

Investigation of Science Teachers’ Integrating Edutional Technologies into the Covid-19 Pandemic Process

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Abstract

The ability to use edutional technologies in distance education is very important during the covid pandemic process. The aim of this study is to determine the competencies and needs of science teachers in using technology in the covid-19 pandemic distance education process. The research was carried out with phenomenology techniques, one of the qualitative methods. Data were collected by applying semi-structured interview forms containing 7 open-ended questions to 21 science teachers working in the central districts of Manisa province, then analyzed via consent analysis method. Finally, by creating themes and codes, frequency and percentage distributions were revealed to understand and. When the findings were examined, the biggest obstacles to distance education were the internet connection, infrastructure-hardware problems and the inability to discipline students. Students’ entering the online lesson with their cameras closed, the noise from the home environment, and could not join online lesson were reflected in the opinions of the participants as problems. If our students are more active by making presentations, these problems will be minimized and the quality of distance education maximize. It was observed that although science teachers having experience in using technology are more active, science teachers with insufficient experience in using technology could not conduct scientific experiments for their students in the distance education process. In addition, integrating different student-centered educational techniques and measurement-evaluation activities with technology are other problems.

Keywords: Science Education, Educational Technology, COVID 19, Distance Learning.

Introduction

Due to the Covid 19 pandemic, it has been determined that approximately 1.6 billion children and young people are affected by the closure of schools in many countries around the world and the transition to compulsory distance education (Miks & McIlwaine, 2020; cited in Bakioğlu & Çevik, 2020). At the same time, the Ministry of National Education extends access to educational activities as much as possible with the EBA (Education Information Network) distance education portal, EBA TV, zoom, teams and so on in Turkey. Between 21 September 2020 and 16 October 2020, EBA was visited approximately 3.5 billion times. The EBA Mobile application has reached 21.8 Million downloads for Android devices and 2.5 million for IOs devices. Around 10 million students and 850 thousand teachers have actively used EBA on the same dates (Yeğitek, 2020).

Along with the fact that the positive effects of the integration of edutional technologies into education in the face-to-face education process are undeniable, both educational staff and students use the internet in education. Use computer-based learning is compulsory in the distance education process (Mulenga & Marban, 2020). Nevertheless, it has been observed that this process, which is rapidly transitioned to computer-based education in the form of an emergency action plan, puts more pressure on teachers who do not have sufficient skills to

use educational technologies (Iwai, 2020). The effect of teachers' ability to use educational technology also depends on which technology they will use at which stage of the learning process (Pamuk et al., 2012). In addition, teachers' educational approaches depend on their self-efficacy, professional development level and personal preferences (Alt, 2018).

The use of technology in education activities is an inevitable reality rather than an option in changing social life because of a covid pandemic. Technology-supported education activities offer the opportunity of equality of opportunity with the advantage of being economically accessible (Weller, 2013), as well as providing environments that make it possible to study at any time and place (Şahin, 2010; cited in Ünal, 2017). With the compulsory distance education process, teachers' knowledge, experience and competence in using educational technologies have become more important. On the other hand, the advantages of technology-supported distance education activities, which are passed along with the pandemic process, have disadvantages such as the inability to make eye contact as in face-to-face education, lack of emotional communication, lack of technical infrastructure, inadequate device-connection, inadequacy in measurement-evaluation practices, and some of the teachers are unfamiliar with the programs used. (Bakioğlu & Çevik, 2020).

Science education is suitable to be carried out on digital platforms with different content of science. It is seen that educational technology makes learning permanent by providing multimedia learning environments that enable students to observe difficult things and do dangerous experiments through simulation techniques (Aktamış & Arıcı, 2013; Namdar & Küçük, 2018). Educational technology tools are divided into four sections, non-interactive tools such as videos, documents, worksheets; interactive tools such as animation-simulation; measurement-evaluation tools such as kahoot, quiz, learning apps; individual or collaborative tools, google classroom, padlet, social media platforms, etc. (Namdar & Küçük, 2018). The interest of teachers in these educational technology, which we can describe as Web 2.0 tools, has increased in recent years; it is especially important that using web 2.0 tools in science education offers multimedia learning environments and contributes to meaningful

