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Physics Teachers' Course Processes in Distance Education

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Abstract

The global spread of the Covid-19 pandemic in 2020 made distance education an essential requirement. Teachers, as one of the key stakeholders in education, have been significantly affected by this shift. It can be stated that physics teachers have been significantly affected by this process. This research examined how physics teachers conducted their lessons in a distance education setting. The study employed a case study approach, a type of qualitative research design. The study included 20 physics teachers from state and private schools across various regions of Turkey. Data were collected using a semi-structured interview and an observation form. The data gathered through the interview form were analyzed using the content analysis method. Many platforms/programs used by physics teachers were identified during the pandemic period. The positive and negative aspects of these programs were evaluated. The course materials and measurement and evaluation tools used by teachers in lessons during this process were determined. Considering the findings obtained from the study, several suggestions were provided.

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Introduction

Nowadays, rapid developments in communication technologies have led to the formation of a global education system. The rapid and remarkable advancements in computers, the internet, television, and other information technologies have given rise to innovative applications in the field of education. The most important of these applications is distance education. Distance education is a comprehensive learning activity that eliminates time and space boundaries and offers many learning activities through electronic or non-electronic systems (Altıparmak, 2011). The fact that distance education eliminates space boundaries allows people with different characteristics and backgrounds to come together and carry out learning activities (Rovai & Downey, 2010). Since the Covid-19 pandemic, distance education has emerged as one of the most significant transformations in the field of education. The global pandemic that occurred between 2020-2022 has radically changed the world of education and made distance education a necessity. In cases where suitable places, times and conditions for educational activities are not possible, distance education must be provided so that each student can receive quality education. This situation also directly supports the principle of equal opportunities in education.

In recent years, learning environments that determine the quality of education have played a critical role so that students can easily access information and experience effective learning processes. Properly structured educational environments provide students with rich learning experiences and enable them to learn information effectively. Planning and programming the environment in which learning will take place in accordance with its purpose, using appropriate methods and techniques, and finding the necessary materials are very important in this process (Karaman, 2011). The use of written and printed resources, which is one of the basic elements of traditional educational methods, is inadequate to fulfill the needs of today's changing generations. This traditional approach is increasingly having difficulty in attracting students' attention and maintaining their interest (Somyürek, 2014). Educators need to develop new generation teaching applications in order to dynamically manage content transfer. (Thorton, Ernst, & Clark, 2012). The globalization of communication technologies has brought education systems to a global dimension. Rapid advances in information systems such as television, computers, and the internet have resulted in the development of new applications in education. These developments have enabled the discovery of different methods to enrich learning experiences and attract students' attention. One of these applications is distance education. Distance education can be described as a structured and organized learning process that utilizes electronic or other communication tools. This activity eliminates time and space limitations through special communication methods and offers various learning activities to users (Altıparmak, 2011). Individuals with different abilities can easily receive effective education through online distance education environments (Rovai & Downey, 2010). However, the limited teacher-student and student-peer interaction in distance education can lead to a lack of motivation and also bring some negativities. Although distance education serves as a significant alternative when suitable space, time, and conditions are unavailable, it also comes with its own challenges and limitations. Particularly during the pandemic, distance education emerged as an indispensable solution for providing equitable access to education and ensuring that all students receive high-quality learning experiences. In this process, the role of technology in education has become increasingly more significant.

Research Problem

A review of the literature reveals numerous medical studies that focus on the effects of the Covid-19 pandemic (Hirsch et al., 2020; Andreadakis et al., 2020; Janiri et al., 2021). This is due to the rapid spread of the pandemic and the priority of research in the field of medicine due to its serious health threat. However, the need to examine this process in terms of education is important, especially with regard to teachers' roles and the impact of the pandemic on educational environments. As noted by Mulenga and Marban (2020), to effectively capture the paradigm shift in education, it is essential to include teachers and their perspectives on the pandemic process in the research. This ensures that the changes in practices in educational environments are understood based on the experiences and perspectives of teachers. The Covid-19 pandemic has revealed the need for teachers and academics in the education sector to effectively use digital tools in teaching and distributing content to students (Mulenga and Marban, 2020). This period has facilitated the enhanced incorporation of digital devices, online resources, social media technologies, and e-learning activities. In their study, Agnoletto and Queiroz (2020) stated that digitalization is not just a simple process. The "learning technologies" to be used in a process that includes difficulties and restrictions can only be a starting point. Distance education is not just an activity, but also a complex process that includes a number of difficulties and restrictions. It is important to investigate factors such as the difficulties that teachers may encounter while carrying out this process, the restrictions brought by the pandemic, the status of the regional internet and technological infrastructure, their computer self-efficacy, their attitudes towards distance education, their personal computer ownership status and pandemic concerns. Starting from the latter half of 2020, there has been a considerable rise in study on distance education in the context of the pandemic within the education sector. Analyzing these studies reveals a focus on the challenges faced by teachers, students' difficulties, the perspectives of teachers, the effectiveness of distance education, and the ways in which educational activities were conducted during the pandemic (Karaca et al., 2021; Özdemir, 2021; Tosun, 2021).

