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A survey on the views of students sharing the same environment in distance and face-to-face education regarding teaching environments

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Abstract

The application of internet technology to distance education has resulted in exciting advancements. However, the obstacles encountered reduced this enthusiasm. Integration of distance education and face-to-face education has been the focus of more research in recent years. For both learning environments to be effective, students' opinions about these environments are important. The aim of this study is to investigate the views about teaching environments of students who share the same environment in face-to-face education preceding distance education, distance education and face-to-face education following distance education. This research is a survey study. The universe of the survey comprises of 12th grade students enrolled in high schools affiliated with the Ministry of National Education in Turkey in the 2021–2022 academic year. Due to the COVID-19 pandemic in their 10th grade, these students have transitioned from face-to-face education to distance education. These students have engaged in both face-to-face and distance education with the same classmates and teachers. Within the scope of the survey, 622 high school students were administered a questionnaire. The analysis of the questionnaire responses yielded findings on topics such as teaching environment materials, in-class communication, active participation, and teaching focus. According to students, after distance education, teachers use the smart board more efficiently. At the same time, more blackboards are being used in science and mathematics courses than before distance education. It has been determined that distant education classroom communication is problematic. It has been determined that face-to-face education is preferred by students over distance education. Students believe that some face-to-face courses can be taught remotely. However, it is understood that students prefer face-to-face science and mathematics instruction to distance education. It has been discovered that the majority of students believe there is a difference between face-to-face education before and after distance education. It has been established that the number of students who believe that classroom discussions occur in face-to-face science and mathematics courses has fallen dramatically after distance education compared to before distance education.

Keywords: Face-to-face education preceding distance education; Distance education; Face-to-face education following distance education; Science and mathematics teaching environments; Student views

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1. Introduction

1.1. Introduce the problem

Researchers in education work to promote learning and equal access to educational opportunities for all pupils. Some studies focus on distance education (DE), which makes education possible in situations where the learner and the learning resource are not physically together. DE has developed over time, depending on the opportunities offered by technology. In this process, the impact of technology and media on educational environments has been a controversial issue. Clark (1983) argued that "Consistent evidence is found for the generalization that there are no learning benefits to be gained from employing any specific medium to deliver instruction.". While some researchers, such as Kozma (1994), opposed Clark's claim, others, such as Bernard et al. (2004), supported this claim. Jahng et al. (2007) argue that Clark and Kozma represent opposite extremes in this debate. Kozma (1994) reframed the questions raised by Clark to explore the conditions under which the media will influence learning. He sought an answer to the question, "In what ways can we use the capabilities of the media to influence learning for particular students, tasks, and situations?" in his study. He said that these studies would help the field of educational technology develop and improve education. Bernard et al. (2004), on the other hand, say that the characteristics of pedagogy tend to take precedence over the media and that the features of instructional design are important. They state that instructional design depends on factors such as instructional strategies, feedback, and learner engagement.

Researchers have compared distance learning and face-to-face environments for a long time. According to Schramm's research from the 1960s, there was no significant difference between instructional television from classroom instruction. Also, he concluded students learn fast and efficiently with instructional television (Saba, 2000). Russell (1999) stated that DE is as effective as face-to-face education (FFE). Johnson et al. (2000) found that there was no difference between the learning outcomes of the online course and the traditional face-to-face formats of a graduate course. According to Jahng et al. (2007) research at the post-secondary level, there was no appreciable distinction in student academic achievement between DE and FFE.

After the 2000s, the use of computers and the Internet in educational environments became widespread. DE has started to be offered more in online environments. With these developments, it is evident that studies on the integration of computers into teaching and online education have increased. There are attempts to use these environments together rather than compare DE and FFE in studies.

Due to its properties, including its absence of time and space constraints, economy, and flexibility, DE is advantageous. Distance learning is a wise choice, particularly for people who wish to boost their resumes without quitting their jobs. A rising number of academic

institutions provide graduate-level distance learning programs. However, as distance learning spread, the challenges encountered in the process grew increasingly evident. These challenges include things like poor social interaction, complicated technology, and a lot of potential for student distraction. Educational institutions are attempting to address these challenges and provide quality DE (Moore, & Diehl, 2019; Sadeghi, 2019).