learning. In the literature, although there is much research on the use of educational technology in science education in face-to-face education, the studies relating to technology and infrastructure problems, classroom management problems, teachers' thoughts, virtual learning, etc., teachers encountered in distance education during the covid 19 pandemic process were limited. Studies involving a multifaceted psychosocial dimension (Bakioğlu & Çevik, 2020; Iwai, 2020; Mulenga & Marban, 2020; Özdoğan & Berkan, 2020; Sarioğlu et al. 2020; Ünal & Bulunuz, 2020). No study has been found in the Turkish literature regarding the preferences and competencies of teachers in the use of technology focused on teaching activities in science lessons. This study will guide the determination of measures and suggestions to be taken to increase the efficiency of science teachers in distance education activities.

"Have science teachers been able to fruitfully benefit from educational technologies in teaching procedure, class activities, measurement and evaluation during the transition to distance education activities during the pandemic process?" is the problem statement of the research. It is important for the quality of educational activities to determine the status, competencies and needs of science teachers to utilize educational technologies in distance education and to face what type of problems. Determining the skills of science teachers in integrating educational technology into distance education is important in determining the needs and requirements in this field.

The aim of this study is to determine the competencies and needs of science teachers in using educational technologies in the covid-19 pandemic distance education process. For this purpose, the following questions were asked;

1. What are the difficulties you encounter during the distance education lessons?
2. What do you have experience with using educational technology in teaching procedures in the distance education process?
3. What do you have experience using educational technology in measurement and evaluation activities in the distance education process?
4. How would you evaluate yourself in terms of self-efficacy to use educational technology in the distance education process?

5. What are your efforts to increase the efficiency of a science lesson in the distance learning process?
6. What do you think about the physical conditions to increase the efficiency of a science lesson in the distance education process?
7. What do you think about the teaching methods and techniques to increase the efficiency of a science lesson in the distance education process?

Method

This study was carried out with phenomenological design, one of the qualitative research methods. The phenomenological design allows the underlying reasons of an existing reality to be examined and the current condition to be explained in a healthy way (Yıldırım & Şimşek, 2013).

Participants

The study group of the research consists of 21 science teachers working in the districts of Manisa city center, selected by using the “Purposeful Sampling” methods. The purpose of choosing this group working in a high level of the socio-economic area, their students do not have economic and technical infrastructure problems related to participation in distance education.

Data Collection Instrument

To collect data, the semi-structured interview form was created. Regarding the content validity of the interview form, after the opinions of 4 science teachers form revised then the form was sent to 3 academicians in science education. According to their thoughts, forms were rearranged and finalized as the data collection tool.

Procedure

The interview form was first published online

environment by using the “Google Forms” then was delivered to participants by direct message or social media products, such as whatsapp groups of school/district science teachers. It took approximately 10-15 minutes to answer the interview form.

Data Analysis

The data obtained in the study were analyzed by the content analysis method. The essential process in content analysis method is to collect similar data within the framework of certain concepts and themes and to organize and interpret these concepts and themes in a way that the reader can understand (Yıldırım & Şimşek, 2006; as cited in Selçuk & Palancı, 2014). For each research question, the data is categorized in codes and then create suitable themes. The frequency and percentage analysis of the codes were brought together in tables.

Results

The answers given by the participants were analyzed separately for each question item. The study group is 52.4% female and 47.6%, male. The teaching experiences of teachers are 4.8% 6-10 years, 38% 11-15 years, 9.5%, 16-20 years, 18.9% 21-25 years, 24% 25-30 years, and 4.8% for over 30 years. As seen, a science teacher who has teaching experience the under 10 years is low because of the Turkish government’s procedure that after graduation, teacher must pass the national exam then must work in the east part of the country for at least 5 years. After 5 years, if you find an available position west part of the country, you have a chance to work. Therefore teachers who participated in this study have much teaching experience (Table-1).