Teachers are among the most impacted individuals in the distance education process. (Bakırcı et al., 2021). The distance education process has created some difficulties for teachers, especially in areas such as technology use and student participation. First of all, the use of distance education platforms and tools can present a new experience for teachers, necessitating an adaptation process to technology (Bıyıklı and Özgür, 2021). In addition, limited interaction in the classroom and students having different environments at home create an additional difficulty for teachers in maintaining the interest and motivation of students (Beşaltı, 2021). It can be argued that science teachers were particularly and considerably impacted with this process (Ametepe and Khan, 2021). Specifically, there is a noticeable gap in the literature concerning research on physics education and physics teachers during the pandemic (Kırtak, 2020; Ametepe and Khan, 2021; O'Brien, 2021; Madhurima et al., 2021; Şentürk et al., 2022). Given that investigating the effects on physics teachers' lesson-processing methods and teaching skills during the pandemic can provide valuable insights for other educators and inform future research, this study holds significant importance.

Research Aim and Research Questions

The primary aim of this study is to explore the distance education experiences of physics teachers working in high

schools and to understand their perspectives on distance education, with the goal of addressing the existing gap in this area. It is believed that the experiences of physics teachers during this process could serve as an inspiration for their colleagues in other subjects. The issues addressed in the research were expressed as follows.

- What is the process of physics teachers in teaching in distance education?

Methodology

This study utilized a case study design, which is a qualitative research method. The primary characteristic of a qualitative case study is the in-depth investigation of one or more cases. This involves examining various factors related to the case (such as the environment, individuals, events, and processes) with a holistic approach, focusing on how these elements influence the case and how they are influenced by it (Yin, 2009). The study utilized a holistic multiple case design, where more than one case is examined, each of which can be considered holistic.

Participants

The study group includes physics teachers working in high schools under the Ministry of National Education throughout Türkiye. Purposeful sampling methods are generally used in qualitative research. It is thought that purposeful sampling methods will be useful in discovering and explaining phenomena and events in many cases. Qualitative research is flexible by nature and researchers can use this feature as a positive aspect. For this reason, researchers can use more than one sampling method (Yıldırım and Şimşek, 2018). In this way, it is aimed to access richer descriptive and in-depth information about the study. In the study, maximum variation sampling and theoretical sampling methods, both of which are purposeful sampling techniques, were employed. The aim of using maximum variation sampling is to form a relatively small sample that maximally reflects the diversity of individuals who may be involved in the issue being studied (Yıldırım and Şimşek, 2018). The aim of the study is to find out whether the experiences of physics teachers working in both public and private schools and different types of schools throughout Turkey during distance education are common phenomena. According to this diversity, different dimensions of physics teachers' distance education experiences have been revealed. Interviews were conducted with 20 physics teachers who participated in the study and observations were made with 10 teachers. The institutions where the teachers who could not be observed worked did not allow them to share their course records. One of the principles to be considered in determining the sample size in qualitative research, the "theoretical sampling" approach, was put forward by Glaser and Strauss in 1967. This approach states that it is necessary to continue collecting data until the saturation point, where concepts and processes that can be the answer to the research question begin to repeat (Yıldırım and Şimşek, 2018). The participants of the research consist of 20 physics teachers working in public and private schools in different regions of Turkey in the 2020-2021 academic year. The names of the participants were not used to ensure the ethics and confidentiality of the research. The participating teachers; They are named with the codes T1, T2, T3…T19, T20. The demographic characteristics of the physics teachers who participated in the study, along with the grade levels they taught during the distance education period and information regarding the transition dates to distance education, are presented in separate tables in the section below. Table 1 presents the descriptive demographic characteristics of the physics teachers who participated in the study.

Table 1. Demographic Characteristics of Physics Teachers

Properties	Category	Number of Teacher
Professional Experience	5-10 years	8
	10-15 years	4
	15-20 years	8
Type of School Graduated	Faculty of Education	14
	Faculty of Science	6
Type of School Works	Anatolian High School (Private)	4
	Anatolian High School (State)	3
	Multi-Program Anatolian High School	2
	Project School Anatolian High School	1
	Vocational High School	2
	Anatolian Vocational High School	5
	Anatolian Religious High School	2
	Social Sciences High School	1
Region of Work	Mediterranean	3
	Eastern Anatolia	3
	Aegean	3
	Southeastern Anatolia	3
	Central Anatolia	3
	Marmara	3
	Black Sea	2

Instrument and Procedures

In this study, interview and observation methods, which are the frequently used data gathering methods in qualitative research, were used. The steps followed while preparing and applying these data collection tools are explained in detail in the following section.

Interview Form

A semi-structured interview technique was utilized for data gathering in the study. Because this technique offers a flexible area to conduct different interviews with different participants on similar topics during the data collection process (Noor, 2008). A semi-structured interview form was prepared in order to determine the distance education experiences of physics teachers in the study.

With a view to ensure the credibility (internal validity) of the study; expert opinions were sought before the application for the interview form prepared by the researcher to be used in the study. Opinions were received from three academicians working in the field of education for the prepared interview form. The experts were asked to evaluate whether the questions were suitable for the scope of the subject to be researched and whether they were

clear and understandable. In line with the data acquired from the expert opinions, the form was re-examined by the researcher in terms of issues such as understandability, clarity and appropriateness of the questions and necessary corrections were made. During the interviews with the physics teachers, the participants' answers to each question were repeated and the participants were asked to confirm, and if there were any misunderstandings, they were immediately corrected. The pilot study of the interview form executed with two physics teachers. Based on the results of the pilot application and feedback from field experts, one question was removed from the interview form. In addition, the sub-questions (at the end) were arranged and made ready for application. Before the interviews, the teachers were given explanations about the study. The interviews were made in a conversational environment as natural as possible. In this way, it is thought that the teachers conveyed their experiences in the distance education process more clearly. The responses given by the teachers were documented, provided back to them in written form, and the participants were requested to verify the accuracy of their answers. This method, commonly used in qualitative research, is referred to as "participant validation" (Yıldırım and Şimşek, 2018). In the study, obtaining participant confirmation is used as a method to increase internal reliability. The participants' answers to the questions posed are presented in the form of direct quotes in the findings section. A lesson record was requested from some of the teachers who were interviewed. The alignment of the teachers' responses to the interview form was verified by analyzing the lesson recordings. This process was intended to strengthen the validity of the study.