While research on distance learning is ongoing, the COVID-19 pandemic has given it a new angle: indispensability. At the time the pandemic was declared in Turkey, students in the 10th grade together with all other students shifted from FFE to DE. These students received DE in the 11th grade and in-person instruction in the 12th grade. All courses were given face-to-face, then from a distance, and then face-to-face within the same school. It is a special circumstance in which all courses are given via DE. However, what distinguishes these students from others is their experience with both FFE and DE within the same educational setting. This procedure is unprecedented in the history of education. The information provided by students in this situation about their classroom setting is important. It is expected that the results will be useful for figuring out what is going on and making learning environments better. Numerous studies on DE undertaken during the COVID-19 pandemic are documented in the literature. However, no research has been identified on the contexts of FFE after DE or the impacts of DE on FFE after DE. The study is expected to contribute to the literature on FFE, particularly following DE. This study aims to uncover the views of students who participated in face-to-face education preceding distance education (FFEPDE), distance education (DE), and face-to-face education following distance education (FFEFDE) about these environments.

Q1: What do the students think about distance education courses?

Q2: How do students think about face-to-face education following distance education?

Q3: How do students see the distinction between face-to-face education preceding and following distance education?

Q4: How do students think about science (physics, chemistry, biology) and mathematics education in these three different learning environments?

2. Method

2.1. Research design

Usually, surveys are designed so that information about the population can be inferred from the responses obtained from the sample. Surveys are used in educational research to describe opinions, beliefs, and attitudes (McMillan & Schumacher, 2006). In the present study, survey from nonexperimental designs was used to infer the opinions of high school students about DE, FFEPDE and FFEFDE.

2.2. Research sample

The research population consists of 12th grade students attending high schools in Turkey associated with the Ministry of National Education during the academic year 2021-2022. COVID-19 epidemic, these students were required to switch from FFE to DE when they were in the tenth grade. These students got face-to-face instruction in the ninth grade and the fall semester of the tenth grade; DE in the spring semester of the tenth grade and the entire eleventh grade; and face-to-face instruction throughout the final year of high school. These students spent their whole high school careers in the same classrooms with the same teachers and classmates. The population of the survey research consists of a total of 990248 students. This number is taken from the data of formal education national education statistics published by the Ministry of National Education (2020). Many researchers state that it would be sufficient to determine the appropriate sample size with a 95% confidence level and a 5% margin of error. Researchers created a sample size table using the formula used in Krejcie and Morgan's 1970 study (The Research Advisors, 2006). According to this table, our sample size for the survey study, whose population is 990284, with a 95% confidence level and a 5% margin of error, was determined as 384. This number coincides with the number of samples calculated according to the number of survey items.

In the research, a questionnaire was applied to 647 people. When the answers to the questionnaires were examined, it was determined that 25 questionnaires were invalid. The remaining 622 questionnaires were analyzed after the invalid questionnaires were removed. The number reached is above 384 with the targeted sample size. Demographic information about the participants is presented in Table 1. According to Table 1, 316 of the 622 participants were female and 306 were male.

Table 1. The demographics of participants

Participant Gender	*f*	*%*
Female	316	50,8
Male	306	49,2
Total	622	100

2.3. Measures

In the study, a questionnaire instrument was developed to examine the DE and FFE processes. The survey is divided into two sections. In the first section, participants were asked about their demographics and the equipment used for DE. The second section consists of 44 items organized into five Likert-type questions. In the second section, there are 17 entries about DE, 6 about FFEPDE, 13 about FFEFDE, and 8 about comparisons of these processes. The Cronbach Alpha reliability coefficient of the questionnaire was determined at 0.943. The data collection tool used in the research was developed by the

researcher. All of the questionnaires were reviewed by two field practitioners and a Turkish-language practitioner. As a result of the expert review, the necessary corrections were made, the forms were re-examined, and feedback was given that they were ready for application. A pilot application was made for the survey. The pilot application took approximately 25 minutes. The final form of the questionnaire was given along with the pilot application feedback. The Cronbach Alpha reliability coefficient of the questionnaire was determined at 0.943. The data collection tool used in the research was developed by the researcher. All of the questionnaires were reviewed by two field practitioners and a Turkish-language practitioner. As a result of the expert review, the necessary corrections were made, the forms were re-examined, and feedback was given that they were ready for application. A pilot application was made for the survey. The pilot application took approximately 25 minutes. The final form of the questionnaire was given along with the pilot application feedback.

