T.C.

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MASTER THESIS

SCIENCE TEACHERS' USE OF AND VIEWS ON DIGITAL MATERIALS DURING THE WEB-BASED DISTANCE EDUCATION

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FEN BİLGİSİ ÖĞRETMENLERİNİN WEB TABANLI UZAKTAN EĞİTİM SÜRECİNDE DİJİTAL MATERYAL KULLANIMINA İLİŞKİN KULLANIM DURUMLARI VE GÖRÜŞLERİ

YÜKSEK LİSANS TEZİ

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I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

15.09.2022

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ÖZET

Yüksek Lisans Tezi

FEN BİLGİSİ ÖĞRETMENLERİNİN WEB TABANLI UZAKTAN EĞİTİM SÜRECİNDE DİJİTAL MATERYAL KULLANIMINA İLİŞKİN KULLANIM DURUMLARI VE GÖRÜŞLERİ

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Bu çalışma fen bilgisi öğretmenlerinin dijital materyaller hakkındaki görüşlerini ve web tabanlı uzaktan eğitim dönemindeki dijital materyal kullanım durumlarını ortaya koymak amacıyla hazırlanmıştır. Öğretmenler derslerini şekillendirirken öğrencilerin dikkatini çekecek, motivasyonu artıracak ve ders başarısını yükseltecek materyaller kullanmaktadır. Bu materyallerin çeşitliliği ve kullanımı öğretmenin materyal bilgisi ile doğru orantılıdır. Teknolojik gelişmelerle beraber zaman içerisinde materyaller de farklılaşmıştır. Öğretmenler de öğrencilerine daha faydalı olabilmek adına bu değişim ve gelişime ayak uydurmalıdır. Özellikle fen bilgisi dersinde oldukça etkin ve çok kullanılan materyaller dersin anlaşılmasını kolaylaştırmaktadır. Daha önceki yıllarda kullanılabilen modeller ve maketler gibi materyaller bu dönemde âtıl kaldığından öğretmenlerin öğrencileri motivasyonunu arttırmak adına farklı yöntemlere başvurması gerekmektedir. Her ne kadar dijital materyaller son zamanlarda derslerde kullanılıyor olsa da web tabanlı uzaktan eğitim sürecinde süregelen ders anlayışının kısa sürede değişmek zorunda kalmasıyla bu konu daha önemli hale gelmiştir. Fakat diğer materyallerde olduğu gibi dijital materyallerin kullanımı da etkinliği de öğretmenlerin materyaller hakkındaki bilgisi ve materyallere olan ilgisi ile yakından alakalıdır. Bu sebepten dolayıdır ki dijital materyallerin derste kullanım sıklığı da

öğretmenlerin teknoloji okur-yazarlığı ölçüsünde olmaktadır. Bu araştırmada öğretmenlerin kendi teknoloji okur- yazarlıklarını kabul durumları ile dijital materyal kullanım durumları arasındaki ilişki araştırılacaktır. Bu amaca yönelik olarak görüşme formu ve anket çalışması hazırlanmıştır. Hem nicel hem nitel verilerin bir arada kullanılacağından dolayı karma yöntemlerden olan açıklayıcı sıralayıcı yöntem tercih edilmiştir. Yarı yapılandırılmış anket formundan elde edilen verilen içerik analizi yapılarak değerlendirilmiştir. Anket formundan elde edilen veriler çeşitli faktörlere göre analiz edilerek çalışmaya eklenmiştir.

Anahtar Kelimeler: Fen Bilgisi Öğretimi, Öğretmen Görüşleri, Dijital Materyaller, Web Tabanlı Uzaktan Eğitim

ABSTRACT

M. Sc. Thesis

SCIENCE TEACHERS' USE OF AND VIEWS ON DIGITAL MATERIALS DURING THE WEB-BASED DISTANCE EDUCATION

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This study aims to reveal science teachers' use of and views on digital materials during the web-based distance education period. While shaping their lessons, teachers use materials to draw student attention, increase motivation and enhance course success. The variety and use of these materials are directly related to the teacher's knowledge of the related material. Along with technological developments, materials have changed over time. Teachers are expected to keep up with this change to be more beneficial to their students. Effective and widely used materials in science lessons make the lesson easier to understand. Since materials such as models and shapes used in previous years became idle in this period, teachers are expected to find different methods to increase student motivation. Although digital materials have been used in lessons recently, the ongoing course understanding in the web-based distance education process had to change in a short time, which has become more significant over time. However, as with other materials, the use and effectiveness of digital materials are closely related to the teacher's knowledge of and interest in materials. Thus, the frequency of the use of digital materials in the course synchronizes with the teacher's technology literacy. This research examines the relationship between teachers' acceptance of technology literacy and the use of digital materials. For this purpose, an interview form and a questionnaire study were prepared. Since both quantitative and qualitative data are used together, the explanatory ordinal method, which is a mixed method, was preferred. The

content obtained from the semi-structured questionnaire form was evaluated by making content analysis. The data obtained from the questionnaire form were analysed considering various factors and added to the study.

Keywords: Science Teaching, Teacher Views, Digital Materials, Web-Based Distance Education

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1. INTRODUCTION

The basic structure of education, systematically and in its simplest form, can be revealed by seeking an answer to the questions; who educate whom, for what purpose, and how? (Krüger & Grunert, 2006). While seeking answers to these questions, many definitions of education have been made throughout history. Although these definitions differ according to the needs and conditions of the period, the concept of education has certainly never lost its importance. It is not possible to think of the concept of education separately from human beings, and it is not possible to think of the education history separately from the history of humanity. When we look at the civilizations with an important place on the stage of history, we see that they have their own understanding of education. Although the educational orientations of the countries differ, it is not correct to ignore the effects of the events that affect many regions and even the whole world. While natural disasters, great discoveries, wars and many similar events seen in different periods of history have their place in the history of humanity, they also shaped the educational understanding of the period (Köçer, Koçoğlu & Öner, 2020).

Every event that affects humanity leaves an impact on the concept of education. For this reason, the understanding of education changes from society to society. Each society adopts an educational approach depending on its cultural elements, way of life and even regime. However, while some events in history brought different perspectives to education, some of them caused great changes. The COVID-19 pandemic is one affecting the whole world.

According to the data from the World Health Organization, the first COVID-19 case appeared in Wuhan, China (WHO). After this first case in December 2019, the rapidly spreading disease evolved into a pandemic. Considering the way it's transmitted and the rate of infection, preventive measures have been immediately implemented by most countries. According to the data from the Turkish Ministry of Health, the disease is being transmitted through the intake of droplets that comes from sick people coughing, or by the entry of the virus into the body through mouth, eyes, nose after touching the surfaces contaminated by these droplets (Ministry of Health of the Republic of Turkey). Considering the ways of transmission, it has become obvious that crowded environments increase the likelihood of infection. Although people may voluntarily stay away from social environments such as cafes, bars, restaurants, theatres, cinemas, concerts, and symposiums as a precaution, it is unlikely to avoid compulsory public environments such as workplace and school. Although wearing face masks and abiding by hygiene rules minimize the risk of infection, public

spaces still pose a great risk considering the rate of infection.

With the rapid spread of the COVID-19 pandemic, countries have started to take different measures. Adopting a shift working system, holding remote meetings, imposing curfews, and cancelling crowded events are just some. Even visiting markets after an appointment is made sets an example of the measures taken. Although the duration of the restrictions and the measures taken differ country by country, an opinion has become common on one issue: Continuing face-to-face education at schools poses a great risk to the society. For this reason, the Ministry of National Education has switched to distance education for the first time starting from November 20, 2020, as per the decision taken at the Presidential Cabinet Meeting (Ministry of National Education). Although face-to-face education was recessed from time to time, distance education had to be done most of the time.

Even though the distance education concept is regarded as a concept that has emerged with the outbreak of the pandemic, it actually has a long history. It is known that different countries around the world have different studies and practices for distance education. The term ‘distance education’ was used in an article written by William Lighty at the University of Wisconsin in 1906 in the USA (Uşun, 2006). Studies on distance education were carried out in many European countries, including France and England. In Germany, a country viewed one of the pioneers of distance education, such institutions as "Tele colleg", Fern universität" and "Deutsch Institut für Fernstudien" were established in 1856, and these institutions are still active today (Elitaş, 2017). In light of all this information, it can be stated that distance education takes an important part in the history of world education. It is possible to see distance education studies frequently in the educational history of the Republic of Turkiye.

Although distance education was regarded as beneficial in our country in 1923 due to the current situation, it remained to be discussed solely as a concept until the 1960s (Bozkurt, 2017). The studies remained suggestions only and could not be implemented because the existing technologies were not suitable for distance education. One of the distance education methods acknowledged globally at that time was teaching by letter. Towards the end of the 1950s, given the developments in the world and the needs of the country, the programs that focused on education by letter were examined by the Turkish Ministry of National Education, and necessary research was carried out accordingly. As a result of this research, a letter teaching course was opened for the first time for bankers outside Ankara in the 1958-1959 academic year (Uşun, 2006). Over time, distance education studies gained momentum and the General Directorate of Letter Teaching and Technical Publications was founded in

1966; then, in 1974, the trial higher education school was opened, but a year later it was closed for various reasons (Gelişli, 2015). Over time, with the arrival of different technologies and the development of the already-existing ones, different methods were used in distance education and many institutions started to operate. Uşun (2006) summarizes the distance education process in 11 steps:

1. Conceptualization Process
2. Instruction by Letter
3. Trial Higher Teachers' School
4. Informal Higher Education Institution
5. Open Primary School
6. Open Education High School
7. Open Education Faculty
8. Vocational and Technical Open Education School
9. Fono Open Education Institution
10. Distance Higher Education Studies Based on Inter-University Communication and Information Technologies
11. E-Learning Applications

The biggest factor that facilitates and disseminates distance education is indisputably the developments in the information technologies. Remote access to information has become easier with the widespread use of computers and the Internet. This progress and convenience in computer technology not only opened a different door to distance education but also managed to find a place for itself in formal education. One concept that has been mentioned together with the use of technological developments is educational technology.

Although electronic tools used in schools come to mind when educational technology is referred, this concept contains more meaning. Alkan (1974) defines educational technology as a whole of systems consisting of personnel, tools and methods that plan and carry out education and teaching in the best way possible. It can be said that technological developments as well as these tools differ by each period. If the discovery of fire was recognized as the first technological development, the first educational technology could be accepted as fire. Since making and using fire was the biggest need in that period, it became crucial to transfer it to the coming generations. Even though technology changed shape and form continuously in later periods, the only thing that remained unchanged was the importance of integrating the new developments into education. Isman (2015) has broken

down the historical development of educational technology into 5 periods:

1. Development of early educational technology theories (0-1900)
2. Development of audio and visual aids (1900-1980)
3. Computerized education (1980-2000)
4. Automation, cybernetics and virtual education (21st century)
5. Fundamental change of the education system (upcoming centuries)

The educational technologies used in each period are considered more advanced than the previous period. However, the educational tools that are currently used do not disappear immediately with the arrival of new technologies; they continue to be used together for a while. For this reason, it is possible to divide the education technologies still used today into two: modern and classical education technologies. Figure 1 illustrates educational technology and its dimensions.

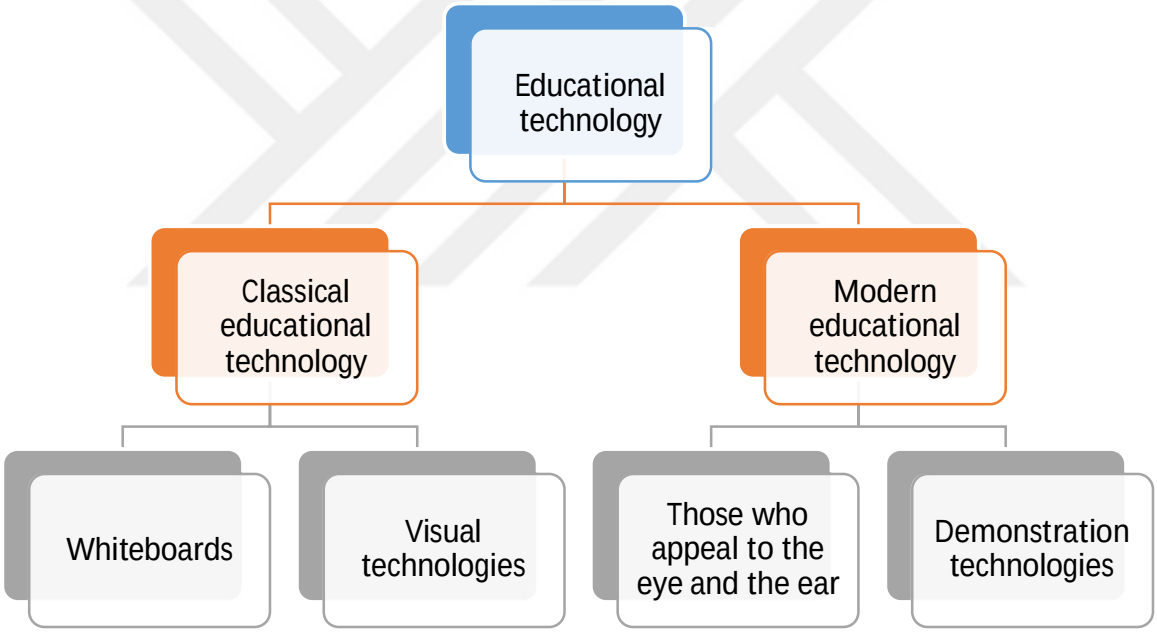

Figure 1: Educational technology (Isman, 2015)

Once these periods of development and the table are considered, for those using modern educational technologies during the virtual education period, computers, the Internet and other virtual environments and applications that enter our lives have become an indispensable part of daily life and educational environments. According to data from TUIK in Figure 2 (2020), internet use among young people aged 16-24 in the Republic of Turkiye in 2020 is 93.0%. It is 75.9% among individuals aged 25-74. The data confirms factors above.