Observation Form

Observation is one of the methods used to deeply define a behavior that occurs or is likely to occur in an environment. If the researcher wants to obtain a detailed and time-extended image of a behavior that occurs, he/she can choose the observation method (Yıldırım and Şimşek, 2018). With the observation technique, the researcher can observe, evaluate and reach judgments about the activities and the process in general (Karasar, 2009). In the study, an observation form was prepared for the purpose of examining a lesson that physics teachers conducted through distance education. The observation form was prepared in a way that would respond to the research problems and opinions were obtained from two faculty members who are experts in the field. In the study, the observation method was used to confirm the data collected through interviews. Thus, it the study aimed to establish its credibility, ensuring internal validity.

Data Collection

Because of social isolation measures throughout the Covid-19 pandemic, interviews with participants were conducted through the Zoom platform. Participants were asked 14 open-ended questions from the interview form through this platform. The answers to the questions were captured using the interview recording feature on the Zoom platform. The interviews were conducted in a conversational environment as natural as possible. In this way, it is thought that teachers conveyed their experiences through the distance education process more clearly. The duration of the interviews was about 45-50 minutes. The interviews were conducted during the pandemic period. In this period when social communication was restricted, providing teachers with the opportunity to express their experiences caused the interviews to be longer. This situation is considered a positive situation for

the researcher. Indeed, in qualitative studies, it is necessary to collect as much data as possible from the participants so as to conduct thorough research. The answers given by the teachers were put in writing and delivered to the teachers, and the participants were asked to confirm their answers. This method, which is commonly used in qualitative research, is defined as “participant confirmation” (Yıldırım and Şimşek, 2018). In the study, participant confirmation is used as a method to increase internal reliability. The responses provided by the participants to the questions are presented as direct quotes in the findings section. Some of the interviewed teachers were asked to provide a lesson recording. The consistency of the teachers' responses to the interview questions was assessed by reviewing the course records. This approach aimed to enhance the validity of the study.

Data Analysis

The data were analyzed through the application of the content analysis method. Content analysis includes a method performed by organizing and interpreting similar data according to certain motifs (Yıldırım and Şimşek, 2018). In this methodology, it was tried to determine certain words or concepts in the text or text groups. By examining the existence, meanings and relationships of words and concepts, inferences were made about the messages conveyed in the texts. In order to carry out the data analysis process, the answers given by the teacher to the questions were collected in written format, then these responses were examined in detail and unique codes were created in line with each answer. Codes containing similar expressions were collected under a certain theme. Finally, categories related to the results of the study were obtained from these themes and presented in the findings section as a report.

Validity and Reliability

The validity and reliability of scientific research are critical for ensuring that findings are trustworthy and applicable (Arslan, 2022). Validity refers to the extent to which measurement and evaluation tools effectively capture the studied phenomenon (Creswell, 2013). In qualitative research, these concepts are often addressed through credibility (internal validity) and transferability (external validity) (Lincoln & Guba, 1985). Credibility evaluates the alignment of findings with reality, questioning whether the results accurately represent what actually exists. Transferability, on the other hand, concerns the degree to which findings can be applied to other contexts, participants, or situations, provided there are fundamental similarities (Merriam, 2015). To enhance transferability, qualitative studies should provide detailed descriptions of contexts, participant characteristics, and study conditions.

Reliability, traditionally associated with the consistency of results across different scenarios and researchers, is replaced in qualitative research by the concepts of dependability and confirmability (Lincoln & Guba, 1985). Dependability ensures that findings are consistent with the data collected, while confirmability examines whether the results are shaped by the study itself rather than researcher biases. Techniques such as audit trails, peer debriefing, negative case analysis, and thick description are employed to reinforce these aspects (Ravitch & Carl, 2019). This study also adhered to these principles, implementing various strategies to minimize factors that could compromise validity and reliability while ensuring a rigorous research process.

The Researcher's Role

During the Covid-19 pandemic, the researcher worked as a physics teacher at a private school, gaining firsthand insight into the challenges faced by teachers. To explore these experiences further, he developed a set of interview questions designed to capture diverse perspectives. Throughout the study, he conducted interviews with teachers, transcribed the conversations, and systematically analyzed the data. Codes were identified based on the frequency and significance of recurring expressions in the transcripts. These codes were organized into themes, which were subsequently grouped under broader categories to provide a structured understanding of the data (Creswell, 2013). Additionally, the researcher received formal training in the qualitative data analysis software "Nvivo" during his doctoral studies to improve the rigor and efficiency of the data analysis process.

Results

Findings regarding the teaching methods of physics teachers during the distance education period are presented in Figure 1.