3. Results

Items related to the DE process, items regarding the FFEPDE, items related to FFEFDE, and a comparison of the DE environment and the FFE environment.

3.1. Items related to the distance education process

According to Table 2, 66.2 percent of the participants attended the courses by mobile phone. It is observed that the most commonly used communication device after a mobile phone is a laptop (%20,8), and that a percentage of the students do not have a device to participate in the DE process (%1,8).

Table 2. The most used communication device while attending courses in distance education

Communucation device	*f*	*%*
Mobil Phone	410	66,2
Laptop	129	20,8
Desktop Computer	31	5
Tablet	23	3,7
No Device to Participate	11	1,8
Mobil Phone- Laptop	9	1,5
Mobil Phone- Desktop	4	0,6
Mobil Phone- Tablet	1	0,2
Mobil Phone- Laptop-Desktop	1	0,2
Total*	619	100

** 3 students have not marked any of these items*

According to Table 3, it is observed that the most common data provider in this process is a fixed internet line. On the other hand, it has been found out that the percentage of students who do not have access to the internet is 27%.

Table 3. The most used data provider while attending courses in distance education

Data provider	*f*	*%*
Fixed internet	473	76,8
Postpaid mobile internet	74	12
Prepaid mobile internet	38	6,2
No internet access	17	2,7
Someone else's internet line beside my family	8	1,3
Fixed internet line- Postpaid mobile internet	6	1
Total*	616	100

** 6 students have not marked any of these items*

In the questionnaire, the materials used in courses during the DE process were asked about. 491 students have stated that teachers teach through verbal lectures during courses. Regarding the materials that were used in a DE environment, 382 students stated that digital books were used, 325 students used PowerPoint presentations, and 317 students used videos. Other materials are sorted as scanned course notes (190 students), pen and book (189 students), digital drawing programs (143 students), animations (78 students), and simulations (25 students).

Other items of the questionnaire are designed as Likert scales. The data obtained from those items is presented below.

Table 4. Technical glitch in distance education

Items	*1%*	*2%*	*3%*	*4%*	*5%*
1. In the courses I attended during the distance education, the teachers frequently experienced technical problems.	8,5	12,1	32,6	21,7	25,1
2. In the courses I attended during the distance education, I frequently experienced technical problems.	12,6	19,5	31,4	18,8	17,7

1- Strongly Disagree; 2- Disagree; 3- Partially agree; 4- Agree; 5- Strongly agree

According to Table 4 the mode of item 1 is 3. Nearly half of the students stated that teachers frequently experienced technical difficulties during the DE process. The mode of item 2 is 3. %36,5 of the students stated that they frequently experienced technical problems, %31,4 of them partially experienced them, and %32,1 of them stated that they did not experience technical problems frequently.

Table 5. Participation in distance education

Items	*1%*	*2%*	*3%*	*4%*	*5%*
3. I attended all courses during the distance education.	8,2	12,8	44,9	21,9	12,2
4. I actively attended all courses during the distance education.	15	21,4	35,8	15,3	12,5

1- Strongly Disagree; 2- Disagree; 3- Partially agree; 4- Agree; 5- Strongly agree

According to Table 5, the mode of item 3 is 3. The data in the third item reveals that most of the students did not attend all courses in the DE process. The mode of item 4 is 3. It was discovered that 36.4 percent of students did not actively participate in DE courses, while 35.8 percent participated partially. The rate of those who stated that they actively participated in the courses was determined to be 27.8%.

Table 6. Communication in distance education environment

Items	*1%*	*2%*	*3%*	*4%*	*5%*
5. In the distance education courses I attended, there were in-class discussion about the topic.	23	27,7	29,1	11,8	8,4
6. I communicated with the instructor during the distace education courses I attended.	11,7	15,8	32,2	22	18,3
7. During the distance education process, I communicated with my classmates in the courses I attended.	21,5	25,5	25,8	14,7	12,5
8. In the process of distance education, in-class communication was more frequent than in traditional education.	71,6	14,8	6,9	1,9	4,8

1- Strongly Disagree; 2- Disagree; 3- Partially agree; 4- Agree; 5- Strongly agree

Table 6 covers communication inside the DE context. According to the mode of item and the data of the third and fifth items, almost half of the students stated that there was no discussion in class in the DE process. The mode of item 6 is 3. Nearly half of the students stated that they interacted with their teachers during DE courses. The mode of item 7 is 3. Nearly half of the students stated that they did not communicate with their peers during DE courses. The mode of item 8 is 1, in which DE and FFE were compared in terms of classroom communication, and it was determined that almost all of the students thought that classroom communication in DE was less than FFE.