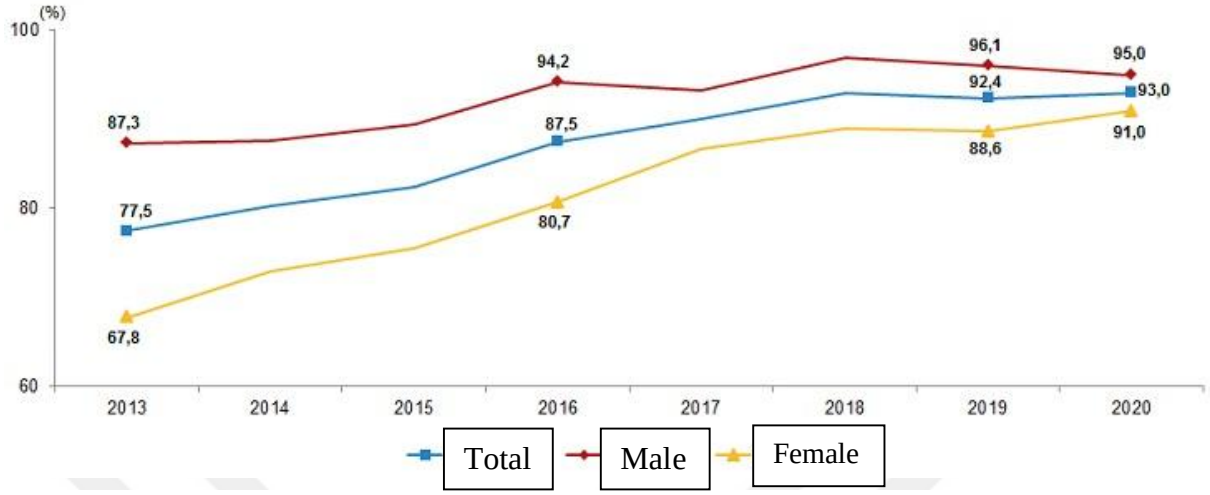

Figure 2: Internet use by age.

The rapidly surging use of the Internet and computer has changed the everyday life and affected the educational environments. Psychology's view of education has been based on the same theory for centuries, which is Thorndike's theory that reads, “Learning is related to strengthening or weakening the response to a stimulus; pleasing and satisfying behaviours are more likely to be repeated” (Mayer, 2009). By introducing information technologies into our daily lives, this viewpoint has begun to be questioned. Educational environments have started to change rapidly along with the change in perspectives and technological developments. However, change in educational environments takes place within a certain system and over time, as it should be.

With the development and spread of computer technology, different projects have been designated in many countries to make use of this technology in education. The first known use of computer technologies in education was the flight simulator used to train pilots at MIT (Massachusetts Institute of Technology) in 1950 (Roblyer, Edwards & Havriluk, 1997). In 1974, a group of experts was brought together by the Ministry of Technology, and the research group in Germany prepared a report on computer use on high school level and submitted it to the relevant authorities. It was understood that a workshop on which computer language would be used at schools was prepared in 1976 (Graf, Keil, Löethe & Winkelmann,1981). South Korea caught up with the trend in the late 1990s (Ahn, 2020). With the widespread use of computers in the Republic of Turkiye, studies were initiated. In 1984, the Turkish Ministry of National Education for the first time launched studies on computer education in formal education, bringing 1100 microcomputers to secondary

education institutions as part of the "new information and communication technology" studies (Uşun, 2004).

Although these developments differ in each country, computer technology has a significant impact on education starting from the early stages, and studies have been carried out in this context. The integration of information and communication technologies into education took place at different times depending on the current situation and development level of the relevant country. Although education policies with regards to the integration of information and communication technologies in higher education were encountered in England between the years 1960-70, there were no relevant decisions in education policies until 1990 in Egypt (Bardakçı & Keser, 2017). The increase in the use of information technologies in the country has made the integration of education compulsory and accelerated this process. In this case, we can say that two important factors speed up the integration of information and communication technologies into education: the development of technology and its widespread use.

The development of computerized technology enables wider use of computers. However, the benefits are not limited thereto, since the different areas of computer use and different developments such as the internet and virtual reality environments have put computers at the centre of our lives. Considering the narrative of pedagogue John Dewey, "School is not a preparation for life, but life itself", it is apparent that computers, now occupying a larger space in our lives, are also significant in educational environments. It is known that one of the areas where the Internet concept that emerged with computer technology in our country was first used was TÜVEKA (Turkish Universities and Research Institutions Network) established in 1986 by Ege University (Saka, 2019). In light of this information, it can be said that this technology has been a part of education from the very beginning.

The easier internet access brought by computer technology has made the information technologies more well-established and significant in education. The use of computer technology in education can be classified into five areas:

- ✓ Educational research
- ✓ Educational services
- ✓ Measurement-evaluation
- ✓ Guidance services (Mercan, Filiz, Göçer, & Özsoy, 2009)

With the use of these technologies in education, the scope of these areas above has expanded, and different forms of education have emerged. As a result, new concepts have appeared in

the education literature. Although computer-related learning might be called computerized education at the beginning, this concept has been divided into two different subtitles in terms of use and purpose. Computer-assisted and computer-based education are two concepts that have deep roots in the literature. And recently, e-learning has become one of the concepts frequently encountered in education.

Computerized education in general can be defined as teachers' use of different programs and features on computers to make the lesson more fun and efficient (İşman, 2015). Looking at the history of education, it is seen that teachers always try to integrate new technologies into education to enrich the learning environments. However, the integration of information technologies into education has made radical changes to the classroom environment and our perspective of education.

Computerized education is divided into two given the purpose and amount of computer use in the course: computer-based and computer-assisted instruction. While the basic instructor is the teacher in computer-assisted education, the computer becomes the basic instructor in computer-based education (İşman, 2001). In other words, as it can be understood from these definitions, educational activities are carried out by the teacher during computer-assisted teaching and the computer is used to support the lesson. Short videos, presentations or education-based games regarding the course content are different materials teachers can use. In computer-based teaching, while the teacher is in the position of a guide, the educational software prepared or used by the teacher becomes the main instructor. The resources prepared for the course content are provided to the students in the computer environment, and the practice and evaluation tests are done on the computer. The course of the test is determined according to the level of the student, allowing the student to learn at her/his own pace. Computerized tests, virtual laboratories and different educational software can be used in computer-based teaching.

In addition to these two teaching methods, it is necessary to look at the concept of e-learning, which has come to the fore recently, when the topics of computers and teaching are considered. Although this concept has differentiated over the past years, it can be defined today as the combination of digitally provided content with learning services (Mason & Rennie, 2006). As can be understood from the definition of e-learning, it is a form of teaching intertwined with distance education and computer technology. It is possible to perform e-learning in two ways:

1. Simultaneous (synchronous): a form of teaching where the instructor and the student are not in the same place, but are in the course online at the same time,

2. Asynchronous (asynchronous): a form of teaching in which the student can get self-education by accessing the materials prepared by the trainer whenever he/she wants (Herand & Hatipoğlu, 2014).

As in every form of teaching, making computers a part of teaching will have positive and negative aspects on teaching, regardless of their contribution to the course and the way and amount of use. However, due to the COVID-19 pandemic, which has topped the global agenda, it is now a must to integrate computers into education. But it is unfortunately impossible to mention about a normal integration. Because in such a situation that started suddenly and required different measures, teachers and students had to make a rapid transition to distance education and computerized education.

1.1 Purpose of the Study

This study aims to determine the use of digital materials by teachers in the COVID-19 process. Although this process is a saddening period for the whole world, from an academic point of view it has provided an environment that cannot be created experimentally. With the transition to distance education, teachers had to use different materials and teaching methods, and they had the opportunity to test first-hand which of these materials was more effective. This research tries to reveal which materials are used, why and how often, taking into account the opinion of teachers. For this purpose, five sub-problems were specified:

- Are the age, gender, professional experience and province differences of science teachers effective in their views on digital materials? Do the frequencies of digital material use change depending on these factors?
- Is the university experience of science teachers (graduation year, frequency of use of materials by university professors, whether material lessons are taken) effective in material selection?
- Do science teachers' views on technology literacy and their self-evaluation affect the frequency of digital material use?
- What are the views of science teachers about the necessity and benefits of digital materials for the lesson?
- What is the frequency of use of digital materials in the web-based distance education process of science teachers? What kind of materials did they prefer? Did it make a difference in the perspective of teachers in this process?

1.2 Research Limitations

- The research was conducted with science teachers only who have taught during the distance education period.
- The teachers who filled out the interview form work in Bartın province.
- 146 teachers participated in the survey.

1.3 Assumptions

- It is assumed that the participants provide accurate and reliable information to the questions in the data collection tools and reflect their feelings and thoughts in a sincere way.
- It is assumed that the researcher did not act with prejudice throughout the research and encoded the data carefully.

1.4 Definition of Key Terms

Science Education

Although science education has different definitions according to many researchers, it can generally be defined as teaching and evaluating scientific processes, the nature of science, and science content. In addition, science educators evaluate the state of science understanding by conducting research on teaching the above-mentioned concepts (McComas, 2013).

Distance Education

The most distinctive feature of distance education is the provision of education by using various electronic media tools while the learner and the teacher are at different times and places (Zawacki-Richter, 2017).

Educational Technologies

All of the technological tools used to increase educational permanence and facilitate teaching are called educational technologies (Huang, Spector, & Yang, 2019). Educational

technologies have also developed in parallel with these developments since the first periods of technology development. While the useful technologies continue to be used, the less useful ones have become obsolete over time.

2. LITERATURE REVIEW

2.1 Education and Teaching as a Concept

Undoubtedly, one of the most difficult concepts to define is education. Although this concept, which has many aspects and factors, covers a large part of our lives, it may have a different meaning for everyone. Education, like love, cannot be reduced to a "scaffolding of facts," and the desire to make a complete definition can blind us to its multiplicity, flexibility, and aesthetics (Gibbs, 2021). Whether students or educators, everyone who has been active in the education system has a few words to say about the definition of education. However, making a holistic definition of education is not as easy as it seems. One of the main reasons, as Emile Durkheim emphasizes, is that education cannot be considered independent of culture (Doğan, 2021). Differences in the culture of each society have revealed differences in the structure of education and, most importantly, in its purpose. Therefore, the definition of education has varied for years and changed from society to society.

This has led to the emergence of many different definitions. Although some of these definitions made with different perspectives have not been accepted and fallen into oblivion over time, some of them have gained a solid place in the history of education. Different perspectives, life situations and interests show themselves in defining education. For example, John Stuart Mill, who sees life as an art, likens education to art, and since the greatest aim of art is happiness, he suggests that education should aim at the happiness of the individual (Öztürk, 2019). On the other hand, John Lock tries to place his views upon different foundations, towards the ideal of the gentleman like virtue and wisdom (Raithel, Dollinger & Hörmann, 2009).

Another view comes from Ellen Key and Maria Montessori, underlining the importance of children's independence and creativity in education. These researchers argue that the child should be raised in such a manner that he/she would develop himself/herself within the framework of scientific thinking (Raithel, Dollinger, & Hörmann, 2009). The German philosopher Immanuel Kant, who never wrote a book on education but took his place in the history of education when his notes from the lectures he had given were published, described freedom as one of the most important elements of education while focusing on the discipline of education and emphasized that human beings could be mature and free thanks to education (Kaya, 2020).

It becomes likely to make an inclusive definition by gathering all these aspects of education

together. After reviewing several definitions in his book, Tezcan (1996) defines education as a process that helps develop the personality and provides the knowledge, skills and behaviours required by a person in adulthood. Doğan (2021), on the other hand, defines education as a social event that holds the adults accountable for the education of the coming generations.

When all these definitions are considered, it is understood that education tries to prepare the individual for the future and in the best possible manner by using the existing conditions. To build the future, the changes and developments in the modern world should be integrated into education and education should be allowed to renew itself.

As it can be understood from the definitions above, education is a lifelong process. However, although the concept of teaching is incorrectly used in place of education, two basic features distinguish teaching from education. Teaching is implemented in a planned and programmed manner and completed within a certain period, but there are other essential features of teaching: the learner, the teacher, the teaching environment, the knowledge or behaviour to be taught, and social and individual goals (Baytekin, 2011).

Given the definitions of both concepts, we can conclude that teaching is a part of education, but it is carried out in a more planned and programmed manner than education itself.