Table 1: Distribution of Demographic Information by Gender

Gender		Women(w)	Group %	Men (m)	Group %	Total (w+m)	Inside Variable %
Seniority Year		11	52,4	10	47,6	21	100,0
	0-5	0	0	0	0	0	0
	6-10	1	100	0	0	1	4,8
	11-15	3	37,5	5	62,5	8	38
	16-20	1	50	1	50	2	9,5
	21-25	2	50	2	50	4	18,9
	25-30	4	75	1	25	5	24
	30+	0	0	1	100	1	4,8

The first question, “What are the difficulties you encounter during the distance education lessons?” was asked. The science teachers’ responses were analyzed by gathering 9 codes into 5 sub-themes in 3 main themes. In human-related problems, the reason of teachers was 31.3% and students were 27.1%. Among the problem of the reason of

teachers, the highest frequency code was “inability to the discipline of students” 22.9%. The highest reason for students’ problems was “inability to concentrate” 12.5%. The technology related problems are divided into “Internet problems” 22.9%, “lack of hardware problems” % 12.5% and “Insufficiency of Time” 6.3% (Table 2).

Table 2: Opinions of Science Teachers about Difficulties in the Distance Education Lessons

Main Theme	Sub-themes	Codes (frequency)	Percent
Human Related Problems	Student Related (13)	Insufficient Participation (6)	12,5
		Inability to Concentrate (7)	14,6
	Teacher Related (15)	Inability to discipline of students (11)	22,9
		Inability to Experiment (2)	4,1
		Having a Little Child at Home (1)	2,1
		Lack of Knowledge in Using Programs (1)	2,1
Technology Related Problems	Internet Problems (11)	Failure to Connect, Disconnection (11)	22,9
	Lack of Hardware(6)	Microphone / Headphone Failure (6)	12,5
Time Problems	Insufficiency of Time(3)	Insufficient Course Duration (3)	6,3

The fact that the turn-off cameras, the inappropriateness of the environment in the house and the noise pollution in the background were stated as important problems in controlling the students. In addition, the reduction of the standard 40 minutes in face-to-face education to 30 minutes in online education has also been reflected in the opinions of the participants in the form of a shortage of time. Some participants were also incapable of using synchronous education programs, having little-aged children at home, etc. It was determined that the lesson performance was negatively affected by these problems. Here are some of the science teachers comments;

T-16: “Limited facilities and insufficient equipment affect the number of class attendance and the quality of the course. Students without quality microphones and headphones cause excessive noise pollution. Noises in the house also negatively affect it.”

T-5: “I was completely unprepared about distance education. Therefore, the biggest obstacle was my lack of knowledge on this subject.”

T-20: “Students do not turn on their cameras, expect attention from us because our little children

cannot go to school or kindergarten at home, children do not attend classes on time, leave early, sometimes never come to lessons, working families cannot follow their children.”

The second research question, “What do you have experience with using educational technology in teaching procedures in the distance education process?” was asked to the participants. It was observed that only two science teachers feel inadequate technology users (7.4%). The rest of the science teachers’ answers were divided into 5 sub-themes. 24.3% of the participants mentioned the programs where they carried out synchronized lesson activities such as zoom and teams. Subsequently, power-point slides, word documents, videos and e-book as an non-interactive tools were mentioned with a rate of 31.7%. One participant uses only EBA (3.7%). Only 7.4% of technology users actively use interactive tools in their lessons. When the participants’ responses were examined one by one, it was seen that female teachers talked less about technological tools types on this subject, and male teachers integrated technological tools into their lessons in various ways (Table 3).

Table 3: Teachers’ Opinions Regarding their Experience on Using Educational Technologies in Distance Education

Main Theme	Sub-themes	Codes (frequency)	Percent
Not Active (2)	Insufficiency (2)	Finding yourself inadequate (2)	7.4
Active Using (19)	Synchronous Course Programs (9)	Zoom / Teams (9)	24.3
	Using Non-interactive tool (11)	Power-point Slides (3)	8.1
		Word Documents(3)	8.1
		Videos(3)	8.1
		e-Books (2)	7.4
	EBA (1)	EBA (1)	3.7
	Using Interactive tool (2)	Interactive activities (1)	3.7
		Simulations (1)	3.7
No details (2)	Active using (2) (No detail)	7.4	

Some comments of science teachers support the results;

T-1: “We specialize in programs like Zoom.”

T-10:”Various interactive activities aimed at taking the education and teaching process out of monotony with the knowledge I have gained by attending various seminars.”

T-7: “It was the first time I had such an experience. They have difficulties. There were cases when I could not attend classes due to the intensity..”