Table 7. Interest-attention in distance education environment

Items	*1%*	*2%*	*3%*	*4%*	*5%*
9. I listened carefully to the courses that I attended during the distance education.	9,7	16,7	34,1	26,5	13
10. I was satisfied with the courses that I attended during the distance education.	19	24,8	38,1	12,1	6
11.I was so bored with the courses that I attended during the distance education.	9,8	9,6	23,2	24	33,4
12. My attention distracted quickly in courses I attended during the distance education.	10,3	10,6	19,4	25,1	34,6

1- Strongly Disagree; 2- Disagree; 3- Partially agree; 4- Agree; 5- Strongly agree

According to Table 7, the mode of item 9 is 3. Regarding the data of the third item, it is seen that nearly half of the students listened to their courses carefully, and the majority of other students stated that they partially agree. The mode of item 10 is 3. 38.1 percent of students are partially satisfied with the DE courses they attend. However, it is observed that approximately half of the students are dissatisfied with DE courses. However, it is seen that nearly half of the students weren't satisfied with the DE courses they attended. The mode of items 11 and 12 is 5. Most students stated that they found courses boring and that their attention dwindled quickly in class.

Table 8. Materials used in the distance education environment

Items	*1%*	*2%*	*3%*	*4%*	*5%*
13. In the process of distance education, Web applications that were not employed in face-to-face education were utilized.	22	17,8	27,5	19,2	13,5
14. In the courses I attended during distance education, we viewed movies and animations related to the topic.	14,5	17,5	33,8	21,1	13,1
15. In the courses I attended during distance education, simulations pertaining to the subject matter were utilized.	29,1	27,5	27	10,8	5,6

1- Strongly Disagree; 2- Disagree; 3- Partially agree; 4- Agree; 5- Strongly agree

Despite the fact that the mode of item 13 is 3, 39.8% of students believe that web applications that are not used in FFE are used in DE. The mode of item 14 is 3. Most of the students stated that they watched video and animation in DE courses. As well, the mode of item 15 is 1. More than half of the students stated that simulations are not used in DE courses.

Table 9. Science and mathematics courses in distance education

Items	*1%*	*2%*	*3%*	*4%*	*5%*
16. In distance education science courses, we had more opportunities to view experiments than in traditional classrooms.	63,8	22	9	3,4	1,8
17. Courses in science and mathematics taught through distance education were more productive than those taught face-to-face.	70,1	17,1	6	3,9	2,9

1- Strongly Disagree; 2- Disagree; 3- Partially agree; 4- Agree; 5- Strongly agree

According to Table 9, the mode of item 16 is 1. Almost all of the students stated that they have not observed any science experiments in DE courses. At the same time, the mode of item 17 is 1. It has been found that nearly all students believe that DE science and mathematics lectures are less effective than FFE.

3.2. Items regarding the face-to-face education preceding distance education

Table 10. Science and mathematics class environment in face-to-face education preceding distance education

Items	*1%*	*2%*	*3%*	*4%*	*5%*
18. In face-to-face education prior to distance education, our science and mathematics teachers only taught by writing and drawing on the board.	16,9	19,6	30,6	16,7	16,2
19. In face-to-face education prior to distance education, our science and mathematics teachers used the smart board as a blackboard.	13,2	15,1	34	23,2	14,5
20. In face-to-face education prior to distance education, our science and mathematics teachers were having in-class discussions on the subject.	9,3	16,9	30	28,1	13,7
21. In face-to-face education prior to distance education, our science teachers were doing demonstration experiments.	37,5	27,8	21,1	9,2	4,4

1- Strongly Disagree; 2- Disagree; 3- Partially agree; 4- Agree; 5- Strongly agree

Table 10 covers science and mathematics courses in an environment of FFEPDE . In this process, 32.9% of students stated that their science and mathematics teachers only taught courses by writing and drawing on the board, while 36.5% disagreed and 30.6% partially agreed. 37.7% of students reported that science and mathematics teachers used the smart board as a chalkboard during the FFE process prior to the DE, 34% partially agreed, and 28.3% disagreed. 41.8% of the students stated that there was classroom discussion regarding the topic during science and mathematics courses in the FFE environment before DE, while 30% of the students partially agreed and 26.2% disagreed. Most of the students stated that demonstration experiments were not conducted in FFEPDE .