2.2 Science Education

The purpose of scientific theories is to make sense of how our environment and nature work, but since this process of making sense can never be fully completed, the search for scientific knowledge must continue for generations (Loxley, Dawes, Nicholls, & Dore, 2016). The task of advancing the theories developed by the scientists of one period, together with the developing technology in the following periods, is inherited by the new generation of scientists. In this way, scientific knowledge progresses exponentially and nurtures from different sources. For this reason, teaching scientific theories is of great importance.

Although children can discover some things with the sense of curiosity, deficiencies in the sense of scientific knowledge will cause gaps in their understanding of the world. A child may be able to experimentally discover the importance of water and sun in the growth of a plant, but he or she needs accepted scientific knowledge, known as photosynthesis, to understand why a plant cannot survive without water and sunlight (Loxley, Dawes, Nicholls, & Dore, 2016). For this reason, teaching scientific knowledge correctly to the young will not only help people make sense of life but also support the development of science. Jack

Holbrook and Miia Rannikmae (2009) defined the nature of science teaching under 3 main factors:

1. Teaching the nature of science
2. Developing personal characteristics
3. Supporting social development

In this context, the importance of science education in terms of both personal development and community development has become apparent.

The French Revolution in the 18th century and the developments that followed led to great revolutions in scientific studies and paved the way for radical changes in science teaching. While the need to earn a scientific structure in educational activities manifested itself in Europe, educational activities in Turkiye developed in this direction during the Republican Period, but with the passage of time it turned into a system that had ignored the individual in the teaching process (Şimşek & Şimşek, 2010). The curriculum that was reorganized in line with the constructivist theory at the beginning of the 2000s changed this situation. According to the curriculum updated in 2018, the teacher assumes a more guiding role. The aim is that students gain high-level thinking skills by integrating science, mathematics, engineering and technology into one another (Aydoğdu & Kıngır, 2019).

According to the curriculum published by the Turkish Ministry of National Education, one of the specific objectives of the science course is to ensure that all individuals are educated as science and technology literate (MEB, 2018). Therefore, when science education is highlighted, this concept should be emphasized first. Science and technology literate individuals:

- Should find science and technology interesting and useful.
- Should use their understanding of science and technology to enjoy the social and natural environment in which they live.
- Must have an idea of the cognitive improvements that are meaningful to them at the current level of science and technology (Carin, 1993).

Science and technology literacy are a broad concept that cannot be narrowed within this framework. This concept, heard more often as technology occupies more space in our daily lives, has been used in many different senses. Norris and Philip (2003) have summarized some of them as follows:

- Ability to distinguish non-scientific information from scientific knowledge
- Ability to understand science and scientific applications

- Ability to distinguish what counts as science
- Ability to act independently in learning science
- Ability to think scientifically
- Ability to use the acquired scientific knowledge as a problem-solving skill
- Ability to reason on science-based issues
- Understanding the nature of science
- Appreciating science and scientific curiosity
- Awareness of the risks and benefits of science
- Ability to think critically about science

Considering all this, we can refer to science and technology literacy as the desire and effort to acquire scientific knowledge by pursuing the developing technology in light of the information provided by science. At the same time, the ability to make sense of the acquired information and develop problem-solving skills using this information is a common feature of science and technology literate individuals (Yaman, 2020).

2.3 Distance Education

With distance education, one needs to comprehend the methods which are not under the constant and direct control of the teachers, where the teacher and the learner are not in a common place but are still planned, guided and consulted by an educational institution (Zimmer, 1995:339, cited in Astleitner & Leutner, 1998). As can be understood, the main factor that distinguishes distance education from face-to-face education is that it eliminates the obligation of the teacher and the learner to be in the same environment. With the disappearance of this obligation, the obligation to take part in the course simultaneously is eliminated, too; however, with the developing technology this has become a choice. In other words, distance education is a form of teaching that provides flexibility for the learning time and learning place (Kocayiğit & Uşun, 2020). However, this is not the only feature that distinguishes distance education from face-to-face education.

Although distance education has similar aspects to classical education, its unique advantages have emerged with the great strides of technology, especially in the direction of communication (Karakuş, Ucuzsatar and others 2020). Although Kırık (2014) has stated that hierarchy continues to exist in distance education, he has also drawn attention to its stable, complex and non-linear structure and showed that the support of this teaching style by new technologies is among its strengths. Considering the history of distance education, the

learner and the teacher can't come together in different places at the same time and carry out the teaching, but today's technology makes this possible.

In doing so, distance education can be evaluated today under two different models. The simultaneous (synchronous) model is the model in which the teacher and the learner are in different places at the same time. It draws attention with its ability to allow mutual interaction and create a classroom. However, the asynchronous model prepared by the instructor for the use of the student provides convenience by offering the student the opportunity to study at convenient times and re-watch the content (Demir, 2014).

It would not be wrong to say that this century is the age of information and communication, and for this reason, it is not acceptable to end education in a constantly changing and renewing world. Although it has always been accepted that education starts from birth and continues until death, this fact now holds greater importance. Moore and Diehl (2019) have emphasized the work of Charles A. Wedemeyer, one of the leading educators in this field. When stressing distance education, according to Wedemeyer, students should be able to learn individually to access education, and education must be student oriented. When these three factors are combined, the fundamentals of distance education come to light. As it can be understood, although distance education is learner-centred, it is also a learning form based on the desire and motivation of the individual to learn.

Distance education has its advantages, but its disadvantages are too many to ignore. Distance education may offer equal opportunities; however, it is mainly based on individual motivation, it minimizes social interaction, parents are not literate enough to help students and full learning cannot be realized because it is not very well-constructed (Ertuğ, 2020; Garrote & Neuenschwander et al., 2021). In some cases, though, distance education may become inevitable in such situations as the COVID-19 pandemic.

2.4 Use of Technology in Education

As with the concepts of education and training, educational technology and instructional technology are very close to each other, but they still need to be handled separately. However, before moving on to the definitions of these concepts, it is necessary to look at the meaning of technology.

Since technology is not a one-dimensional concept, defining it becomes difficult. TDK defines technology as "all the tools and information related to elements developed to control and change the material environment of humans." (TDK). Soysal (2019) defines technology

as a development made by the human mind but also a contribution to mankind's development. As can be understood from these definitions, many concepts affect and are affected by technology. According to İşman (2001), technology can be closely related to seven main concepts as follows:

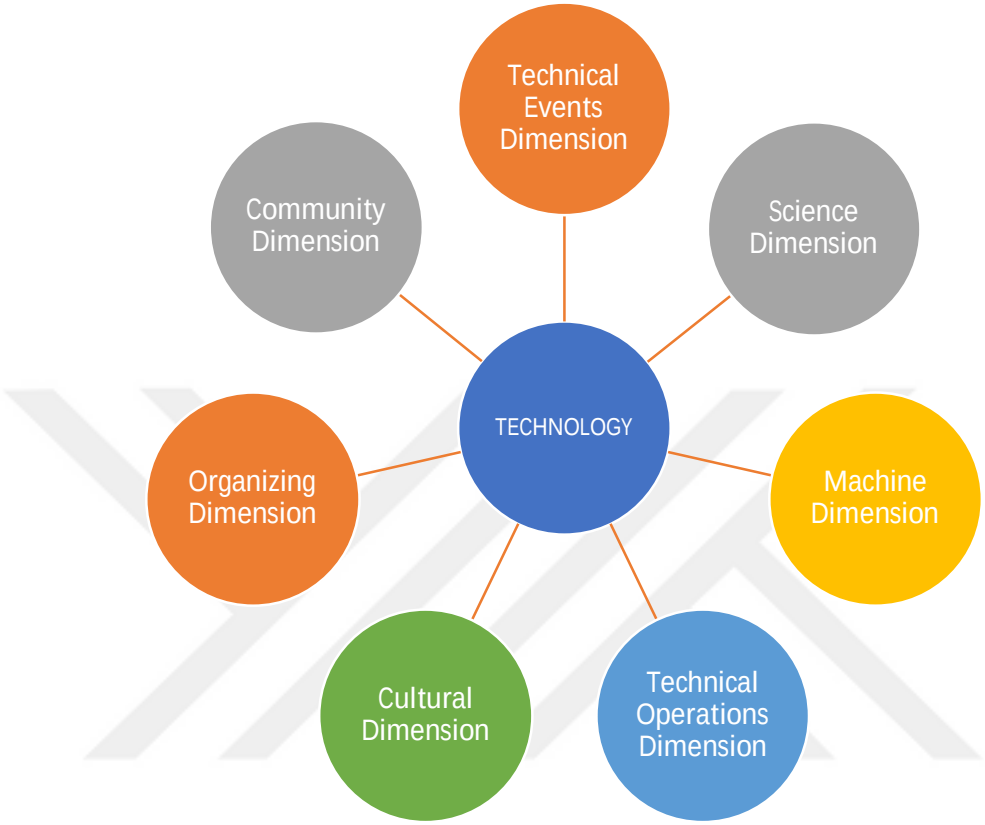

Figure 3: Technology related concepts

When we look closely at these concepts in Figure 3 , we can say that the cultural and social dimension of society are both the social part that affects technology and is affected by it. It is very hard to think of education being unaffected by a factor that influences the society itself. With the development of technology and its use in education, the concepts of education and training technologies emerge.

Educational technology contains the use of tools, technologies, resources, and strategies to enhance the learning experiences such as formal learning, informal learning, non-formal learning, lifelong learning, on-demand learning, workplace learning, and just-in-time learning (Huang, Spector & Yang, 2019). Because education continues throughout life, the use of technology in the learning process in any part of human life can be evaluated in the scope of educational technology. Examples include receiving in-service distance training for the job being performed, watching instructional videos about hobbies or listening to

audiobooks related to a topic of interest.

On the other hand, the instructional technologies can be considered as the selection of materials and processes intended for the targeted learning (Geçit, Yıldırım et. al., 2015). When we look at both concepts, it becomes clear that educational technologies are more comprehensive, and that instructional technology can be considered as a subcategory of educational technologies. However, the common point of these two concepts is to make education and training environments more effective and efficient using developing technological tools. Two important factors can be shown as obstacles to these developments in the education system, one of which is that teachers do not have enough technical knowledge to integrate technological tools into their lessons (Bacanak, Karamustafaoğlu & Köse, 2003).

Naturally, a teacher is expected to know how to integrate technological tools into the lesson. At the same time, they should be able to evaluate the effectiveness of the material, understand how to make the learned subject more understandable, and carry out the assessment and evaluation process more effectively. When all these factors are brought together under a single concept, the concept of technological pedagogical content knowledge emerges (TPACK) (Çetinkaya Aydın, 2019).

Built on three main pillars - namely pedagogical knowledge, content knowledge, and technology knowledge, TPACK enables teachers to optimize their teaching practices by helping integrate technology into the classrooms effectively (McComas, 2013). These three main pillars and their components are summarized in Mishra (2019) as follows:

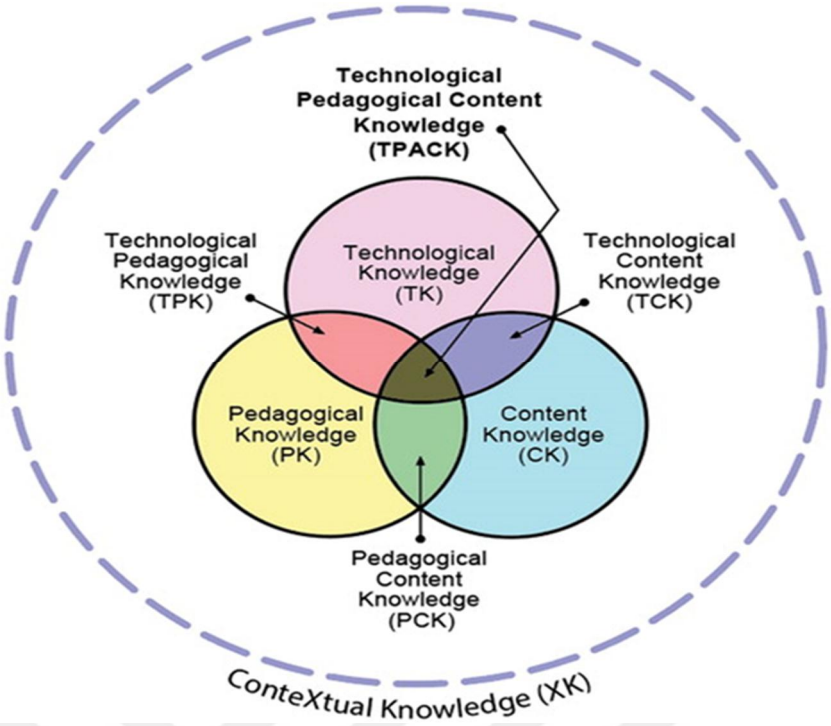

Figure 4: Technological pedagogical content knowledge.

As it can be understood from Figure 4 , it is not enough to have sole technical knowledge in teaching methods.

In summary, to use the technology effectively, a teacher should be well-aware of the teaching methods, possess the prior pedagogical knowledge, and is expected to renew his/her technology knowledge persistently.