T-20: “I started distance education for the first time with the pandemic process. At first, I was very anxious because we could not control the programs. I teach our lessons on EBA and zoom.”

“What do you have experience with using educational technology in measurement and evaluation activities in the distance education process?” was the third question of the research. The striking answer was “did not use technology in measurement and evaluation,” with a rate of 47.6%—almost half of the participants use conservative measurement and evaluation techniques. The rest of the science teachers responses were categorized into 3 codes, 23.8% of the participants using online tests, 9.6% of participants using EBA, 9.6% of participants using synchronize checks students in lesson time, and 9.6% of participants using Web 2.0 tools (kahoot, quiz applications etc.) (Table 4).

Table 4: Teachers’ Opinions Regarding the Usage of Educational Technologies in Measurement and Evaluation Activities in Distance Education

Main Theme	Sub-themes	Codes (frequency)	Percent
Technology Usage in Measurement & Evaluation	No use (10)	I didn’t use (10)	47,6
	Have use (11)	Online Tests(5)	23,8
		EBA (2)	9,6
		synchronized checks students (2)	9,6
		Web 2.0 tools (kahoot, padlet, quizz) (2)	9,6

Some of examples science teachers’ opinions regarding the usage of information technologies in measurement and evaluation activities in distance education;

T-6: “I did not use it for measurement and evaluation.”

T-16: “I get started interested with remote exams during the epidemic period. I was the Central Exam coordinator at the school. I carried out tasks such

as following the online trial exams of publications, directing students to these exams, preparing collective results on a school basis.”

T-4: “I think we cannot get accurate, fast and reliable feedbacks in measurement and evaluation..”

T-11: “I can check whether my students have done it by sending a test or a video over the EBA. I can throw my homework through different applications

such as Padlet and see what my students do.”

In the question of “How would you evaluate yourself in terms of self-efficacy to use educational technology in the distance education process? self-efficacy perceptions of science teachers about using educational technology were analyzed. It is observed that 23.6% of the participants felt themselves an inadequate user or need to improve their skill, 53.1% of the participants were good at the medium level

and 11.8% of the participants were in the good level. The rest of them felt they were at a professional level. Although a low level of educational technology users felt inadequate, they had the aim to develop and adapt to the distance education process. Moreover, when the distribution of participants as good and very good users was examined, the self-efficacy perceptions of male participants are higher than women science teachers (Table 5).

Table 5: Teachers’ Views on Using Technology in Distance Education About Self-Efficacy

Main Theme	Sub-themes	Codes (frequency)	Percent
Self-efficacy status	Low	I'm inadequate (2)	11.8
		I have to improve myself(2)	11.8
	Medium	I'm intermediate (3)	17.7
		I Had Difficulty At The Beginning, But I Developed During The Process (6)	35.4
	Good	Good (1)	5.9
		4 out of 5 (1)	5.9
	Pro	Very Good (1)	5.9
		Expert Use (teacher trainer) (1)	5.9

Here are some examples of teachers responses;

T-1: “I was inadequate at first. Soon I prepared myself for my students. Children are very important to me.”

T-10: “Although we had difficulty the first time, I got used to it in the following process.”

T-16: “The epidemic period allowed me to improve my skills in many subheadings and reach extreme levels, although I was far above the normal level in the field of using technology.”

The 5th question of the research was, “What are your efforts to increase the efficiency of a science lesson in the distance learning process?” The 36

answers given by the participants were collected under 3 main themes, students-focused (11,1%), lesson-focused (83.3%) and time-focused (5.6%), and four sub-themes, active students participation, content and teaching methods oriented, additional lesson. In the code of ensuring lesson-focused, using power-point slides, videos and animation were 30.5%, EBA was 11.1% and interactive lesson learning was 2.8% as in the content-oriented sub-theme; question solution activity was 22.2%, doing experiments was 13.9% and using online trial activity was 2.8% as in the method-oriented sub-theme (Table 6).