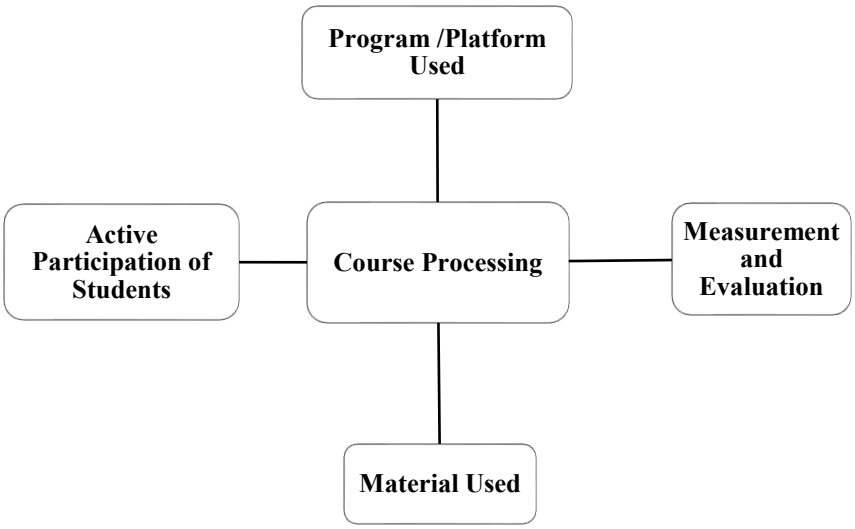

Figure 1. Physics Teachers' Lesson Processing Situation in Distance Education

Based on the interviews with physics teachers, the following themes were identified concerning course delivery during the distance education period: programs/platforms used, measurement and evaluation, materials utilized, and student participation. The results related to these topics are presented individually in the next section. The codes related to course delivery are illustrated in Figure 2.

Programs/Platforms Used

Findings regarding the programs/platforms used during distance education in interviews with physics teachers are presented in Figure 2.

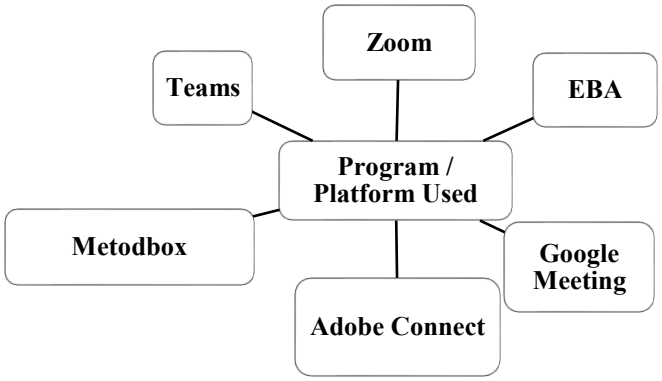

Figure 2. Programs Used by Physics Teachers

The interviews with physics teachers revealed that Zoom, EBA, Teams, Adobe Connect, Metodbox , Google Meeting programs/platforms were used in distance education. The evaluations of physics teachers regarding these programs/platforms were examined within the framework of two sub-themes as positive and negative aspects, and the evaluations concerning these examinations has been presented offered in Table 2.

Table 2. Evaluation of The Programs Used By Physics Teachers in Distance Education.

Program/Platform	Sub Theme	Code	Participants	Frequency
Zoom	Positive	Easy to draw shapes	T4, T8, T9, T10, T12, T14, T17, T20	8
		Writing on screen	T7, T8, T9, T12, T14, T19	6
		For Reflect visually	T8, T10, T14, T19, T20	5
		Ability to watch videos	T4, T13, T20	3
		Toolbar is useful	T8, T13, T18, T19	4
		No waste of time	T8	1
	Negative	Connection problem	T14, T17	2
		No simulation/interactive experiment	T3	1
EBA	Positive	Video	T4, T5, T6, T9	4
		Assigning homework	T4, T5, T6	3
		Measurement and evaluation test	T3, T9	2
		Homework check	T4	1
		Simulation	T4	1
	Negative	Failure to take attendance	T5, T14, T17	3
		System crash	T5, T14, T17	3
		Time limit for planning	T10, T18, T19	3

Program/Platform	Sub Theme	Code	Participants	Frequency
	Negative	Content confusion	T17, T19	2
	Positive	Recording available	T1	1
		Not suitable for teaching	T9	1
Adobe Connect	Negative			
		No student images	T1	1
	Positive	No time limit	T11	1
Google Meeting	Negative	Not suitable for teaching	T9	1
		Planning in advance	T10	1
Teams	Positive	Uploading content	T6	1
	Negative	-	-	-
		Suitable for course	T15, T16	2
		Similar to Zoom	T15	1
		Drawing shapes	T15	1
		Assigning homework	T15, T16	2
	Positive	Checking homework	T15, T16	2
Metodbox		Online exam	T15, T16	2
		Exam analysis	T15, T16	2
		System crash	T15, T16	2
	Negative	Connection problem	T15, T16	2

The interviews with physics teachers revealed that they used Zoom and EBA programs the most during distance education. Physics teachers mentioned some positive aspects of the Zoom program. These are; it is easy to draw shapes, it allows for the projection of visual materials and writing on the screen, it prevents time loss and it has a useful toolbar. The following teacher opinions regarding these findings can be given as examples.

T4: "I was able to show videos. I was able to show audio videos. I didn't have any problems with the program."

The teacher's opinion below can be given as an example opinion regarding the usability of the Zoom program's toolbar.

T13: "…to be honest, having your own pen and other things, writing materials made my job much easier."

Physics teachers mentioned the negative aspects of the Zoom program, such as the lack of simulations and interactive experiments and connection problems.

T3: "Frankly, I would like to see more simulations and more interactive experiments in physics classes."

T4: "…We tried to do things from Zoom, but there were always connection problems."

It is observed that the physics teachers who participated in the study generally expressed negative opinions about

the EBA program they used during distance education. Teachers expressed negative opinions such as having a time limit for lesson planning, not being able to take attendance, the system crashing and the content being mixed. The following teacher opinions can be given as examples regarding these findings. The following teacher opinion can be given as examples of not being able to take attendance, the system crashing and the content being mixed.

