, 2020, and education activities were transferred to EBA TV. To reach more students, the distance education was extended to TRT EBA TV after a while with an agreement between the Ministry of National Education and TRT. It was observed that the views of the participating teachers on the mathematics courses broadcasted on TRT EBA TV varied. It could be suggested that this diversity also reflected the perceptions of the teachers during the pandemic. It was observed that pragmatist teachers considered EBA courses acceptable since the application allowed the education to continue under the unexpected current conditions of the time. Other teachers considered the content quite superficial and simple, and stated that they identified mistakes that could lead to misconceptions in EBA courses, and these teachers could be considered the realistic ones. Also, other teachers believed that EBA courses could be improved and listed certain recommendations. Thus, it could be concluded that the teachers believed that the mathematics courses broadcasted on EBA could be improved even if they were not productive and permanent, and they considered it a requirement for the sustenance of education.

Based on the study findings, it would be accurate to classify the instructional styles of mathematics teachers in distance education under two groups: problem-solving and instruction. It was determined that teachers focused on z books, exams (especially achievement tests), and sharing question on social networks when solving problems (Bakioğlu & Çevik, 2020). It could be suggested that they employed various resources and software in instruction. It was determined that teachers predominantly employed the EBA site in instruction. Since they connected to the Zoom platform via EBA to create online classes, the above-mentioned finding could be expected. Although they stated that they preferred the Zoom platform for online classes, the online course hours differed. Considering the time when the present study was conducted, this variation was normal. The duration and number of courses were not standard; however, the mathematics teachers stated that they instructed online classes for up to 24 hours a week based on the student requirements. The number of teachers who stated that they did not instruct any online class was quite low at the time of data collection.

Similar to any novelty, distance education has advantages and disadvantages. The perceptions of mathematics teachers about the advantages of distance education included the freedom provided by the method to instruct the course whenever and wherever they desired.

Teachers stated that distance education provided flexibility in time and space (Bardelle & Martino, 2012) and it was easier to instruct or attend the classes at home. It was stated that the advantages of distance education in the learning-instruction process included ease of access to resources, support for students with individual learning awareness, improvement of self-evaluation skills, and facilitation of classroom management. Furthermore, teachers considered the review and improvement of technological skills to adapt to the process as an opportunity (Bakioğlu & Çevik, 2020) and considered this an advantage for their personal and professional development. Basilaia & Kvavadze (2020) reported that the adaptation to online instruction and assignments in distance education had a positive impact on teacher competencies. It was determined in the study is that mathematics teachers considered online education an advantage since it prevented the discontinuation of the education process and interruption of the student involvement. Burke and Dempsey (2020) reported similar results in a study conducted with school administrators. The views of the principals on the reasons for the adoption of distance education in schools in Ireland also included themes such as sustaining the interaction with students and routines.

Mathematics teachers, who expressed the above-mentioned advantages of distance education, also stated certain cognitive, affective, social, health-related and technical disadvantages. Mathematics teachers, who considered distance education as an obstacle to active communication with the students, complained that the classes were not effective and permanent, students were indifferent, could not focus and the classes were not sufficiently effective. Teachers also argued that student follow-up was difficult, and they could not provide active feedback, and the process also had disadvantages in measurement and evaluation. They stated that negative beliefs developed and increased among the students about distance education, the uncertainty of the pandemic wore the students out and affective learning was negatively affected in the process. Similar to previous study findings, teachers emphasized the technical problems they experienced as a disadvantage of distance education (Fiş Erümit, 2021; Keskin & Özer Kaya, 2020; Almanthari, Maulina & Bruce, 2020) and stated that not every student was involved in distance education in the same degree. Teachers argued that the students could not collaborate, communicate effectively in distance education, and peer learning was not possible, reflecting the social disadvantages of distance education. Teachers also emphasized that sitting in front of the screen and exposure could lead to various health problems. Teachers stated that the impact of distance education was not the same on all students. Based on the Figures 7 and 8 that reflect the advantages and disadvantages of the process according to the teachers, the sub-theme of student-oriented nature in both figures should be associated with this view. Based on the cognitive impact of the process, teachers considered distance education as an advantage for students who are competent in self-learning, require less assistance in the learning process, and could self-evaluate.