2.5 Computer and Educational Activities

Demirel (2019) defines computer-aided education in his education dictionary book as ‘the use of computers in all activities related to learning-teaching and school administration’. It is easier to define computer-aided education. To facilitate educational activities, boost the education quality and ensure the permanence of the materials taught, the computer and various programs used in computers become involved in the educational environment (Benzer, Çiftcı et al., 2012; Şahin, 2020; Yanpar Sailing, 2021; Sarıtaş, 2013; Niegemann & Weinberger, 2020). As with many materials, there are many beneficial and harmful aspects of using computers in educational activities.

The beneficial aspects are giving instant feedback to the student, creating cheap and fast content, and encouraging students to design, whereas the harmful aspects are the high

software costs, insufficient staff competencies, and systemic problems (Alkan, 2011). One of the reasons why computer-aided teaching has many positive aspects is that there is more than one form of use. Until 1990, these applications were evaluated in two formats, but they are grouped currently into four categories:

- Repetition and practice software
- One-to-one educational software
- Simulation software
- Educational game software (Özkılıç et al., 2007)

Many different teaching models have been developed to strengthen the positive aspects of computer-aided education supported by these applications and mitigate the effect of the negative aspects. While developing these teaching models, the main theories to be used primarily are specified. Several major theories have contributed to the development of Computer Aided Learning, including constructivism, sociocultural theory, problem-based learning, sedentary cognition, active learning, cognitive apprenticeship, and cognitive flexibility theory (Kovalchick & Dawson, 2004). Mixed teaching, inverted learning (flipped class) and e-learning are the main examples of these teaching models.

2.5.1 Blended Teaching Model

The blended teaching model is one of the most comprehensive. Given its historical development, the blended education model can be defined as (1) the instruction provided face-to-face and remotely together, (2) the instruction in which some students acquire it face-to-face while some remotely or (3) the instruction is done face-to-face or remotely by different instructors (Güzer & Caner, 2014). The blended education model has taken different names over time and become more comprehensive. According to Shaidullin (2014) et al., blended education is divided into 6 different models:

1. Face-to-Face Driver Model: An important part of the training program is carried out in direct interaction with the teacher in school electronic training besides the main program.
2. Rotation model: School hours are allocated between individual electronic instruction and classroom activities in the presence of the teacher. The teacher in the classroom also provides remote support services.

3. Flex model: A large part of the training program is carried out remotely in an electronic environment. The teacher is present for each student remotely, arranging meetings with small groups or individually to solve topics that are difficult to understand.
4. Online lab model: Training is carried out under electronic educational conditions, which are held in classrooms equipped with computer equipment in schools. Students can be trained traditionally in the classroom system despite online courses.
5. Self-blend model: Apart from the must courses, students can select different courses. Different schools and educational institutions may act a sole environmental medium.
6. Online driver model: A large part of the training is carried out using electronic information resources. Periodic meetings are held with teachers. Internal consultation, interview, and examination procedures are mandatory.

We see that the basic logic of this model and the other blended ones, which can be divided into different categories, is to create a comprehensive teaching model by combining computer technology and distance education, as well as teacher support and face-to-face education.

2.5.2 Flipped Learning

This teaching theory, which is also referred to as flipped learning or flipped classroom, aims to step outside the classical classroom model with the help of technology. In the classical learning model, the student learns the theory part of the lesson in class and completes the repetition and homework at home, while in flipped learning, the student learns the theory part of the course at home using a computer, videos or different materials, and the exercise and reinforcement part is done with the teacher in the school environment (Schallert, 2015; Schmal, 2019; Saracaloğlu, Akkoyunlu & Gökdaş, 2020).

Although flipped learning seems to be a part of the blended teaching model, it differs from blended education in some definite lines. Presenting the theory remotely with the help of videos and getting prepared for the lesson are only two of them, and according to research, this teaching style is at least as effective as the classical model and even more effective than the classical model (Reidsema, Kavanagh, Hadgraft & Smith, 2017).

The biggest goal of inverted education is to minimize the time spent on the theory part and reserve the earned time for the teacher-supervised activities and exercises (Fischer & Spannagel, 2012). In this way, the student will be under the supervision of the teacher during

the exercise and reinforcement part while performing the learning individually at convenient pace. This model, helping prevent misconceptions and mislearning, provides students with plenty time for classroom activities.

Given the definition and characteristics, inverted education is built on 4 main pillars: student activation, learning through multimedia, learning support and autonomy (Finkenberg & Trefzger, 2019). A successful learning and teaching environment will be provided once they all are considered.

2.5.3 E-Learning (Electronic Learning)

It is quite difficult to define e-learning. E-learning, with no fixed definition, is defined in various sources as follows: learning with the help of technology, giving or learning information electronically, and learning with the help of the Internet (Parlakkılıç & Güldüren, 2019; Kergel, & Heidkamp-Kergel, 2020; Gozutok, 2007; Yamamoto et al., 2011).

These various definitions have in common the digital learning platform, especially the Internet, as a learning environment. E-learning includes the use of worksheets that the teacher will hand to the students during the online lesson. Today, many universities, such as the Virtuelle Hochschule Bayern, offer their students the opportunity to attend online classes as part of distance learning (Zwerenz, 2008). At this point, e-learning, which seems to be a continuation of distance education, can be realized using different methods such as electronic mail, educational videos, and synchronous lessons (Revermann, 2006).

It is hard to offer an exact definition for electronic learning. However, in general, based on the previous definitions and explanations, a general definition highlighting the teaching model made in various ways in an electronic environment can be given. Although this concept, which seems to expand its scope with the development of technology, is regarded as one of the future learning styles, its positive and negative sides should be stressed.

E-learning aims to achieve three positive outcomes:

1. Ensuring or increasing the course participation of students who are not able to or do not want to participate in traditional face-to-face education,
2. Making teaching content more cost-effective,
3. Enabling the faculty members to reach more students without diminishing the quality of learning (Jethro, Grace & Thomas, 2012).

Some difficulties come with e-learning. Failure to manage time effectively, financial difficulties, technology infrastructure deficiencies, insufficient support staff, planning deficiencies, inadequacy of reward and participation incentives are just a few (Gülbahar, 2009). In general, e-learning seems to be the future of education and the continuation of the current distance education.

2.6 Cognitive Theory of Multimedia Learning

Based on the teaching theories, an answer to the question of how a better learning is achieved and how this learning becomes more permanent is sought. First, how learning occurs must be understood to answer this question. In history, different studies have come up with different answers to this question. According to cognitive theory researchers, learning is a mental theory that cannot be directly observed, and the information received from the outside world, voluntarily or involuntarily, by our sense organs, is recorded in our minds through different processes (Özden, 2021).

Two important factors help transport the information brought to the short-term memory via the sense organs into long-term memory, that is, the onset of what we call learning: perception and attention (Filbert & Weatherspoon, 1993). In other words, the teaching style and materials we use to enhance learning and permanence are expected to increase the student perception and attention. These factors alone are naturally not enough to define teaching theory.

The cognitive theory argues that the learner should be able to use the knowledge acquired in different ways by taking an active role in the learning process, and the teacher should assume the role of guiding this process (Fer et al., 2014). As it can be understood from here, the goal of cognitive theory is to reach the student's entrepreneurial and independent mindset. To be able to do these in the process, the student needs to structure the information he/she receives with his/her sense organs in his/her mind. According to research, the structuring of information is focused on three basic principles in the cognitive field:

1. Dual channels: People use two separate channels to process visual and auditory data.
2. Limited capacity: People can process only a few pieces of information they receive from each channel at the same time.
3. Active processing: Learning can occur when people use appropriate cognitive processes; using materials appropriately and organizing them into a coherent

structure, such as combining previously learned knowledge with newly learned knowledge (Clark & Mayer, 2016)

These basic assumptions were not only adopted by Mayer, but different scientists supported these assumptions (Kuzu, 2014). Given these assumptions, cognitive theory in multimedia learning has become one of the most remarkable theories in the age of technology.

As can be understood from these three principles, the cognitive theory emphasizes the importance of the materials used in multi-environment learning and underlines the mental process of learning. Mayer (2009) has stated that people can learn better in a learning environment where pictures and words are jointly used rather than the sole use of words. This best summarizes the cognitive theory of multimedia learning. The theory suggests that learning environments should be supported with both words and pictures so that it becomes easier for the learner to structure the information in his/her mind. Considering the current technological tools, it has become easier to produce and use materials with this feature.

However, it would be wrong to regard the cognitive theory of multimedia learning as the enrichment of materials with pictures only. According to Mayer (2009), the instructional messages to be given should be designed by considering the way the human mind works. The principles of dual channels, limited capacity and active processing, which constitute the basic building blocks of the theory, have been developed considering the mindset in human learning process. Although the three principles establishing the theory above provide ease of learning, they cause 2 problems:

1. As soon as the student is provided with too much information through a channel, the working memory is overloaded, and the acquisition of information is hindered.
2. Memory is overloaded when both channels need to process a lot of information simultaneously. This is because the working memory must keep a lot of information active at the same time (Niegemann & Domagk et al., 2008).

Mayer (2009) argues that using the multimedia learning effectively will eliminate these two problems; thus, given the intended purpose the necessary ones among the 12 rules should be carefully selected for an effective use. Multimedia environments can be used to amplify responses, acquire information, and build knowledge. The design principles that should be applied regardless of the learning purpose are examined under 3 main titles depending on their functions.

1) Principles of Reducing Unnecessary Operations

i) Coherence Principle: Students learn more easily if there are no foreign words in the learning material.
ii) Signalling Principle: People learn better when hints that highlight key points in the learning material are added.
iii) Redundancy Principle: The student learns better when the picture and sound are given only, rather than the picture, sound and text elements altogether.
iv) Spatial Contiguity Principle: Learners learn better if the relevant text and pictures look close to each other on the screen.
v) Temporal Contiguity Principle: Compared to using repeatedly, the simultaneous use of pictures and texts that are in relation to one another makes learning better.

2) Principles for Managing Basic Operations
   i) Segmenting Principle: The student learns better if the subject is divided into appropriate sections instead of offering it as a whole.
   ii) Pre-training Principle: People learn more easily when they have prior knowledge of the names and characteristics of the concepts to be taught.
   iii) Modality Principle: People learn from pictures and narration better than they do from animation and text that appear on the screen.
3) Principle of Strengthening Creative Processes
   i) Multimedia Principle: Rather than just narrating, when painting and narration are used together, people learn better.
   ii) Personalization Principle: Learning is easier through the use of informal (diary) speaking style expressions rather than the use of formal (academic) speech style expressions.
   iii) Voice Principle: Using human voice instead of a digital voice in the material for the students improves learning.
   iv) Image Principle: That the image of the person giving the lesson remains on the screen does not necessarily contribute to better learning.

When teaching within the framework of cognitive theory of learning in multimedia is favoured, enough care must be given not to burden the student with a cognitive load. It can be defined as the overloading of the learner's processing mind by transferring much information simultaneously (Sorden, 2012; Plass, Moreno & Brünken, 2010; Sweller, Ayres & Kalyuga, 2011). The theory provides a more effective and permanent learning situation. The main purpose of the twelve principles is to prevent the computational and digital burden so that the student can concentrate on what he/she needs to learn.

2.7 Multimedia Learning Tools

Before moving on to the concept of digital materials, it is necessary to look at what teaching materials and their functions are. Teaching materials are resources that teachers choose and use during the lesson. They consider the subject and the student to facilitate the learning process, make the lesson more enjoyable and increase the permanence of the learned information (Ağır, Arıkan, Çakır et al., 2013; Petko, 2019). As can be understood from this definition, the materials used in the course should be remarkable for the student as well as appropriate to the course content. The materials for the students who have grown up in the age of technology should also be compliant with age. It is possible to examine the materials used today in two separate categories: classical educational materials and modern educational materials (Sever, 2010).

Digital materials are named differently by different researchers: cognitive learning tools, hypermedia learning environments, learning object systems, etc. There are ample definitions and fields of use. Digital materials are all multimedia environments, such as software, programs and videos, which support the student's learning pace with the help of computers and make learning permanent (Kunert, 2011). Digital materials are divided into two: Learning digital materials, which have a more instructive side and are closer to the classical materials used as an aid to the lesson, and exercise-oriented digital materials, which allow the student to learn at his/her own pace and concentrate more on exercise and comprehension than on learning (Petko, 2010).

Some researchers think that human interaction plays a significant role in digital materials becoming useful and positively effective (Wengenmayr, 2001). What is meant by interaction is the teacher in the position of guiding the students. Teacher's support may be needed in cases where the material is insufficient, more explanation is needed or there exists a confusion of concepts. For this reason, digital materials should not be considered as a new form of education, but rather as teaching materials.

Multimedia learning tools are viewed as beneficial, even though researchers are sceptical about their usefulness. These tools hurt the development of social life skills, encourage the use of other technological tools and thus may cause problems in language development, cause the risk of developing spelling errors in most interactive learning platforms which are open to general use but are age-inappropriate, and impair child development. (Fuchslocher,

2017). To eliminate these challenges and make the tools more effective, the materials must be meticulously prepared. Material design principles must be strictly applied. These principles are mentioned in detail in the previous section. Appropriate materials should be used for different activities and different topics.

Hypermedia learning environments are diverse, and they are constantly renewed. Videos, animations, worksheets, blogs, interactive materials, virtual laboratories, Web 2.0 tools, presentations, games, graphics, and many other learning tools fall into the category of digital materials (Somyürel, 2013).