> *T5: "…for example, we did distance education for 1.5 years and we couldn't even get attendance from EBA. …There were a lot of crashes in EBA. I mean, every week there was a problem in one of our lessons. …The things we use in EBA are very dirty, let me put it this way, teacher, they put so much content into EBA…"*

The following teacher's view can be given as an example of the view that there is a time limit for lesson planning.

> *T10: "… so there is a situation like this, you have to create a lesson within a certain time, otherwise you cannot create the lesson or there is no possibility of making changes…"*

The following teacher's view can be given as an example of the view that the system is crashing.

> *T5: "There are a lot of crashes in EBA. I mean, every week there was definitely a problem in one of our lessons*."

Physics teachers have expressed positive opinions about the EBA platform. They have stated that the presence of videos, simulations, measurement and evaluation tests on the EBA platform, the ability to assign homework and to regularly check homework are positive opinions. The following teacher opinions support these opinions and can be given as examples.

> *T4: "I had not examined the simulations in EBA very much. For example, I came across very nice videos."*
>
> *T9: "There are additional videos etc. EBA has a good question pool. There is another section called EBA Academic. There is a large question pool there too.*

The following teacher opinion is an example of an opinion that can be given regarding the crashing of the EBA platform.

> *T14: "… sometimes we could not connect to EBA, both me and the children, I think it may be due to overload."*

The following teacher opinion can be given as an example of the Team platform being suitable for lesson planning, while the EBA platform not allowing this.

> *T10: "There was an advantage in Teams. We could easily plan in advance in Teams. But there was a certain day limit in EBA. The system does not allow it after a certain period of time. For example, I assign a lesson that has 3 hours left. I forgot to enter. It did not allow me to assign that lesson. But there was no such problem in Teams."*

Physics teachers have made some positive opinions about the Metodbox program. The fact that the interface of the Metodbox program is similar to the Zoom program, that it allows assigning and checking homework, and

that online exams can be held were stated as positive aspects. They reported the system crashing at certain intervals and connection problems as negative opinions. The following teacher opinions regarding these findings can be given as examples. The teacher view below is similar to Zoom, and can be given as an example for drawing shapes, screen projection, assigning homework, and homework control codes.

T15: "…our institution used Metodbox. Its interface is similar to Zoom. That's why drawing shapes etc. was easy. I used features like screen mirroring. We uploaded students' homework from here and ensured their control."

The following teacher's view can be given as an example of an opinion regarding automatic lesson recording in the Adobe Connect program.

T1: "Adobe automatically takes a recording. Children can then listen to the recordings of these lessons again."

The following teacher's view can be given as an example of an opinion regarding Google Meeting and the Adobe Connect program being unsuitable for teaching lessons.

T9: "… Normally, we would have meetings in Adobe Connect anyway. It is suitable for holding meetings, not for teaching lessons. …Google Meeting can be a suitable program for holding meetings and maybe marking the document in some way, but it is not suitable for teaching lessons."

The following teacher's view can be given as an example of an opinion regarding the lack of student images in the Adobe Connect program.

T1: "… children do not have images anyway. There is nothing, only sound is heard."

In the interviews conducted with physics teachers, it was determined that two teachers used Microsoft Teams. It was stated that physics teachers generally had positive opinions about this platform. Teachers made positive comments such as allowing for advance planning and uploading content. The following teacher's opinion can be given as an example of the opinion that it allows for content uploading.

T6: "But there is something in Teams. You can upload things there. Homework can be uploaded to children. You can do things whenever you want."

The following teacher's opinion can be given as an example of the unlimited session duration of Google Meeting compared to Zoom.

T11: "But Zoom's screen sharing was limited, like 40 minutes. But Google Meeting's screen sharing was unlimited."

Measurement and Evaluation

The measurement and evaluation activities carried out during distance education in the interviews with physics teachers are given in Figure 3. Two sub-themes, namely homework and exam, were determined regarding the measurement and evaluation theme of Physics Teachers during the distance education period. The findings

regarding these themes are given in Table 3.

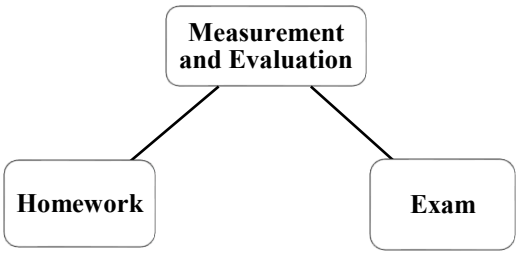

Figure 3. Assessment and Evaluation Situations of Physics Teachers in Distance Education

Table 3. Physics Teachers' Assessment and Evaluation Status During the Distance Education Period

Sub Theme	Code	Participants	Frequency
Homework	Assignment of homework	T1, T2, T3, T4, T5, T6, T7, T9, T10, T11, T12, T13, T14, T15, T19, T20	16
	Homework check	T3, T4, T6, T7, T9, T12, T14, T15, T16, T19, T20	11
	EBA	T2, T4, T5, T6, T8, T9, T14	7
	K12	T1, T12	2
	Metodbox	T15, T16	2
	Google Classroom	T7	1
	Project Assignment	T6	1
	Padlet	T1	1
Exam	Subjects taught face to face	T1, T2, T6, T7, T9, T13, T19	7
	Online exam	T1, T11, T12, T15, T16, T20	6
	Questions in the book	T1, T4	2
	ÖSYM questions	T3	1
	EBA	T3	1

Regarding the sub-theme of homework, they stated that they were generally able to give homework to students during the distance education period, but there were serious problems in terms of checking the homework. It was determined that teachers working in public schools generally gave homework via EBA, while teachers working in private schools used applications such as Google Classroom, K12, Metodbox, and Padlet. The following teacher opinions can be presented regarding these findings.