It could be suggested that the difficulties experienced by mathematics teachers in distance education and their views on the disadvantages of distance education were consistent and associated. It was determined that the teachers experienced instructional, technological, affective and procedural difficulties. Due to the nature of the mathematics course, the need to instruct numbers, shapes, symbols and the relations between these elements in writing may have led to instructional problems. Adverse cycles such as internet access problems, technical reasons such as lack of tablet computers (Bakioğlu & Çevik, 2020; Erduran & Muslu, 2020; Almanthari, Maulina & Bruce, 2020) or low interest in the course due to emotional factors such as low motivation and anxiety, difficulties in the acquisition of achievements due to the lack of confidence in technological competencies and lack of hardware such as computers or tablets among the teachers, or the lack of teacher-student communication, leading to ineffective instruction could have led to difficulties in the process (Sengıl Akar & Kurtoğlu Erden, 2021).

It could be suggested that the above-mentioned problems could have led to the idea that distance education could not be an alternative in mathematics instruction, but could only be useful to repeat previous topics, to catch-up with the curriculum, and in problem-solving, as a compliment to face-to-face education. It was suggested that the same difficulties also affected teacher preference for distance education. The fact that there was not a single participating teacher who preferred distance education to face-to-face education unconditionally supported the above-mentioned finding.

Based on the teacher responses to various questions such as the difficulties they experienced in distance education, whether distance education could be an alternative to face-to-face education, and its feasibility in mathematics education, the mathematics teachers could not prioritize the quality of the instruction, they did not have sufficient time to improve instructional quality and tried to save and sustain the education process during the initial days of the pandemic, when the present study was conducted (Basilaia & Kvavadze, 2020).

Due to the pandemic, several teachers in different branches at all grades started to live unusual lives. However, it should be accepted that it would take more time to adapt to the process in the mathematics course, the learning of which is based on abstraction and in which the students need to comprehend abstract concepts. The present study confirmed the difficulty in the instruction of mathematical concepts online during the pandemic process based on the views of the teachers (Irfan, Kusumaningrum, Yulia & Widodo, 2020; Almanthari, Maulina, & Bruce, 2020). For the students to develop high-level mathematical skills, learning environments that allow investigation, exploration and explanation should be developed (Van De Walle, Karp & Bay Williams, 2012). Thus, it could be argued that mathematics course is open to development in face-to-face learning environments (Khirwadkar, Khan, Mgombelo, Obradovic-Ratkovic & Forbes, 2020). Then, the following question should be considered: “How should the online learning and instruction processes be in mathematics?” It could be predicted that scholars will have to work on an answer to this question.

In summary, it could be suggested that distance education is a solution to maintain learning activities during the pandemic (Lestari & Gunawan, 2020). It was accepted that teacher-student and student-student interactions would be as effective as face-to-face education when adequate methods are employed (Rüzgar, 2004). Furthermore, it could be suggested that teachers who own the required devices for the instruction and comprehension of the mathematics course, uninterrupted and cost-effective internet access, adequate resources and motivation would manage the process better, and students with the same facilities would be the frontrunners in online mathematics classes (Mulenga & Marban, 2020).

5. Recommendations

The participants of current study were mathematics teachers working in secondary schools. It is expected that similar studies will be carried out for teachers in other branches.

All students and teachers can be offered free and unlimited internet connection and technological tools to use in mathematics lesson.

During and/or after the pandemic, in-service education courses should be organized in order to improve teachers' skills in using information technologies and designing learning environments in distance education.

Learning environments in distance education should be prepared in a way to increase learner-content, learner-teacher, learner-learner interaction. Especially in mathematics lessons, interactive content that teachers can use in lessons should be developed.

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