2.8 Previous Research on The Topic

Since the pandemic process is still new, it is sufficient to look at the last few years for research on this subject. Although distance education is a form of education that has existed for many years, it is accepted as an alternative to face-to-face education. However, transitioning to compulsory distance education during the pandemic requires a different environment and perspective. For this reason, this part of the study summarises further studies conducted during the pandemic.

In his study, Kaya (2021) examined the views of social studies teachers on distance education. In his study with 21 teachers, he prepared a semi-structured interview form as a data collection tool. He analysed the data according to various factors and revealed the teachers' opinions on this process. Teachers' positive and negative perspectives, problems and motivation regarding the distance education period were evaluated. Although there are positive thoughts about presenting different materials to students, it can be concluded that student motivation is low. In addition, the study also discloses that technical and infrastructure problems have been seen frequently during this period.

Tanık-Önal (2020) draws attention to the views of the parents of the students in his study during the pandemic. A semi-structured interview form was used in the study, and it was conducted with 17 parents of sixth-grade students. According to the research, parents think that the EBA platform positively affects students' science learning. In addition, it was concluded that the student's interest in the lesson was positively affected by the video-assisted lectures. In addition to these positive aspects, the lack of social interaction of the students in the distance education process and the inability to create an experimental environment were the factors that negatively affected the students' success.

Fackler and Sexton (2020) tried to bring a different perspective to education during the

pandemic period through document analysis in their study. This study reveals teachers' crisis management skills in a challenging time. The study also states that teachers have an idea about digital materials that they have not used or used less in this period before and have started to use them quickly.

Gozum and Demir (2021) focus on preschool teachers' perceptions of self-efficacy in technological pedagogical content knowledge during the pandemic period. It reveals that teachers' self-efficacy in technical, pedagogical content knowledge, one of the crucial concepts of the distance education period, is directly related to their technology and pedagogy knowledge. Although this study is essential for the pandemic period, it is also vital for the technology adaptation of teachers in the later period.

Şahinoğlu and Sağlam Arslan (2021) tried to examine the distance education period from the perspective of high school science teachers. Contrary to most studies, teachers working in private schools preferred drawing attention to a different point in the period. The study revealed the teachers' opinions using a semi-structured interview form. In this study, it is seen that teachers have applied different digital materials to enrich the lessons in this period. Technological deficiencies and infrastructure problems are also among the emerging issues.

Çeliker and Tumru (2022), in their research, tried to determine teachers' views through metaphor, unlike other studies. Their interviews were held with 215 science teachers, and the interview forms were shared with the teachers over the internet. As a result of this study, as in other studies conducted in this period, among the problems that teachers noted are students' unwillingness to participate in the lesson, technological infrastructure problems and computer deficiencies.

3. METHOD

The term method comes from the ancient Greek, meaning "to follow" and describing a systematic approach to acquiring knowledge in science (Wintzer, 2016). This part of the study highlights information about the model of the study, the research group and data collection tools. In addition, the application process of the questionnaire and interview form for data collection and analysis are revealed. The role of the researcher in the study and the validity and reliability of the research is discussed in this section, too.

3.1 Research Model

Since this study aims to examine the opinion of the teachers about digital materials during the web-based distance education period, a questionnaire has been prepared intended for the teachers and an interview form has been developed to examine and interpret the overall opinion in more detail. This study, highlighting quantitative and qualitative data, uses mixed methods.

The mixed method combines the quantitative and qualitative methods (Creswell, 2006). According to Christensen (2011) et al., the mixed research model differs from the quantitative and qualitative research methods in 7 points:

1. Combines hypothesis/theory and testing to generate equal emphasis.
2. Thought and behaviour contain predictable and contextual elements.
3. The mixed method combines objective, subjective and intersubjective.
4. The general and the particular are integrated into this method.
5. The qualitative and quantitative data are used both under a single study.
6. The method blends statistics and qualitative data reporting.
7. It is a practical method based on the attempts to integrate the general and the particular.

According to Creswell (2006), there are six basic designs that researchers can choose from the mixed method. Three of them are simultaneous designs and three of them sequential designs. This study has used sequential explanatory design of the mixed pattern designs. In sequential descriptive design, quantitative data is collected and evaluated. Qualitative data is used to increase the quantitative data and eliminate the challenges that may arise during quantitative data analysis. The study findings bring together the quantitative and qualitative

data (Baki, & Gökçek, 2012).

A questionnaire was applied following the sequential explanatory design. Then, a semi-structured interview form was implemented, and the data obtained were analysed together to reach a conclusion.

3.2 Study Group

Two different working groups were designated. 146 teachers from 36 different provinces in the western Black Sea and Marmara regions have completed the related questionnaire. Five teachers working in the western Black Sea Region performed the interview with the participants. Participants were selected for easy accessibility, and it was considered that they had taught during the pandemic period.

3.3 Data Collection Tools

The study aims to determine how the opinion of the science teachers on digital materials vary depending on different variables in the web-based distance education process. For this purpose, a questionnaire study was prepared to collect data and find out the frequency of digital material use, and the materials favoured over certain variables. In addition, a semi-structured interview form constituting the qualitative side of the research was prepared.

The questionnaire to determine qualitative research data was sent over via the Internet and more participants were sought to fill out the questionnaire. The questions of different sub-problems were presented under different sections for an easier understanding of the questionnaire. The aim is to reach different-aged people from different cities.

Semi-structured interviews, comprising the research's quantitative part, were carried out in various ways due to the COVID-19 pandemic. Some were performed over Zoom, Microsoft teams and other similar video calling applications, as well as over the phone. A few of them were carried out face-to-face, which is why it took longer than expected to apply the questionnaire.

The data collection tools that constitute the quantitative and qualitative aspects of the research are examined under two separate headings in this section.

3.3.1 Quantitative Data Collection Tools

3.3.1.1 Questionnaire

The questionnaire is a data collection tool prepared to direct the target group to collect data by the purpose of the research (Akalın, 2015). In this study, a questionnaire prepared by the researcher was used as a quantitative data collection tool. The questionnaire was then organized by taking opinions from 2 different experts. Although it seems easy to prepare a questionnaire, if it is not prepared properly, it can cause incorrect results as it can affect the research result. The development of a questionnaire is an extraordinarily complex matter, but in addition to intuition, attention should be paid to language and sense of experience, and more importantly, a satisfactory result can be obtained when scientific knowledge of the processes occurring during a questionnaire is also considered (Porst, 2013).

There are points to be consider in preparing a questionnaire. The type and format of questions and the way the questionnaire is applied should be pre-determined correctly to reach the true purpose of the research (Gürbüz & Şahin, 2014). The questionnaire applied as part of this research consists of 25 questions. Two questions are open-ended and 23 are closed-ended. The reason why open-ended and closed-ended questions are used together is that the questionnaire becomes more effective when the two types are used together (İlhan, Güler & Taşdelen Teker, 2020).

The 5-point Likert-type scale was used in the questions. The Likert-type scale is a type of scale in which the person filling out the questionnaire can respond to a given proposition measured by the degree of agreement, with the person selecting the appropriate option from one to five (1) strongly disagree (2) disagree (3) undecided (4) agree (5) strongly agree (Croasmun & Ostrom, 2011). The questionnaire was sent over to the participants through the Internet, and the data obtained was recorded anonymously.

3.3.2 Qualitative Data Collection Tools

3.3.2.1 Interview Form

In the study, a semi-structured interview form was used as a qualitative data collection tool. Semi-structured interview is a form of interview in which the researcher asks questions addressing the main topics of the research and allowing the exchange of ideas with the

interviewer (Trainor, 2013). As can be understood from this definition, a semi-structured interview provides more clarity and comprehensibility of the data obtained and prevents the interviewer from deviating from the subject.

As part of this study, the researcher prepared the semi-structured interview. The form was finalized with the help of expert opinion. The interview form that consists of thirteen questions includes six sub-problems. Finally, the obtained data were categorized and examined.

3.4 Data Analysis

The data collected was analysed in two different ways. The data obtained from the questionnaire study was analysed with the SPSS program. The data from the interview form were categorized and tabulated. The tables were interpreted and added to the section of Findings. The interview form was examined based on 6 sub-problems. Following the section focusing on personal information, the questions were examined and analysed under 2 main sections.

4. FINDINGS

This section concentrates on the findings and comments about the research. Since two different methods were used to collect data, the findings were divided into two. The findings were obtained from the interview form, and the findings related to the questionnaire study were discussed. The findings and their interpretations were examined sequentially as sub-problems.

4.1 Findings and Interpretations of the Data obtained from the Questionnaire

4.1.1 Descriptive analysis of the answers to the first part of the questionnaire

This part of the questionnaire includes data on the personal and professional information of the participating teachers. Questions 1,2,3,4,5, and 6 form this part. Table 1 indicates the frequency data of the participants by gender.

Table 1. Frequency data of the participants by gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	117	80.1	80.1	80.1
	Male	29	19.9	19.9	100.0
	Total	146	100.0	100.0	

Table 1 shows that 80.1% of the participants were female and 19.9% were male.

Table 2. Frequency data of the participants by age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	25-30	45	30,8	30,8	30.8
	30-35	43	29.5	29.5	60.3
	35-40	24	16.4	16.4	76.7
	40-45	15	10.3	10.3	87.0
	45-50	10	6.8	6.8	93.8
	50-...	9	6.2	6.2	100.0
	Total	146	100.0	100.0	

Given the age groups of the participants, the 25-35 age group indicates the highest percentage in total. Table 2 demonstrates the age group of '50 and above' is at least 6.2%.

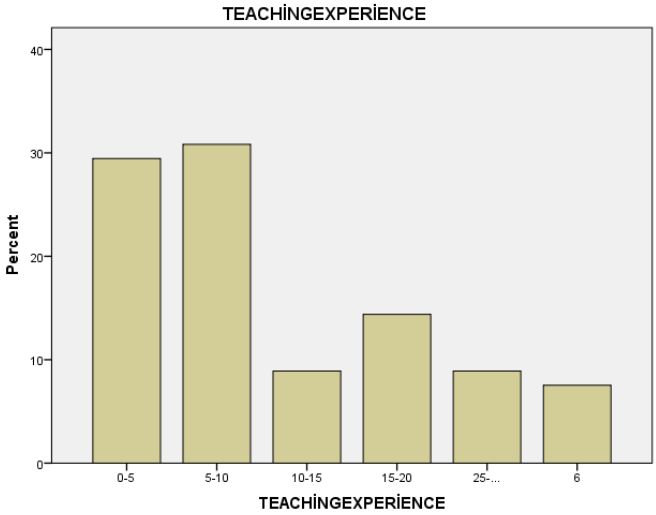

Figure 5: Teaching experience.

The data on teaching experience in figure 5, shows that the density of those teaching for 5-10 years is 30.8%, the highest percentage of the group.

Table 3. Frequency data on the institution where teachers work

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Public School	134	91.8	91.8	91.8
	Private School	12	8.2	8.2	100.0
	Total	146	100.0	100.0	

The data on the type of institution shows that 91.8% of the teachers work for government institutions.

4.1.2 Descriptive analysis of the answers to the second part of the questioner

This section includes the analysis of the data related to the university education of the participants (Questions 7,8,9,10 and 11).

The 7th question which is the first question of this part contains data on the years of

graduation of the participants from the university.

Table 4. Frequency of participants by graduation year

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1980	1	.7	.7	.7
	1988	2	1.4	1.4	2.1
	1989	3	2.1	2.1	4.1
	1991	1	.7	.7	4.8
	1995	2	1.4	1.4	6.2
	1996	2	1.4	1.4	7.5
	1997	6	4.1	4.1	11.6
	1998	3	2.1	2.1	13.7
	1999	2	1.4	1.4	15.1
	2000	2	1.4	1.4	16.4
	2001	1	.7	.7	17.1
	2002	8	5.5	5.5	22.6
	2003	5	3.4	3.4	26.0
	2004	10	6.8	6.8	32.9
	2005	4	2.7	2.7	35.6
	2006	6	4.1	4.1	39.7
	2007	3	2.1	2.1	41.8
	2008	3	2.1	2.1	43.8
	2009	5	3.4	3.4	47.3
	2010	5	3.4	3.4	50.7
	2011	19	13.0	13.0	63.7
	2012	3	2.1	2.1	65.8
	2013	10	6.8	6.8	72.6
	2014	4	2.7	2.7	75.3
	2015	6	4.1	4.1	79.5
	2016	9	6.2	6.2	85.6
	2017	3	2.1	2.1	87.7
	2018	5	3.4	3.4	91.1
	2019	3	2.1	2.1	93.2
	2020	8	5.5	5.5	98.6
	2022	1	.7	.7	99.3
	2023	1	.7	.7	100.0
	Total	146	100.0	100.0	

The second question examines the situation of taking material courses at the university.

Table 5. Frequency of taking material courses at university

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	111	76.0	76.0	76.0
	No	35	24.0	24.0	100.0
	Total	146	100.0	100.0	

Table 5 indicates that 76% of the participants took material courses at the university.

The answers to the 9th question "Did you design or use digital material during your university education?" are shown in Table 6.