T4: "I gave it via EBA and it is checked, it was good that I was able to give it as completed or not."

T8: "We could send homework via EBA. Then I could share it as a screenshot or PDF."

T13: "I would send it as a photo. For example, I would send a test as a photo to the group and they would send me their solutions as something."

The following teacher opinion can be given as an example opinion regarding giving homework to students via

Padlet during the distance education period.

T1: "I gave things via Padlet, I gave homework, for example, we used it during this pandemic."

The video recording of the lesson given by S1 during the distance education period was examined within the framework of the lesson observation and it was observed that he gave homework to students via the Padlet program, as stated above. The following teacher opinions can be given as example opinions regarding the difficulty of checking the homework given to students during the distance education period.

T3: "There is no problem in giving homework. There was a problem in checking the homework. ...of course, there was no such thing as looking at your homework and checking it."

The following teacher's view can be given as an example of the problematic nature of homework control and the use of the Google Classroom program for homework control.

T7: "I was giving homework, but it was difficult to control, what was I doing during the control? I opened a class on Google Classroom. I was sending questions. I said, you will solve them and send them immediately. Here, they were posting photos of the homework I sent there."

The following teacher's view can be given as an example of the assignment of project assignments during distance education.

T6:"...I distributed the project assignments. Do a simple experiment with the materials you find at home about the conservation of energy. They shot very nice videos."

The following teacher's view can be given as an example of the assignment being made on the K12 platform during distance education.

T12: "A platform called K12. For example, the institution I currently work at conducts its work there. ...even the parents were notified when they did not do their homework."

The following teacher's view can be given as an example of the assignment and control being made through the Metodbox system.

T15: "We were doing our homework via Metodbox, there it was obvious whether the student did or did not do it because it was uploaded.

Regarding the exam sub-theme, EBA, ÖSYM questions, questions in the book, topics taught face-to-face, online exam codes were determined. The following teacher opinions regarding these codes can be presented as examples.

S3: "I did it and I sent the exam via EBA. I did it this way. Again, I said, come on, we are having an exam now, sometimes I had especially the 11th graders solve ÖSYM questions. They solved them and then we checked together like that, I mean when I sent them online, I did a comprehension test to see how much was understood when the topic was finished."

The following teacher opinions are sample opinions indicating that the content of the exams held during the distance education period was formed from face-to-face lessons.

T9: "We measured and evaluated as much as I could teach the students face-to-face. The reason for this was that the entire class would come to the written exams, the entire class would attend the face-to-face education, but one or two students would attend online."

The following teacher opinions can be given as sample opinions regarding the implementation of online exams during the distance education period.

T1: "…it happens like this, the children would take lessons for 6 hours and the children would take exams after these 6 hours…In other words, we actually did regular measurement and evaluation for the children."

Active Participation of Students

The findings regarding the theme of active participation of students during distance education in the interviews conducted with physics teachers are given in Table 4.

Table 4. Things Done for the Effective Participation of Students During the Distance Education Period

Code	Participants	Frequency
Solving Questions	T1, T3, T6, T8, T11, T12, T15, T16, T20	9
Speaking	T3, T4, T5, T6, T7, T14, T15, T19, T20	9
Examples from Daily Life	T5, T6, T8, T20	4
Chatting	T5, T8, T14, T19	4
Giving Grades	T8, T16	2
Following the Student	T5	1

When Table 4 is reviewed, it can be observed that physics teachers stated that they ensured the active participation of students in the lesson during distance education by having students solve questions, addressing them during the lesson to ensure their active participation, giving examples from daily life and chatting. Furthermore, teachers mentioned that they ensured the active participation of students by making statements about giving grades to students. The following teacher opinions can be given as sample opinions regarding having students solve questions and addressing them.

T4: "…I promised, come on Arda, you tell me. Arda answers, but come on Burak, you tell me."

The video recording of the lesson made by S4 during the distance education period was examined within the framework of lesson observation and it was observed that he called out to students by name during the physics course in order to make sure their participation in the lesson.

T5: "I call the children by their names from time to time to get their attention. I want them to speak up. I want them to send me what they wrote after class."

The following teacher's view can be given as an example view on having students solve questions and giving grades in order to keep students active during the distance education period.

T8: "We were giving questions and asking students to answer the questions after a short waiting period. Students could write their answers on the screen. …We were doing it to scare them. We will pass those who come here, etc."

The video recording of the lesson made by S8 during the distance education period was examined within the framework of lesson observation. In order to promote active participation of students in the lesson, he asked students questions and asked them to solve them during the lesson. The following teacher's views can be given as example views on having conversations in order to keep students active during the distance education period.

T5: "Since my participation was usually 4-5 people, I preferred not to turn off the microphones and always talk to the children. I tried to keep it lively."

The following teacher's view can be given as an example view to give examples from daily life to keep the student active during the distance education period.

T6: "For example, I am talking about Maglev trains. How is it, teacher? Like this? He asks a question. He asks a question."

The following teacher's view can be given as an example view to give grades to keep the student active during distance education.

T16: "…well, I was saying that it will affect your oral grade."

Materials Used

Findings regarding the theme of materials used during distance education in interviews with physics teachers are given in Table 5.