Table 11. Materials used on smart board in face-to-face education preceding distance education science and mathematics courses

Items	*1%*	*2%*	*3%*	*4%*	*5%*
22. In face-to-face education prior to distance education, our science and mathematics teachers taught by showing videos and animations on the smart board.	15,4	16,7	35,9	22,7	9,3
23. In face-to-face education prior to distance education, our science and mathematics teachers taught using simulations on the smart board.	24,9	23,3	34,1	12,9	4,8

1- Strongly Disagree; 2- Disagree; 3- Partially agree; 4- Agree; 5- Strongly agree

Table 11 is about materials which used in smart board on FFE science and mathematics courses before DE. 32% of the students stated that they used videos and animations; 35% reported using them partially; and 33% reported not using them. While nearly half of the students stated that simulations were not used in science and mathematics courses, 34,1% of the students stated that they used them partially.

3.3. Items related to the face-to-face education following distance education

Table 12. Student opinions about face-to-face education following distance education

Items	*1%*	*2%*	*3%*	*4%*	*5%*
24. I am pleased to acquire face-to-face education in the twelfth grade.	9,8	3,4	11,3	17,3	58,2
25. Science and mathematics courses should be taught face-to-face.	5,5	2,7	8,4	19,1	64,3
26. I grasped the value of face-to-face education in the process of distance education.	8,4	5,5	17,4	18,1	50,6
27. Some courses in the face-to-face education process can be delivered remotely.	20,6	9,1	20,1	19,3	30,9

1- Strongly Disagree; 2- Disagree; 3- Partially agree; 4- Agree; 5- Strongly agree

The students' perspective on FFEFDEis shown in Table 12. It has been determined that the majority of 12th graders are satisfied with FFE. The majority of students felt that science and mathematics courses should be taught face-to-face. The majority of students indicated that they understood the importance of FFE in the DE process. It was discovered that half of the students believed that certain FFE classes could be delivered distantly.

Table 13. Communication in face-to-face education following distance education

Items	*1%*	*2%*	*3%*	*4%*	*5%*
28. I can communicate more easily with the teacher in a face-to-face education than in distance education.	3,5	2,1	9,8	21,1	63,5
29. I can communicate more easily with classmates in a face-to-face education than in distance education.	3,5	2,4	9,2	18,5	66,4

1- Strongly Disagree; 2- Disagree; 3- Partially agree; 4- Agree; 5- Strongly agree

Table 13 addresses communication in a FFE environment after DE. It was discovered that the majority of students think that they communicated with their teachers and fellow students more easily in a FFE setting than in a DE setting.

Table 14. Science and mathematics courses in face-to-face education following distance education

Items	*1%*	*2%*	*3%*	*4%*	*5%*
30. In face-to-face education following distance education, our science and mathematics teachers only teach by writing and drawing on the board.	12,1	19,9	35	20,5	12,5
31. In face-to-face education following distance education, our science and mathematics teachers use the smart board as a blackboard.	10,8	15,9	39,7	22,3	11,3
32. In face-to-face education following distance education, our science and mathematics teachers use the smart board more effectively than before.	11,6	18,6	34,9	22	12,9
33. In face-to-face education following distance education, our science and mathematics teachers are having in-class discussions on the subject.	13,7	18,3	34,9	22	11,1

1- Strongly Disagree; 2- Disagree; 3- Partially agree; 4- Agree; 5- Strongly agree

According to Table 14, 33% of students think that science and mathematics teachers only teach by writing and drawing on the board during FFEFDE. While 32% of the students do not agree with it, 35% partially agree. 33.6% of the students stated that science and mathematics teachers used the smart board as a blackboard in FFEFDE , and 39.7% used it partially. On the other hand, 26.7% of the students stated that they did not agree with this. 34.9% of the students stated that science and mathematics teachers used the smart board more effectively than before during the FFE process after DE; 34.9% of them partially agreed with it, and 30.2% of them did not. It was determined that 33.1% of the students stated that there was a classroom discussion in FFE science and mathematics courses after DE, 34.9% of them were partially done, and 32% of them were not.