Table 6. Frequency of digital material design at university

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	72	49.3	49.3	49.3
	No	74	50.7	50.7	100.0
	Total	146	100.0	100.0	

According to Table 6, 49.3% design digital materials while at university. However, it is 50.7% who do not. The ratios are very close to each other.

The next question as to how often the participating teachers used digital materials at university brings the data in Table 7.

Table 7. Frequency of digital material usage in lessons at university

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	38	26.0	26.0	26.0
	No	59	40.4	40.4	66.4
	Could have been used more often	49	33.6	33.6	100.0
	Total	146	100.0	100.0	

According to Table 7, 40.4% of the participants did not encounter digital materials during the university courses.

The last question of this section is about the status of the participants taking a course on digital materials in their professional lives.

Table 8. Frequency of the use and design of digital materials in university

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	79	54.1	54.1	54.1
	No	67	45.9	45.9	100.0
	Total	146	100.0	100.0	

Table 8 suggests that 54.1% of the participants took a training on the use and design of digital materials in their professional lives.

4.1.3 Descriptive analysis of the answers to the third part of the questionnaire

This part of the research includes the opinion of the participating teachers on digital materials. Whether there is a differentiation by gender, in-service training on digital materials and taking material courses at the university is examined. Given the above-mentioned variables, an independent sample t-test was applied to the data regarding this subject. Also, whether there is a difference in views on digital materials considering age group and professional experience is highlighted. One-way analysis of variance is performed on the variables. Questions 12,13,14,15,16. and 17 serve this purpose. The frequency analysis of the questions was tabulated and added to the study.

The differentiation in responses given by the participating teachers about digital materials by gender is indicated in the Table 9.

Table 9. Gender differentiation in answers to questions on digital materials

Gender		N	X	Ss	Sd	t	p
12	Female	117	4.44	.923	144.000	-.992	.323
	Male	29	4.62	.494			
13	Female	117	3.35	.834	144.000	-2.294	.023
	Male	29	3.76	.951			
14	Female	117	4.34	.842	144.000	-1.229	.221
	Male	29	4.55	.736			
15	Female	117	4.50	.678	76.732	-3.494	.001
	Male	29	4.83	.384			
16	Female	117	4.46	.676	144.000	-1.633	.105
	Male	29	4.69	.660			

17	Female	117	3.52	1.014	51.538	-1.522	.134
	Male	29	3.79	.819			

From Table 9 it can be seen that the answers to the 12nd question regarding the technology literacy level of the teachers and the integration of technology into their lessons do not differ by gender. Women (x=4.44) and men (x=4.62) answered "I agree" on the proposition "Science teachers should have a very high technology literacy level, they should integrate them into their lessons by following technological developments".

The answers to the 13th question "I think my technology literacy level is very good" regarding the proposition do not differ by gender. Women (x=3.35) and men (x=3.76) answered "I am undecided" on average.

The answers given for the Proposition 14 about the necessity of digital materials for science lessons do not differ by gender. When the average of the answers given are examined, it is seen that the male and female participants are not sure that the digital materials are necessary for the science lesson.

"I think digital materials will be useful for students to understand the lesson in science class." The proposition is included as part of the 15th question. After the analysis, it is seen that the answers given to this proposition do differ by gender. When the average of the answers given is examined, it is found that the participants responded as "I agree" to this proposition.

Proposition 16 is that digital materials increase the permanence of the course. When the answers given by the participating teachers are analyzed, it is seen that there is no difference by gender. Also, when the averages of the answers given are considered, the teachers are seen to agree on this proposition.

"I think that digital materials are not used enough in science lessons," is the last proposition in this section. The answers do not differ by gender. Considering the average of the answers given, it is seen that the participants are undecided on this issue.

Table 10. Differentiation of answers to questions on digital materials considering the status of taking materials courses at university

		N	**x**	**Ss**	**Sd**	**t**	**p**
12	Yes	111	4.52	.851	144.000	1.082368	0.280898
	No	35	4.34	.873			
13	Yes	111	3.48	.913	144.000	1.137832	0.25708
	No	35	3.29	.710			
14	Yes	111	4.43	.782	144.000	1.278564	0.203108
	No	35	4.23	.942			
15	Yes	111	4.58	.682	144.000	0.49845	0.618927
	No	35	4.51	.507			

16	Yes	111	4.54	.685	144.000	1.071117	0.285909
	No	35	4.40	.651			
17	Yes	111	3.59	.986	144.000	0.223841	0.823198
	No	35	3.54	.980			

As can be understood from the table, the answers to the questions regarding digital materials do not show a significant difference in terms of taking material courses at the university.

Table 11. Differentiation of answers to questions on digital materials by the status of receiving in-service training

		N	**x**	**Ss**	**sd**	**t**	**p**
12	Yes	79	4.48	.845	144.000	0.023817	0.981032
	No	67	4.48	.877			
13	Yes	79	3.48	.918	144.000	0.745238	0.457343
	No	67	3.37	.813			
14	Yes	79	4.37	.850	144.000	-0.26136	0.794185
	No	67	4.40	.799			
15	Yes	79	4.56	.635	144.000	-0.09521	0.92428
	No	67	4.57	.657			
16	Yes	79	4.48	.695	144.000	-0.4993	0.618333
	No	67	4.54	.659			
17	Yes	79	3.49	.959	144.000	-1.09256	0.276413
	No	67	3.67	1.006			

As can be understood from Table 11, there is no significant difference in the answers given for the in-service reception of digital materials. As the third part of the questionnaire, the frequency analysis of the answers given to the questions about digital materials is given in the Tables below.

Table 12. Average values of the answers given to the questions about digital materials

		12	13	14	15	16	17
N	Valid	146	146	146	146	146	146
	Missing	0	0	0	0	0	0
Mean		4.48	3.43	4.38	4.56	4.51	3.58
Std. Deviation		.857	.870	.824	.643	.677	.981

Table 13. Frequency and percentage analysis of the answers to the 12th question

		Frequency	Percent
Valid	1	5	3.4
	2	1	.7
	3	2	1.4
	4	49	33.6
	5	89	61.0
	Total	146	100.0

As can be seen from the Table 13, 61% of the participants answered to the 12th question as "strongly agree".

Table 14. Frequency and percentage analysis of the answers to the 13th question

		Frequency	Percent
Valid	1	2	1.4
	2	20	13.7
	3	48	32.9
	4	65	44.5
	5	11	7.5
	Total	146	100.0

According to Table 14, 44.5% said “I agree” to the 13th question. Close to this percentage is that of the participants answering, "I am undecided".

Table 15. Frequency and percentages of answers to the 14th question

		Frequency	Percent
Valid	1	3	2.1
	2	3	2.1
	3	5	3.4
	4	59	40.4
	5	76	52.1
	Total	146	100.0

The percentage of the answers to the 14th question stands at 52.1% featuring "I agree".

Table 16. Frequency and percentage analysis of the answers to the 15th question

		Frequency	Percent
Valid	1	2	1.4
	4	56	38.4
	5	88	60.3
	Total	146	100.0

As seen from Table 16, 60.3% of the participants answered the 15th question as "I totally agree".

Table 17. Frequency and percentage analysis of the answers to the 16th question

		Frequency	Percent
Valid	1	2	1.4
	2	1	.7
	4	61	41.8
	5	82	56.2
	Total	146	100.0

Seen from Table 17, 56.2% of the participants answered the 16th question as "I strongly agree".

Table 18. Frequency and percentage analysis of answers to the 17th question

		Frequency	Percent
Valid	1	2	1.4
	2	22	15.1
	3	36	24.7
	4	62	42.5
	5	24	16.4
	Total	146	100.0

According to Table 18, the participants answered “I agree” to the 17th question.

Given the years of teaching experience, Anova analysis of the answers to the questions regarding digital materials is shown in the Table below.

Table 19. Anova analysis of the answers to the questions about digital material by years of teaching

Anova

		Sum of Squares	df	Mean Square	F	p
12	Between Groups	2.948	5	.590	.798	.553
	Within Groups	103.490	140	.739		
	Total	106.438	145			
13	Between Groups	9.660	5	1.932	2.701	.023
	Within Groups	100.155	140	.715		
	Total	109.815	145			
14	Between Groups	3.795	5	.759	1.122	.352
	Within Groups	94.725	140	.677		
	Total	98.521	145			
15	Between Groups	3.319	5	.664	1.641	.153
	Within Groups	56.626	140	.404		
	Total	59.945	145			
16	Between Groups	3.667	5	.733	1.634	.155
	Within Groups	62.826	140	.449		
	Total	66.493	145			
17	Between Groups	11.183	5	2.237	2.437	.038
	Within Groups	128.488	140	.918		
	Total	139.671	145			

Table 19 indicates that according to questions 12, 14, 15, and 16 there is no significant difference between the groups considering the years of teaching experience. Questions 13 and 17, however, show a significant difference within this framework.

Whether there is a significant difference by age in the answers to the questions regarding the digital materials among the groups is shown in the Table below.

Table 20. The differentiation status of the answers to the questions regarding digital materials by age

Anova

		Sum of Squares	df	Mean Square	F	p
12	Between Groups	2.491	5	.498	.671	.646
	Within Groups	103.947	140	.742		
	Total	106.438	145			
13	Between Groups	1.030	5	.206	.265	.931
	Within Groups	108.785	140	.777		
	Total	109.815	145			
14	Between Groups	4.152	5	.830	1.232	.297
	Within Groups	94.369	140	.674		
	Total	98.521	145			
15	Between Groups	1.516	5	.303	.726	.605
	Within Groups	58.430	140	.417		
	Total	59.945	145			
16	Between Groups	3.484	5	.697	1.548	.179
	Within Groups	63.010	140	.450		
	Total	66.493	145			
17	Between Groups	11.525	5	2.305	2.518	.032
	Within Groups	128.147	140	.915		
	Total	139.671	145			

From Table 20 it is seen that according to the answers to the 12th, 13th, 14th, 15th, and 16th questions there is no significant difference between the age groups. There is a significant difference between the groups when the 17th question is considered.

4.1.4 Descriptive analysis of the answers to the fourth part of the questionnaire

This part of the study aims to measure the thoughts of the participating teachers about the use of digital materials during the web-based distance education. The fourth part examines whether there is a differentiation in terms of gender, in-service training on digital materials and taking material courses at the university. An independent sample t-test was applied for the data on this subject through the above-mentioned variables. It is also evaluated whether there is a differentiation in views regarding digital materials considering the age and

professional experience of the participating teachers. One-way analysis of variance is used to reveal it over the variables. The 18th, 19th, 20th, 21st, 22nd, 23rd, 24th and 25th questions serve this purpose.

In addition, the frequency analysis of the questions was tabulated and added to the study.

The differentiation in the answers given to the questions regarding the use of digital materials by gender during the web-based distance is examined in the Table below.

Table 21. The differentiation in answers to the questions regarding the use of digital materials by gender during the web-based distance education

Gender		**N**	**x**	**Ss**	**Sd**	**t**	**p**
18	Female	117	3.52	1.047	144.000	-0.76158	0.447553
	Male	29	3.69	1.137			
19	Female	117	3.90	.814	144.000	-1.00943	0.314461
	Male	29	4.07	.842			
20	Female	117	4.07	.838	144.000	-0.00326	0.997402
	Male	29	4.07	.998			
21	Female	117	2.73	1.031	37.947	-0.81427	0.420573
	Male	29	2.93	1.252			
22	Female	117	3.62	1.006	144.000	1.981656	0.049422
	Male	29	3.21	1.048			
23	Female	117	3.85	.883	36.600	1.174274	0.247869
	Male	29	3.59	1.150			
24	Female	117	3.81	.830	34.135	1.326409	0.193511
	Male	29	3.48	1.271			

When the averages of the answers to the 18th question in the questionnaire are examined, no significant difference is seen. Given this data, the proposition “My perspective towards digital materials has completely changed during the web-based distance education” was answered as "I am undecided" by most participants.

The data from the proposition “I learned a lot more about digital materials during the web-based education process” highlighted in the 19th question is examined, and no significant difference is seen considering the gender.

Given the answers to the 20th question which determine the frequency of using digital materials during the web-based distance education, it is seen that there is no significant difference considering the gender factor. The answers show an increase in the frequency highlighting the use of the digital materials by teachers.

With the answers to the 21st question that disclose the opinion of the participating teachers regarding the preparation of the materials used during the web-based distance education, it is seen that there is a significant difference by gender. However, most female and male participants stated that they did not prepare all the materials on their own.

From the proposition “Digital materials have increased students' participation in the course in the web-based distance education process” highlighted in the 22nd question, it is seen that there is no significant difference when gender is considered.

The answers to the 23rd question highlight the effect of using digital materials on student motivation during the web-based distance education, suggesting that there is a difference considering gender.

The answers to the 24th question highlight the effect of using digital materials on teacher motivation during the web-based distance education, suggesting that there is a significant difference considering gender. The male participants seem to be undecided while female participants seem to be agreeing on this proposition.

Table 22. Difference in answers to the questions on the use of digital materials during the web-based distance education, considering the material lessons already taken.