Table 6: Teachers’ Activities to Increase Efficiency in Distance Education

Main Theme	Sub-themes	Codes (frequency)	Percent
Student-Focused Studies	Active Student Participation (4)	Ensuring Active Participation (3)	8,3
		Assigning Research Assignments (1)	2,8
Lesson-Focused Studies	Content-Oriented Studies (16)	Slides , Videos ,animations (11)	30,5
		EBA (4)	11,1
		Interactive Content (1)	2,8
	Method-Oriented Studies (14)	Question Solution (8)	22,2
		Experiements (5)	13,9
		Online Trial Application (1)	2,8
Time-Focused Studies	Additional Lessons (2)	Additional Lessons (2)	5,6

Teachers, who do not use a student-centered teaching approach because of not know how to activate their students in their science lessons, generally could not finish the subjects on time; they need extra additional lesson time. Some examples of science teachers thoughts are below;

T5: "I am a person who does not like everything. That's why I prepared my slides. I used all the videos EBA has prepared for my lesson.."

T10: "Determining students who do not have enough opportunities and solving students' problems by cooperating with classroom teachers. Participation in the lesson by meeting with their parents in person."

T12: "I ask all of my students one by one questions to include them in the lesson. Before the lesson, I always ask about the situation. If I am going to experiment according to the content of the subject, I am experimenting visually. I ask questions that will make the subject interesting and I am intriguing. I give every student who asks questions the right to speak. I listen and care I ask all of my students one by one questions to include them in the lesson. Before the lesson, I always ask about the situation. If I am going to experiment according to the content of the subject, I am experimenting visually. I ask questions that will make the subject interesting and I am intriguing. I give every student who asks questions the right to speak. I listen and care."

The next question, "What do you think about the physical conditions to increase the efficiency of science lessons in the distance education process?" asked the participants and responses were examined with 26 different answer codes under 2 main themes as to whether they gave suggestions (19 teachers) or not (2 teachers). Two science teachers (7.7%) did not express an opinion to increase the efficiency of teaching in the distance education process because of many variables and the dream situation. the rest of the science teachers' responses were divided into 3 sub-themes, which were student-based suggestion; educational technology suggestions and other equipment suggestions. The 50% of suggestions were related to solving the problems of students and their environment were join in distance education. The study environment rate was 30.7%, including temperature, lights, sitting at a desk, etc., parent control 7.7%, turning on cameras 7.7% and psychological needs 3.8% in the sub-theme of student-based suggestions. The requirement of Internet connection, computer, a laptop should be supplied for all students rate was 34.6% in the sub-theme of educational technology suggestions. The requirement of a little whiteboard and experiment package rate was 7.7% in the sub-theme other equipment suggestions. These suggestions showed that there is no equity in education among our students (Table 7).

Table 7: Teachers' Suggestions Regarding Physical Conditions to Increase Efficiency in Distance Education

Main Theme	Sub-themes	Codes (frequency)	Percent
No Suggestion (2)	No	Too Many Variables (1)	3,8
		This Is A Dream(1)	3,8
Suggestions (19)	Student-Based Suggestions	Study Environment (8)	30,7
		Parent Control (2)	7,7
		Turning on Cameras (2)	7,7
		Psychological Needs (1)	3,8
		Internet & Tablet, Computer Provision (9)	34,6
	Other Equipment Suggestions	Little Whiteboards (1)	3,8
		Packaged Experimental Materials (1)	3,8

Some examples of science teachers thoughts are below;

T-4: "There should be a quiet environment;

students should join lessons alone if possible. When classes are early, I recommend that they have breakfast and join."

T-13: “I think this is a dream. What kind of physical environment can I think of for students whose screens are turned off despite all warnings?” T13: “I have no suggestions. There are too many variables.”

The final question was, “What do you think about the teaching methods and techniques to increase the efficiency of a science lesson in the distance education process?” Participant answers to the last research question were analyzed by creating 27 codes in 4 main (student, ICT, Lesson, and Teachers based) and 6 related sub-themes. In the student-based theme, students should make “preliminary preparations” (8.7%) and “presentations in the lesson” (8.7%). In the ICT theme, teachers suggested

that eliminate the “deficiencies of technological infrastructure” (8.7%) and that their cameras should be turned on (8.7%) in the process of teaching their lessons. In the Lesson based theme, the highest codes were “doing virtual science experiments” (17.4%) and “interactive lessons with students” (13.2%). They also suggested using brainstorming (4.3%) and concept maps (4.3%) teaching techniques. In the Teacher-based based theme, there was one code, “in-service seminars” (4.3%), which are expected to be given by the Ministry of National Education and universities to complete the individual development and deficiencies of teachers (Table 8).