Table 15. Materials used on smart board in face-to-face education following distance education science and mathematics courses

Items	*1%*	*2%*	*3%*	*4%*	*5%*
34. In face-to-face education following distance education, our science and mathematics teachers teach by showing videos and animations on the smart board.	18,8	21,4	37,3	15,3	7,2
35. In face-to-face education following distance education, our science and mathematics teachers teach using Quizizz, Kahoot, etc. on the smart board.	38,1	26,3	21,9	7,1	6,6
36. In face-to-face education following distance education, our science teachers give simulation experiments.	41,8	29,4	19,1	6,6	3,1

1- Strongly Disagree; 2- Disagree; 3- Partially agree; 4- Agree; 5- Strongly agree

According to Table 15, 40.2% of the students stated that science and mathematics teachers did not use video and animation on the smart board during the FFE process after DE. On the other hand, 22.5% of the students stated that these materials were used in science and mathematics courses, and 37.3% stated that they were partially used. More than half of the students stated that during the FFE process after DE, science and mathematics teachers did not use Quizizz, Kahoot, and similar web applications on the smart board, and 21.9% of them partially used it. Most of the students stated that

simulation experiments were not carried out in science courses during the FFE process after DE, and 19.1% stated that they were partially done.

3.4. Comparison of the distance education environment and the face-to-face education environment

Table 16. Comparison of the distance education and the face-to-face education

Items	*1%*	*2%*	*3%*	*4%*	*5%*
37. There is no distinction between distance education and face-to-face education.	67	14,7	9,5	4	4,8
38. I prefer distance education to face-to-face education.	59,2	10,9	12,6	5,6	11,7
39. Face-to-face education is better than distance education in every way.	6,4	7,1	11,9	19,9	54,7
40. I understand the subjects better in a face-to-face education environment than in distance education.	5,9	2,6	10,3	23,8	57,4
41. It is an advantage that there are no space restrictions in the distance education process.	18,8	15,6	25,2	16,6	23,8
42. It is an advantage of distance education that we do not have to spend time going to and from school.	19,8	11,7	21,6	18	28,9
43. I prefer to attend courses in which different web applications are used during the distance education process.	19,1	20,3	36,8	12,9	10,9
44. There are differences between face-to-face education preceding distance education and face-to-face education following distance education	8,3	10	24,8	20,2	36,7

1- Strongly Disagree; 2- Disagree; 3- Partially agree; 4- Agree; 5- Strongly agree

According to Table 16, the majority of students think that there is a difference between DE and FFE. The mode of item 38 is 1. It has been determined that most of the students do not prefer DE to FFE. In the data of Item 39, it was revealed that most of the students think that FFE is better than DE in all aspects. In the data of Item 40, most of the students stated that they understood the subjects better in the FFE environment than in DE. The mode of item 41 is 3. While 40.4% of students see the lack of space restrictions in DE as an advantage, 25.2% see it as a partial advantage, and 34.4% do not see it as an advantage. The mode of item 42 is 5. About half of the students see it as an advantage to have time to go to and from school in DE. The mode of item 43 is 3. 23.8% of the students stated that they would prefer to attend courses in which different web applications are used in DE, and 39.4% stated that they would not. In the data of Item 44, it was determined that more than half of the students thought that there was a difference between FFE before DE and FFEFDE, and 24.3% of them partially agreed with this.

4. Discussion and Conclusions

Almost all of the students surveyed in this study believed that there was a difference between DE and FFE. The vast majority of students believe that FFE is superior in every aspect to DE. Concurrently, the majority of students favor FFE over DE. Students

reported that they realized the value of FFE in the process of DE and were pleased to take the 12th grade sessions face-to-face. Some research findings indicate that there is no distinction between FFE and DE (Jahng et al., 2007; Johnson et al., 2000). However, recent research indicates that students prefer FFE over DE (Bali & Liu, 2018; Gherheş et al., 2021; Karatepe et al., 2020; Tuncer & Bahadır, 2017). According to There are numerous issues with DE, including inadequate of teacher input and learning support services (Ding et al., 2010). Sadeghi (2019) noted that there are distractions and insufficient social contact in DE.