		N	X	Ss	Sd	t	p
18	Yes	111	3.59	1.074	144.000	0.621567	0.535209
	No	35	3.46	1.039			
19	Yes	111	3.94	.856	144.000	0.142145	0.887164
	No	35	3.91	.702			
20	Yes	111	4.07	.931	144.000	0.088391	0.929689
	No	35	4.06	.639			
21	Yes	111	2.79	1.113	144.000	0.511725	0.609628
	No	35	2.69	.963			
22	Yes	111	3.61	1.028	144.000	1.508389	0.133646
	No	35	3.31	.993			
23	Yes	111	3.83	.990	144.000	0.624538	0.533263
	No	35	3.71	.789			
24	Yes	111	3.80	.971	144.000	1.269357	0.206362
	No	35	3.57	.815			

The answers to the questions highlight the use of digital materials during the web-based distance education, suggesting that there is no difference among any of the questions when the material course at university is considered.

Table 23. The differentiation status of the questions regarding the use of digital materials in the web-based distance education process by the status of receiving in-service training.

		N	**X**	**Ss**	**Sd**	**t**	**p**
18	Yes	79	3.39	1.067	144.000	-2.02433	0.044785
	No	67	3.75	1.035			
19	Yes	79	3.92	.859	144.000	-0.11901	0.905433
	No	67	3.94	.776			
20	Yes	79	4.06	.911	144.000	-0.07834	0.937668
	No	67	4.07	.822			
21	Yes	79	2.66	1.049	144.000	-1.33056	0.185435
	No	67	2.90	1.103			
22	Yes	79	3.56	.997	144.000	0.202481	0.839827
	No	67	3.52	1.064			
23	Yes	79	3.86	.843	144.000	0.824459	0.411042
	No	67	3.73	1.053			
24	Yes	79	3.78	.901	144.000	0.533404	0.594576
	No	67	3.70	.985			

Table 23 shows that there is no significant difference among the questions highlighting the use of digital materials by in-service training status during the web-based distance education.

Table 24. The mean values of the answers to the questions regarding the use of digital materials during the web-based distance education

		18	19	20	21	22	23	24
N	Valid	146	146	146	146	146	146	146
	Missing	0	0	0	0	0	0	0
Mean		3.55	3.93	4.07	2.77	3.54	3.80	3.75
Std. Deviation		1.064	.819	.868	1.077	1.025	.944	.938

Table 25. Frequency and percentage values of answers to the 18th question

		Frequency	Percent
Valid	1	2	1.4
	2	31	21.2
	3	24	16.4
	4	62	42.5

	5	27	18.5
	Total	146	100.0

Table 25 shows that the answer to the 18th question is “I agree” standing at 42.5%.

Table 26. Frequency and percentage values of answers to the 19th question

		Frequency	Percent
Valid	1	1	.7
	2	9	6.2
	3	21	14.4
	4	83	56.8
	5	32	21.9
	Total	146	100.0

According to Table 26, the answer to the 19th question appears to be “I agree” standing at 56.8%.

Table 27. Frequency and percentage values of answers to the 20th question

		Frequency	Percent
Valid	1	3	2.1
	2	6	4.1
	3	14	9.6
	4	78	53.4
	5	45	30.8
	Total	146	100.0

According to Table 27, the 20th question was answered by 78 people as “I agree”.

Table 28. Frequency and percentage values of answers to the 21st question

		Frequency	Percent
Valid	1	7	4.8
	2	72	49.3
	3	27	18.5
	4	28	19.2
	5	12	8.2
	Total	146	100.0

49.3% answered the 21st question with "I do not agree".

Table 29. Frequency and percentage values of answers to the 22nd question

		Frequency	Percent
Valid	1	7	4.8
	2	17	11.6
	3	32	21.9
	4	70	47.9
	5	20	13.7
	Total	146	100.0

47.9% answered the 22nd question with “I agree”.

Table 30. Frequency and percentage values of answers to the 23rd question

		Frequency	Percent
Valid	1	5	3.4
	2	8	5.5
	3	28	19.2
	4	75	51.4
	5	30	20.5
	Total	146	100.0

More than half of the participants answered the 23rd question with “I agree”.

Table 31. Frequency and percentage values of answers to the 24th question

		Frequency	Percent
Valid	1	4	2.7
	2	12	8.2
	3	27	18.5
	4	77	52.7
	5	26	17.8
	Total	146	100.0

Most participants, 52.7%, answered the 24th question with “I agree”.

The Anova test is used in this section to address the differentiation status of the questions as regards the use of digital materials during the web-based distance education considering the age groups and teaching experience.

Table 32. The differentiation status of answers to the questions regarding the use of digital materials during the web-based distance education given years of professional experience

Anova

		Sum of Squares	df	Mean Square	F	p
18	Between Groups	7.448	5	1.490	1.331	.254
	Within Groups	156.614	140	1.119		
	Total	164.062	145			
19	Between Groups	2.147	5	.429	.632	.676
	Within Groups	95.168	140	.680		
	Total	97.315	145			
20	Between Groups	1.707	5	.341	.444	.817
	Within Groups	107.608	140	.769		
	Total	109.315	145			
21	Between Groups	7.413	5	1.483	1.292	.271
	Within Groups	160.669	140	1.148		
	Total	168.082	145			
22	Between Groups	7.384	5	1.477	1.427	.218
	Within Groups	144.869	140	1.035		
	Total	152.253	145			
23	Between Groups	3.174	5	.635	.705	.621
	Within Groups	126.066	140	.900		
	Total	129.240	145			
24	Between Groups	4.506	5	.901	1.025	.405
	Within Groups	123.117	140	.879		
	Total	127.623	145			

From Table 32, it is seen that there is no significant difference in the answers given to the questions by the groups with different years of professional experience.

Table 33. The differentiation status of answers to questions regarding the use of digital materials by age groups during the web-based distance education

Anova

		Sum of Squares	df	Mean Square	F	p
18	Between Groups	6.848	5	1.370	1.220	.303
	Within Groups	157.213	140	1.123		

	Total	164.062	145			
19	Between Groups	2.929	5	.586	.869	.504
	Within Groups	94.386	140	.674		
	Total	97.315	145			
20	Between Groups	3.184	5	.637	.840	.523
	Within Groups	106.131	140	.758		
	Total	109.315	145			
21	Between Groups	5.296	5	1.059	.911	.476
	Within Groups	162.786	140	1.163		
	Total	168.082	145			
22	Between Groups	8.317	5	1.663	1.618	.159
	Within Groups	143.937	140	1.028		
	Total	152.253	145			
23	Between Groups	3.513	5	.703	.782	.564
	Within Groups	125.727	140	.898		
	Total	129.240	145			
24	Between Groups	4.212	5	.842	.956	.447
	Within Groups	123.412	140	.882		
	Total	127.623	145			

Looking at Table 33, it is understood that the answers given by the participants to the questions about the use of digital materials during the web-based distance education do not differ considering age groups.

The final analysis made in this section comes from the 25 multiple-choice questions. “Which of the following digital materials did you prefer to use more frequently in the web-based distance education process?” Frequency analysis of the answers to this question is given in the Table below.

Table 34. Frequency analysis of answers to the 25th question

Frequencies

		Responses		Per cent of Cases
		N	Per cent	
25	Videos-Animations-Movies	120	23.0%	82.2%
	Virtual labs - Simulations	75	14.4%	51.4%
	Games	66	12.7%	45.2%
	Presentations	96	18.4%	65.8%
	interactive worksheets	78	15.0%	53.4%
	computer aided books	83	15.9%	56.8%

Other	3	0.6%	2.1%
Total	521	100.0%	356.8%

4.2 Findings and Interpretations of the Data Obtained from the Interview Form

In this section, the data obtained from the semi-structured interview form performed with the participation of teachers during the web-based distance education was tabulated and examined. The data considering the six sub-problems are presented through tabulation. Answers that cannot be tabulated were added to the comments section.

Generalization was made based on the common answers shown in the Tables. The questions are divided into six subheadings considering the six sub-problems already determined, rather than the order of questions in the interview form. The participating teachers were selected from the Western Black Sea region.

4.2.1 Findings and Interpretations of the First Sub-problem

In this section, the first sub-problem is "What is technology literacy according to teachers? What are the teachers' views on the relationship between technology literacy and the use of digital materials?" To seek answers to these questions, the data of the questions in the interview form were analyzed. The data on professional teaching experience is given, too.

In this section, teachers were first asked to introduce themselves briefly. Asking this question aims to determine the situations of taking material development courses at the university.

Table 35. Interview Form. Answers to Question 1

	Teaching experience	Taking material design courses
K1	7	Have taken the course
K2	10	Have taken the course
K3	9	Have taken the course
K4	11	Have taken the course
K5	2	Have taken the course

Among the teachers are those who work for governmental institutions and private

institutions separately. It is found that all the participants interviewed took material courses back in the university. Some participants mentioned during the interview about the different activities in the material design course. The different teaching years made different perspectives examined as part of this research. All the teachers work in the Western Black Sea Region.

The answers provided to the second question of this section, i.e. “What does technology literacy mean to you? How would you explain the relationship between science course and technology literacy?”, were generalized through tabulation. Since the question has two parts, it was deemed appropriate to create two different Tables.

Table 36 contains answers to the first part of the question, "What does technology literacy mean to you?"

Table 36. Interview form. Answers to Question 2

	Keeping up with developing world	Being able to use technology correctly	Fast access to desired information	Being able to integrate technological developments into life
K1	x		x	
K2	x			
K3		x		x
K4		x		x
K5	x		x	x

As can be seen from the table, although teachers defined technology literacy differently, these definitions have some points in common. Three participants emphasized that technology literacy is necessary for both science courses and success in life. One participant teacher said, “With this training they are expected to be conscious of what technology is and when it came out, its interaction with the society, its harm when used incorrectly, the level of development of the country when used correctly, and its impact on the development of the country. She drew attention to the importance of technology literacy education.

4.2.2 Findings and Interpretations of the Second Sub-Problem

A question with two parts in the interview form analyses the data of the questions coming from the second sub-problem. The sub-problem is as follows: “What are the difficulties

faced by teachers while teaching science lessons in the web-based distance education process? What did they resort to eliminate them?

In this section, the 3rd question that reads “Can you tell us a little about the difficulties you encountered in the science lesson during this process? What did you do to overcome these difficulties?” has answers given on the Table, and the prominent answers in the other part were presented in written form.

Table 37. Interview form. Answers to Question 3

	Technical failures	Students don't want to use cameras	Failure to monitor student participation	Lack of equipment	Parent-teacher communication gap	Failure to create the laboratory environment in distance education
K1	x	x	x			
K2			x			
K3				x	x	
K4		x	x	x		x
K5	x		x			x

As can be understood from Table 37, lack of equipment and technical failures are the main problems faced by teachers. Also, the attention deficiency seen among the students who are not used to this course form has negative impacts, too.

A teacher stated that they had tried to motivate the students to eliminate these negativities during this process. However, as they stated, some students could not continue the course because there was nothing, they could do due to lack of equipment and technical failures. Although teachers could anticipate these negativities, these negativities persisted due to the limited possibilities.

The following view of a teacher on this point summarizes the situation: “Some students are absent even in the face-to-face education process, they are unable to focus on the lesson, some of them along with their parents are indifferent to the lessons and some students have no aim to build a career etc. Developing negative attitudes and behaviours is more likely during the online education. No matter how many precautions are taken, even though some problems are reduced by teacher-parent cooperation, student excuses, internet infrastructure and lack of technological tools have kept them from being completely prevented.” What drew the attention of one of the participating teachers was that it became more difficult to

communicate with the students during this process and the social ties with the students were weakened.

4.2.3 Findings and Interpretations of the Third Sub-Problem

This section seeks an answer to the question, i.e. “Is there a change in the frequency of digital material use in science lessons during the web-based distance education process? Has the variety of materials used changed?”. To obtain data for this sub-problem, three different questions were asked towards this sub-problem. A Table was created for each question, and the answers given for the comments section were evaluated separately and attached in writing. The 4th, 5th and 7th questions in the interview form are related to this sub-problem.

First, the 4th question, i.e. “What did you do to enrich the lessons in the web-based distance education process? Did you use these methods before or did you discover them during this process?”, is evaluated, and the findings from this question are tabulated and given in Table 38.

Table 38. Interview form. Answers to Question 4

	Offer different resources	Benefit from EBA	Using Web 0.2 tools	STEAM applications	Educational interactive games
K1	x				
K2		x			
K3		x	x	x	x
K4		x	x		x
K5		x	x		x

As can be understood from the table, most of the teachers preferred EBA (educational information network) as a source. These teachers stated that they had benefited from the methods they had used before but more frequently this time. It is understood that applications using the gamification method were preferred.

Secondly, the 5th question in the interview form, i.e. “Was there any kind of material that you particularly preferred in the process? If yes, what is the reason for choosing this material?”, was generalized and tabulated in Table 39.

Table 39. Interview form. Answers to Question 5

	Interactive tests	EBA	YouTube	Google Forms	Online training platforms
K1	x				
K2		x	x		
K3		x			
K4		x		x	x
K5	x	x			x

From the answers to this question, it is seen that teachers preferred very different materials. However, most teachers preferred EBA as a source. The teachers interviewed said that they also benefited from different sites such as morpakampus, word wall, etc. One of our teachers said that the videos on YouTube are very useful, but they should be chosen carefully.

The 7th question in the interview form, i.e. "Have you ever preferred to use digital materials in your lessons? Has your use of digital materials changed during this process?", has answers summarized in Table 40.