Table 8: Suggestions of Teaching Methods and Techniques to increase Efficiency in Distance Education

Main Theme	Sub-themes	Codes (frequency)	%	
Student Based	Active participation of students (4)	PreliminaryPreparation (2)	8,7	
		Making Presentations (2)	8,7	
ICT Based	Use (2)	Having Cameras On (2)	8,7	
	Infrastructure (2)	Elimination of Technological Deficiencies (2)	8,7	
Lesson Based	Method - Techniques (9)	Live / Virtual Experiments (4)	17,4	
		Interactive lesson with students (3)	13,2	
		Concept Mapsı (1)	4,3	
		Brainstorming (1)	4,3	
		Repeat-Reinforcement Activities (5)	Question-test (2)	8,7
		Homeworks (2)	8,7	
		Documents (1)	4,3	
Teacher Based	Professional and Personal Development (1)	In-Service Training (1)	4,3	

Some examples of science teachers thoughts are below;

T-4: “Since the science lesson is more of an empirical lesson, more place should be given to demonstration experiments and studies that can be done with home materials.”

T-21: “For teachers, in-service training should be given on different applications that they can use information technologies in the best way.”

T9: “Both teachers and students should be prepared for the lesson, the variety of activities appropriate to the student level in the lesson, the students should be active in the lessons, they should use their time efficiently, and the end-of-lesson repeat activities.”

T-12: “Question and answer, lecture, concept map, brainstorming, creating technique.”

Discussion and Conclusions

The biggest obstacle to distance education activities in science education is the inability to control students due to technological infrastructure and hardware problems. With the study of Özdoğan and Berkant (2020), it is seen that similar results were obtained with problems in areas such as infrastructure, communication problems, lack of motivation. Teachers’ rapid transition to online education without having sufficient knowledge and orientation in the form of an emergency action plan has created a sense of inadequacy, especially

in teachers who lack technology user experience. However, it was determined that teachers who initially found themselves inadequate and made an effort to adapt to the process developed themselves in the process and gained a sense of competence. On the other hand, teachers who actively use technology have an advantage in coping with the educational technology problems more easily and in using alternative teaching methods and techniques. In-service training activities are needed to eliminate the feeling of inadequacy in using educational technology and integration into the lesson and to support the development of teachers' abilities (Ünal & Bulunuz, 2020).

It was observed that most of the science teachers declared distance educational tools such as EBA, Zoom, Teams and used these tools for synchronous lesson processes in their class. Still, they did not mention enough alternative educational technology tools such as animation-simulations, virtual laboratory studies, web 2.0 contents, live worksheets, or AR applications. These results also support the view that there is a need for educational activities for teachers to increase their knowledge and experience using these tools in science lessons. Science lessons should be carried out by experiencing and experimenting. This study showed that science teachers have problems in distance education activities, especially in experimental studies. Teachers could not get the desired efficiency from students when using EBA experiments because they only watched and not actively participated in the experiments process. Sariođlan, Altař & řen (2020) stated in their study on this subject that teachers benefited from EBA experiments, after watching EBA experiments in lesson students could do their experiments at home and then upload their experiments to the EBA system. This could be a solution to the problems.

The inadequacy of the use of technology in measurement-evaluation activities in distance education draws attention. While face-to-face education has been observed as a problem (Namdar & Kűçük, 2018), it is seen that turning this into an advantage with the use of technology in distance education cannot be evaluated positively.

If educational, technological devices and technological, infrastructural deficiencies, and

suitable learning physical environment should be provided, the students' productivity and learning level increase that the teacher expects of their students. In addition, teachers should use modern methods/ techniques and more teaching technologies in their lessons, and students should be actively participate in both classroom lectures and lab lectures.

In terms of the results of the study, the following suggestions can be made for researchers: The Ministry of National Education officials should make sufficient efforts to provide various in-service training and infrastructure support regarding distance education, as well as to eliminate the deficiencies caused by the educators themselves and the infrastructure. Even in the face-to-face education process, arrangements should be made to continue to use various experiences, such as various assignments, technological activities, and online measurement and evaluation activities gained in distance education at certain rates.

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