In contrast, the literature describes the benefits of DE, such as the lack of time and space constraints and the time and money savings (İmamoğlu & İmamoğlu, 2020; Paydar & Doğan, 2019; Sadeghi, 2019;). More than half of the participants in this study view the absence of space restrictions and time savings as advantages of DE. However, some students do not view these circumstances as advantageous. Almost all of the students reported that FFE facilitated easier communication with their teachers and classmates than DE. Nearly half of students believe that some face-to-face courses can be taught remotely. Significant numbers of students somewhat agree with this statement. However, it is amazing that the majority of students choose face-to-face science and mathematics instruction. These requests may be a result of the students' perception that DE scientific courses are less effective than face-to-face instruction.

Although practically all of the students have access to the necessary equipment and internet service for DE, they did not enroll in every course. According to the research findings, active student participation, in-class discussion, and communication in DE are constrained. It has been discovered that nearly half of students are unhappy with remote education courses. The majority of students reported that their attention was easily diverted and that they were bored with the courses in DE.

Students' primary communication device in DE is a mobile phone, while the data provider is a fixed internet line. This means that most of the students have a favorable environment to participate in DE. Nevertheless, it is evident from the data that students and teachers face technical difficulties in DE. Sadeghi (2019) lists technical issues as one of the downsides of DE. The fact that students do not attend all sessions, although having the chance to do so, may be a result of technical difficulties and student unhappiness with the courses they do attend. Some of the reasons for dissatisfaction with DE courses may be that students are bored and distracted quickly.

Considering the data, it can be stated that the majority of DE students tend to listen classes attentively. Despite this, the rapid distraction of students can be attributed to their lack of the lack of active engagement in the courses. It is well recognized that active engagement stops students from being distracted and keeps the course from becoming monotonous (Marks, 2000). Another significantly factors that saves the lesson from boringness is the materials used in the lesson. The instructional materials aid in focusing

the students' attention and facilitating their learning (Amadioha, 2009). Some online programs that are inaccessible in FFE owing to a lack of technology are readily available in DE. It is believed that teachers use applications in DE that they cannot use in FFE. According to nearly half of the students, however, a web application other than face-to-face instruction was not utilized in DE classes. On the other hand, over half of students don't prefer to attend remote education classes that utilize many web-based apps. According to some pupils, video and animation are not utilized in DE. On the other hand, the majority of students reported that video and animation were partially utilized. Approximately one-fourth of the 62 biology teachers who worked in remote education during the pandemic era reported using video in their classes, according to the findings of a study (Karakaya et al., 2020). In a different study, high school science and mathematics teachers were interviewed and stated that they employ video and animation in DE lectures, but interactive tools such as simulation and Kahoot are not utilized (Büyükbayraktar,2022). Simulations are readily applicable to DE. Despite this, the data indicate that teachers do not prefer to employ simulation in online education.

DE requires teachers to spend a great deal of time using computers, mobile phones, and the Internet. The expectation is that teachers will use their experiences with DE to FFE. In an interview with high school students for one study, the students reported that teachers who did not use the smart board previously in FFE began to use it after DE was introduced, and that teachers who already used it were using it more frequently (Büyükbayraktar, 2022). In this context, it is believed that FFEPDE and FFEFDE will differ. It is anticipated that both the use of smart boards by educators and the variety of materials displayed on them will grow.

In the study, students were questioned about their science and mathematics classroom conditions prior to and following DE. Almost the same percentage of students agree, partially agree, and disagree whether the subject is delivered by writing and drawing on the chalkboard in FFE science and mathematics course prior to DE. Intriguingly, the proportions of those who strongly disagree and those who strongly agree are nearly identical. The outcomes of FFEFDE reveal an unexpected circumstance in this regard. Although teachers are anticipated to prefer smart boards over blackboards in FFEFDE, the contrary is actually the case. In the literature, it has been determined that the use of smart boards in science and mathematics courses has a positive effect on academic achievement (Gündüz & Kutluca, 2019). In FFE science and mathematics sessions after DE, more students reported that the lesson was taught by writing and drawings on the blackboard than in FFE science and mathematics courses before DE.