Table 5. Materials Used in Distance Education Period

Code	Participants	Frequency
Simulation	T1, T3, T4, T6, T7, T8, T9, T10, T11, T15, T16, T20	12
Interactive book	T3, T5, T6, T7, T10, T11, T13, T14, T15, T16, T17, T20	12
Video	T3, T4, T6, T7, T9, T10, T13, T14, T16, T20	10
Board	T5, T11, T12, T14, T18, T19	6
Paper	T10, T11, T14, T17	4
Poster	T9	1
Cartoon	T9	1
Documentary	T6	1

An analysis of Table 5 reveals that physics teachers used materials such as simulation, interactive books, videos, boards, paper, posters/banners, cartoons, and documentaries during the distance education period. The following teacher's opinion can be given as an example opinion regarding using simulation and having videos watched during the distance education period.

T3: "I have a simulation program that I always use called Phet Colorado. ...For example, there were simulations there that mostly appealed to 11th and 12th graders, whether it was electricity or optics, and I used them from there. For example, if I could find a relevant video, I shared an experiment done on YouTube. I used YouTube and had them watch them. Apart from that, when I say I prepared it myself, as I said, I did not prepare it myself because I bought the USB of these EST broadcasts."

The following teacher's opinion can be given as an example opinion regarding using simulation during the distance education period.

T1: "I can even say that I taught the lesson mostly through simulation."

The video recording of the lesson made by T1 during the distance education period was examined within the framework of the lesson observation. T1 taught the subject of energy in the 9th grade in his lesson. During the lecture, he used a simulation showing energy transformations. This observation supports the view stated by T1 above.

T7: "For example, there are simulations prepared by the University of Colorado. I show them. Sometimes there are such things on Instagram about small topics. For example, there are short videos like that."

The video recording of the lesson made by T7 during the distance education period was examined within the framework of the lesson observation. T7 covered the subject of parallel and series circuits in the electricity unit in his lesson. During the lecture, he used a simulation where he could set up electrical circuits on the PHet Colorado website. This finding supports the view stated by T7 above. The following teacher opinions can be given as sample opinions regarding the use of a board during the distance education period.

T5: "...I put a board behind me in my own school's Zoom lessons and film myself, and I try to teach a simple lesson like I teach in a normal classroom."

The following teacher opinions can be given as examples of using posters, videos and cartoons in physics lessons during the distance education period.

T9: "Yes, I am a little interested in these subjects now. We used to do e-twinning projects before. We had prepared posters, videos, calendars, cartoons and similar different materials using those tools."

The following teacher opinions can be given as examples of opinions regarding teaching the lesson by writing on paper during the distance education period.

T11: "I had a study where I guided them from the screen, knowing that they had paper. I reflected that paper on the screen."

The following teacher's opinion can be given as an example opinion regarding showing documentaries in lessons during the distance education period.

T6: "...For example, I also showed this. There is something on TRT Documentary. There is a documentary called Formulaless Life. ...A teacher from Boğaziçi University did some really nice

experiments with a few students there. I really liked it. It was about aerodynamics and stuff. I showed them."

Discussion

In this section, the lesson teaching processes of physics teachers during the distance education process implemented due to Covid-19 are discussed together with the current literature findings. Based on the interviews with physics teachers, the following themes were determined concerning course processing during the distance education period: used programs/platforms, measurement and evaluation, general course processing of the teacher, materials used, and active participation of the student.

It was determined that Zoom, EBA, Teams, Adobe Connect, Metodbox, Google Meeting programs/platforms were used in distance education. Physics teachers evaluated the positive and negative aspects of these programs/platforms. It was determined that teachers used Zoom and EBA programs the most during distance education. The recommendation by the Ministry of National Education for teachers in state schools to use the EBA platform played a significant role in this regard. Kavuk and Demirtaş (2021) reported in their study that teachers preferred the EBA platform and the Zoom application in distance education. According to Yakut and İçbay (2020), WhatsApp was the most preferred application of communication during the pandemic, while Zoom was the most used distance education platform. Physics teachers mentioned some positive aspects of the Zoom program. These are; it is easy to draw shapes, it allows the projection of visual materials and writing on the screen, it prevents loss of time and it has a useful toolbar.

It was observed that teachers generally shared negative opinions about the EBA program they used during distance education. However, there are also teachers who mentioned its positive aspects. Teachers expressed negative opinions such as having a time limit for lesson planning, not being able to take attendance, the system crashing and the content being mixed. Saygı (2021) reported that, in identifying the challenges faced by classroom teachers during the Covid-19 pandemic distance education process, teachers mentioned that the EBA platform was insufficient. Similarly, there are studies that state that the EBA platform is inadequate (Birhan, 2021; Kızıltaş and Özdemir, 2021; Kavuk and Demirtaş, 2021). There are also participants in the study who stated the positive aspects of the EBA platform. Teachers stated that the EBA platform has videos, simulations, measurement and evaluation tests, the ability to assign homework and regularly check homework as positive views. Türker and Dündar (2020) concluded in their study that the positive views of teachers about EBA are that it has a rich content structure, live lessons and question sharing can be done, and student control can be provided. Yılmaz (2022) emphasized the positive aspects of the educational programs or practices of Social Studies teachers in his study. In this context, it was stated that the usability of the Zoom application was highlighted, that the EBA live class was easy to access for students, and that the usability of the WhatsApp application for educational purposes was emphasized.