According to the data, the use of animation and video in face-to-face science and mathematics classes reduced after DE compared to before it. The percentage of students who believe science and mathematics teachers utilize the smart board more efficiently in FFEFDE than before DE is very close to the percentage of students who believe the

smart board is used as a blackboard. In contrast, this percentage is significantly greater than the percentage of respondents who indicated that video, simulation, and online apps are utilized on the smart board. In this context, it can be said that students associate the effective use of the smart board by science and mathematics teachers with using the smart board as a blackboard. According on the findings of a study, teachers had favorable opinions about smart board applications. However, the results of the study indicate that instructors' use of interactive whiteboards is inadequate, and they require additional practice-oriented in-service training (Bıçak, 2019). In a research performed with high school science and mathematics teachers, teachers said that the use of smart boards before to and after UE did not differ much. According to them, the content they used on the smart board became richer after DE. On the smart board, teachers utilized pdf files (textbooks, resource books, question books), films, and animations, according to the study. Nonetheless, teachers do not employ web 2.0 tools such as simulation and Kahoot during and after DE (Büyükbayraktar, 2022). In this connection, it may be stated that the majority of teachers do not utilize interactive programs on the smart board.

Experiments play a crucial role in science education. Nonetheless, experimentation is a challenging and laborious endeavor. However, developments in instructional technology are helping to overcome the hurdles. In science classes, simulations can be used to conduct experiments (Richards et al., 1992). Experiment films might be shown to students in the courses. Nevertheless, it is clear from the research data that experiment recordings are not utilized in science classes, not even in DE. The majority of students said that there were no demonstration experiments in face-to-face science classes prior to DE. Half of the students claimed that simulation was not used, some students partially used it, and very few students stated that it was used. The majority of students reported that simulation is not used in science classes after DE. This finding highlights an essential situation that needs to be underlined. The literature demonstrates conclusively that there are problems in science classroom experimentation (Bostan Sarıoğlan et al., 2020; Uluçınar, et al., 2004). According to the findings of this study, it can be said the increased use of technology in remote education by teachers does not contribute to the improvement of this scenario.

It is acknowledged, based on the findings of the research, that there are restrictions on classroom communication in DE. It has been determined that these restrictions are less prominent in student-teacher communication but more prevalent in student-to-student communication. According to fifty percent of students, there is no classroom discussion in DE. This circumstance is believed to be a result of classroom communication restrictions. There is research that indicates there are communication issues in DE. In terms of classroom communication, some research indicates that teachers and students prefer FFE over DE (Almahasees et al., 2021; Arık et al., 2021; Büyükbayraktar, 2022; Kocaman & Ersoy, 2021; Türker & Dündar, 2020). According to Salta et al., (2022), the decline in students' emotional participation throughout the transition from traditional to

online learning environments is mostly attributable to the concurrent decline in classroom interaction. The majority of students believe there is a difference between FFEPDE and FFEFDE, according to the research findings. It is acknowledged that there is a difference between classroom discussions in science and mathematics sessions before and after DE. It has been discovered that the number of students who believe classroom discussions occur in face-to-face science and mathematics courses is lower after DE than it was before DE. It is possible to do in-depth study on the causes of this condition and students' impressions of classroom discussion.

Despite the ongoing evolution and advancement of educational technologies, it is intriguing that students prefer FFE over online education. By identifying conditions with which students are dissatisfied, such as communication difficulties in remote education, research can be expanded. In an environment where studies based on the combination of remote education and FFE continue, it is important to establish the advantages and disadvantages of distance and face-to-face education. In remote education, research can be conducted to improve in-class communication, particularly student-to-student communication. It is anticipated that studies that encourage the active participation of students in the environment of remote education will contribute to the advancement of DE. On the other hand, it is evident that challenges in subjects like the efficient use of the smart board by teachers in FFE and experimentation in scientific classes have not diminished. It is known that research is conducted on these topics and that teachers receive in-service training. In future research and in-service training programs, it is expected that utilizing new methodologies, such as blended learning and innovative ways, will be advantageous.

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