It was observed that some of the physics teachers working in private schools used the Metodbox program in the institutions they worked. These teachers made some positive comments about the Metodbox program. These are

that it is suitable for teaching lessons due to its similarity to the Zoom program interface, that it allows for homework to be given and checked, and that online exams can be held. They reported the system crashing at certain intervals and connection problems as negative opinions. In addition, some teachers made negative comments such as Teams, Adobe Connect, and Google Meeting programs not being suitable for teaching lessons. The effective use of distance education platforms is closely related to teachers' competencies in information technologies. In this context, teachers who will take part in the distance education process must have sufficient knowledge and skills in information technologies (Can, 2020).

The measurement and evaluation activities of physics teachers during the distance education period were determined as two subheadings: making exams and giving homework. Teachers generally stated that they could give homework to students, but there were serious problems in terms of monitoring the homework. It was determined that teachers working in public schools generally gave homework via EBA, while teachers working in private schools used applications such as Google Classroom, K12, Metodbox, and Padlet. Yılmaz (2022) emphasized the strengths of EBA in the distance education process as the sharing of activities, homework, and questions via the platform, the realization of live lessons, and the presentation of videos containing lesson explanations and question solutions. During this process, teachers were able to give homework to students via EBA, and it is stated that the EBA platform contributed to the distance education process with the start of the live lesson application (Kırmızıgül, 2020). Teachers carried out some exam activities during the distance education period. Some teachers who participated in the study stated that they gave exams via the EBA platform, while others stated that they gave online exams via different internet applications. When the subject content of the exams was examined, they stated that they gave exams on questions that had previously appeared in ÖSYM exams, questions in the book, and only topics that were taught face-to-face. In their study on determining the distance education experiences of teachers working in science fields (physics, chemistry and biology), Şahinoğlu and Arslan (2021) reported that teachers were inadequate in terms of implementing measurement and evaluation activities.

It has been determined that physics teachers carried out some activities for the active participation of students in the lesson during distance education. Accordingly, teachers ensured that students were active by having them solve questions and addressing them during the lesson. In addition, they stated that they ensured the active participation of students by giving examples from daily life and chatting. In addition, teachers stated that they ensured the active participation of students by making statements that they could give grades to students.

The materials used by physics teachers in their lessons during the distance education period were determined in the study. Accordingly, it was determined that teachers used materials such as simulations, interactive books, videos, boards, posters/banners, cartoons, writing on paper, and documentaries in their lessons. Altunsoy (2022) highlighted that the materials teachers utilized when preparing for online lessons were more varied and enhanced with technological features in comparison to traditional face-to-face education. The research findings indicated that the majority of teachers used videos that combined education with interactive learning during the lesson preparation phase. Additionally, it was found that most teachers also utilized Z-books and Web 2.0 tools. The study further reported that some teachers preferred traditional materials, such as PowerPoint slides, PDFs, and

worksheets, which are commonly used in traditional face-to-face education. During the pandemic period, teachers use different educational materials to enrich their lessons. However, it can be said that various course materials are used to increase student participation in the lesson. Physics teachers stated that in their general lesson processes during the distance education period, they greet the students and have a short conversation before starting the lesson, and then provide information about the subject to be covered. In addition, some teachers said that they ask questions about the previous topic at the start of the lesson, aiming to assess whether the students understand the topics in this manner. Some teachers stated that they have their cameras turned on during the lesson, send the course materials to the students and teach the lesson using the direct narration method. When Altunsoy (2022) examined the teachers' lesson presentation style in his study, he found that most of them use the question-answer method together with direct narration or independently. Teachers generally reported that they use the problem-solving method to reinforce the subject after finishing the theoretical part of the lesson. The two female teachers interviewed in our study stated that they prepare as if they are going to school and appear before the students.

Conclusions and Implications

The findings of this study show that physics teachers have demonstrated significant adaptability and resourcefulness by overcoming various challenges by taking advantage of the opportunities provided by technology during the Covid-19 distance education period. Teachers have been observed to use a range of platforms and materials such as Zoom, EBA, simulations, and interactive videos to enhance teaching and student engagement. However, technological limitations, especially on platforms such as EBA, and difficulties in monitoring and evaluating student progress have created significant obstacles. Despite these challenges, it can be said that teachers have demonstrated their creativity by using various methods to encourage active participation and enrich the learning process. These results emphasize the importance of equipping educators with adequate technological infrastructure and training to improve their competence in digital teaching. Addressing these issues is critical to increasing the effectiveness of distance education and ensuring the delivery of quality education in future scenarios where such approaches may be necessary.

In light of the study's findings, the following suggestions can be proposed to improve distance education processes. The infrastructure of widespread platforms such as EBA should be strengthened, technical problems encountered by teachers should be resolved, and they should be made more user-friendly. In order to increase teachers' digital competence, comprehensive training should be provided on measurement-evaluation, material preparation, and platform usage. The range of materials should be expanded, and teachers should be given easier access to diverse content, such as simulations, interactive videos, and Z-books. Tools that will facilitate measurement-evaluation processes and advanced exam modules should be added to EBA. Methods such as examples from daily life, gamification, and rewarding should be encouraged to increase student participation. Providing the technological advantages used in private schools in public schools will increase resource equality. In addition, professional and psychological support programs should be created for teachers and their motivation in distance education processes should be supported. These suggestions can contribute to future practices being more effective and efficient by providing solutions to the problems encountered by teachers in distance education.

This study is limited to physics teachers who participated in distance education during the Covid-19 pandemic. The semi-structured interview questions designed to explore the distance education activities of the participants are confined to their responses and the observations made by the researcher. The data collected from the interview and observation forms are limited to the teachers who took part in the study.

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