Table 40. Interview form. Answers to question 7

	Yes, I was using it	No, I wasn't using it	Changed	Not changed
K1	x		x	
K2		x	x	
K3	x		x	
K4	x			x
K5		x	x	

As it can be understood from this table, the teachers used digital materials before the web-based distance education period. However, it is also understood that the frequency of the use of these materials has surged during the distance education. The teachers interviewed stated that they tried to find different digital materials to make the lesson more interesting, and as a result, they gained more experiences in digital materials. The following view of one of the teachers is worth the attention: “The contribution of this process is that I was able to provide equal education in all classes although the number of absent students has increased.” Another teacher stated that the teachers could not use digital materials prior to distance education because they did not have smart boards in their classrooms.

4.2.4 Findings and Interpretations of the Fourth Sub-Problem

In this section, the fourth sub-problem, "How is the effect of digital materials on students and teachers in science lessons in this process?", received answers that were tabulated. There are two questions in this section of the interview form. As with other questions, these questions consist of two parts. While the answers to the questions in the first section are tabulated, the comments are given in separate written forms. Questions 8 and 9 is examined in this section.

First, the 8th question, "Did you prefer to prepare the materials you used yourself or did you use ready-made materials? What resources did you use if you already used them? How did you access these resources? This research endorsed by peer's suggestion has answers disclosing the method of access to the digital materials as summarized and tabulated.

Table 41. Interview form. Answers to Question 8

	I prepared it myself	I used it ready	Recommendation	My research	Social media
K1		x	x		
K2	x	x	x	x	
K3	x	x		x	
K4	x	x	x	x	x
K5	x	x	x	x	x

As can be seen, teachers do not hesitate to prepare their materials during this process. Another important point noticed from the interviews is the determination of the teachers to support each other with different materials. It is understood at this very point that the teachers communicated personally with each other more than they did through the social media. Another significant detail is that teachers used very different sources when preparing their materials. They stated that some programs they used are Adobe Photoshop, AutoDesk 3Ds Max, LightWorks, and Google forms. They stated that they made great use of the material design course they had taken at university.

The second question in this section is the 9th question in the interview form that reads "What were the benefits of using digital materials in this process?" The answers given to this question are arranged and given in Table 42. The benefits for both teachers and students were asked.

Table 42. Interview form. Answers to Question 9

	Engaging students	Making a difference	Easier understanding of visual-based topics	Permanence and reuse of prepared materials
K1			x	
K2	x	x		
K3	x			x
K4	x	x		
K5	x		x	x

As can be seen from the table, digital materials have been useful in attracting the student attention and helping them concentrate. It is noteworthy that these materials can be reused for the benefit of the teacher. One teacher draws attention to the advantages of digital materials: “While tangible materials may deteriorate, tear apart, outdate or they are unable to be renewed, the digital content can be updated more clearly and quickly by the web base or the code screen.” Another participant stated that the students were very dull and could not participate in the lesson, but they showed more willingness to participate in the lesson with these materials. The effect of these materials on creating a difference was recognizable during the lesson.

4.2.5 Findings and Interpretations of the Fifth Sub-Problem

The fifth sub-problem of this study, i.e. “What kind of digital materials has benefited science lessons?”, received answers that are generalized and tabulated. Questions 6, 10 and 11 aim to seek answers to the fifth sub-problem.

The 6th question in the interview form, "Have you noticed a type of material that is particularly noticeable to students? What do you think is the reason for this?", is brought under evaluation and examined in Table 43.

Table 43. Interview form. Answers to Question 6

	Tester	No, I didn't	Materials that students can design themselves	Educational games
K1	x			
K2		x		

K3	x		
K4			x
K5	x		x

As can be seen from the table, teachers have very different opinions on this issue. This was also noticeable during the interview. This problem has been more difficult to tabulate because it is not easy to generalize it. Educational games are very diverse, and the participants all have different preferences. The materials that students can design by themselves are the pages where students can prepare test-like games for their friends in an interactive environment. Since the teachers' preferences are different, they are generalized instead of being named.

One of the participating teachers stated that although the first use of each material was very remarkable, the interest of the students waned afterwards. Another teacher stated that factors such as the age-appropriateness of the material and its colour are effective in attracting student's attention. Another different view is: "Long-term materials. In other words, I realized that the materials that give points or similar rewards for every activity done and that you make a progress by collecting them are more interesting for children."

The second question in this section is "Do you think digital materials for science lessons affect the teaching of the lesson? Is there any material that must be used? The 10th question in the interview form was generalized in Table 44and added to the study.

Table 44. Interview form. Answers to Question 10

	Help engage students	Each teacher uses their material	Benefited the lesson	Provides repeatability	Animations	I don't think there is a particular material that must necessarily be used.
K1	x	x				x
K2			x			x
K3	x			x	x	
K4	x		x			x
K5	x		x	x		x

In general, teachers do not think that it is a material type that must be used. It is a situation accepted by all interviewees, and it is beneficial for increasing the student's interest in the

course. One participant said, “When I designed a material that was prepared for students who are slow in learning, I realized after a while that he was in the same place with his friends in terms of learning.” The expression in the form turns attention to a different point. That digital materials allow students to repeat by themselves is one of the important issues that teachers emphasized in the interviews. Although the teachers stated that it is not a material that must be used, they said that animations attract more attention from the students.

The last question in this section is the 11th question in the interview form. The answers that are generalized in Table 45 is given to the question that follows: “What are the limitations of digital materials that you notice?” Although most of the teachers have different opinion on this subject due to different experiences, a generalization has been made.

Table 45. Interview form. Answers to Question 11.

	Inability to maintain control	Technical failures	Lack of access	Students' perspective on materials is limited	Students have difficulty understanding the material
K1	x				
K2		x	x		
K3		x	x	x	
K4		x			x
K5	x	x	x		x

One of the important factors apparent in this Table is that digital materials have lost their usefulness due to technical failures. In the interviews, the interviewees generally state the technical infrastructure and failures result in the digital materials becoming ineffective. Apart from that, that the materials are too complex has a negative effect, too.” The lack of internet infrastructure in every house, the inadequacy of technological tools and that the student's perspective on technology is limited to watching games and videos have caused the acclimation process to be postponed. This was summarized by one participant. Another participant brought attention to a different point, expressing his opinion as such, “Some materials are very difficult to use. Children cannot understand at first. The child who tries to focus on understanding it misses the lesson in the meantime.”

4.2.6 Findings and Interpretations of the Sixth Sub-Problem

In this section, the answers to the two questions regarding the last sub-problem are provided in Tables. Questions 12 and 13 in the interview form are related to the sixth sub-problem. The sixth sub-problem questions the changes that will not occur during the distance education period but after it. “How will the use of digital materials change when face-to-face education returns?” is determined as the sixth sub-problem.

The 11th question in the interview form is as follows: “Did there be any difference in your use of digital materials when the web-based distance education process ended, and you returned to face-to-face education? Has your perspective on digital materials changed?” This question with two parts is generalized and combined under a single Table, i.e. Table 46.

Table 46. Interview form. Answers to Question 12

	There was an increase	No increase	My perspective has changed	My perspective hasn't changed
K1		x	x	
K2		x		x
K3	x			x
K4		x		x
K5	x		x	

As can be seen from the table, there is no significant increase in the use of materials because a digital material is frequently used by science teachers before the distance education period. However, the way the digital materials are considered has noticeably changed. One of the comments that were omitted during the interview is that although science teachers use digital materials to enrich the course before the web-based distance learning period, there is no continuous use of them. However, with the web-based distance education, teachers who are more knowledgeable about digital materials have become more willing to use them. One of the teachers stated that he had already used these materials very frequently and that there was no big change for him during this period.

The last question in this section and the interview form is Question 13, “What are the negativities and contributions that this process brings to you in an educational sense?". It was asked for an interpretation of the process. It is summarized separately for each interviewer, as it cannot be generalized. Table 47 summarizes the answers given.

Table 47. Interview form. Answers to Question 13

	Negativity	Contribution
K1	Couldn't communicate well with students	My tendency to use different sources has increased
K2	I became aware of the negative effects of technical failures on the course	I realized the importance of smart boards
K3	I became aware of the shortcomings of technological infrastructure and realized that this situation had a negative impact on the course.	I have improved myself in designing materials
K4	The workload of teachers has become too much, which has negatively affected teacher motivation	It didn't contribute much; I was already using digital materials in my class.
K5	A very rapid transition made it difficult for teachers and students to adapt	I improved myself in designing materials.

Caused by the sudden transition to distance education, infrastructure deficiencies and technical failures were one of the factors that teachers had the most difficulty with. Another factor that draws attention during the interviews is the reluctance of the parents at the point of parent-teacher communication and the decrease in the student participation in the lesson due to this approach. However, this period had a positive effect on a teacher's self-development. One of the participants said, “I can say that my self-confidence in digital content and material production has increased, there are more experts around me now and the contribution of the content I produce for my students are the biggest contributions to me.”

One of the comments is that although it was a period with benefits, it was also a period when teachers faced a lot of technical infrastructure problems and lack of motivation. One of the participating teachers stated that distance education was very difficult for middle school students, and therefore, teachers had difficulties during this period.

5. DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Discussion

5.1.1 Results Regarding the Findings Obtained from the Interview Form

Technology literacy is an essential concept for science education and students' educational adventures throughout their lives. Although teachers hold different views on technology literacy, it is a critical skill for those who keep up with the developments of the period they live in (Bacanak, Karamustafaoğlu, & Köse,2003). This study showed that science teachers think this concept is valuable for students.

The difficulties experienced by teachers in this period are the reluctance of students to participate in the lesson and technological problems. As in this study, the same result was obtained from the survey of Çeliker and Tumru (2022). Although the teachers themselves came up with solutions to the challenges on these dimensions, there was no precaution that teachers could take against technical malfunctions and lack of materials.

From the viewpoint of science lessons, the positive effect of the laboratory environment cannot be ignored. In this case, although the teachers used different digital backgrounds during the web-based distance education, the lack of labs is attention-drawing (Bakirci, Kayar, Cancan & Tozlu,2022; Birhan & Doğru,2022). The use of digital materials positively affected student attention, but this waned quickly as students mostly used technological tools to play games. One of the reasons for this is that students use these specialised tools in their daily lives (Kumaş & Kan, 2022).

It is noteworthy that during this process, EBA is mainly used. Teachers prefer EBA as a platform they could accept as a starting point in this process for which they are not well-prepared (Çiftçi & Aydın,2020). Also, although different sources are commonly used, the opinion of the teachers on this subject varied greatly. It can be said that the reason for the change in the frequency of use of digital materials among most teachers is that they feel more competent as they deal with digital materials.

Teachers agree that ready-made materials should not be used as they are and should be evaluated in terms of age. Suitability is worth the attention as an idea adopted by teachers. Teachers have become more willing to prepare their materials during this process. It was noticed by the interviewed teachers that they were confident in preparing materials and that

this confidence stemmed from the fact that they earlier took a material preparation course.

It was noticed that teachers had a very positive perspective of these materials. Participating teachers stated during the interview that they received positive student feedback. In addition, the reusability of these digitally prepared materials brought a positive result for both teachers and students. That students can reuse most materials allows them to repeat these materials and provides them with the opportunity to learn at their own pace. This enables students with different learning paces to follow the same course together.

Among the remarkable results, the animations used during the lesson raised the student interest in the class. Despite all these, it is agreed by most teachers believe that the use of games and animations is not compulsory. It can be concluded that the materials should be differentiated according to the course, student needs and subject.

According to the results from the interviews, digital materials made the science lesson positive and fun(Savaş, Güler, Kaya, Çoban & Güzel, 2022). It is understood that when the student is distracted by the lecture technique, the teachers can benefit from these materials to restore the student's attention (Saklan & Ünal,2018). Besides all these benefits, teachers frequently mentioned technical failures and limitations. The most obvious limitation is the difference in student perspectives of materials. Since students identify the concept of games with computers today, they can ignore the educational dimension if gamification exercises are excessive within digital materials. Another point is that some materials are too complex and useless for students and teachers. Thus, it can be said that the effect of material choice on the student is very high.

At the end of this period, teachers with a more positive approach to designing and finding materials showed that this process was challenging since it was considered within the scope of the middle school science course. Attention is drawn to the difficulty of motivating and supervising the students in front of the camera due to the shorter attention span of secondary school students and quicker distraction from the lesson.

5.1.2 Results Regarding the Findings Obtained from the questionnaire

5.1.2.1 Evaluation of the data for the first part of the questionnaire

Given the data, it can be stated that more than half of the participants are aged between 25-35. In other words, it can be said that the average age is young. In this case, it can be concluded that they may be more interested in digital materials and technology. In addition, the teachers who participated in the study were mainly found to work in public schools.

5.1.2.2 Evaluation of the data for the second part of the questionnaire

This course taken at the university enables teachers to have prior knowledge of digital materials. Thus, it was included in the questionnaire. The data shows that the participants are knowledgeable about these materials because they took material courses at the university and can evaluate the related questions accordingly.

Another question in this section is about designing and using digital materials at university. Looking at the data, 49.3% of the participants stated that they had created and used digital material before, and 50.7% had not. When compared with the data in the previous question, it is understood that not all the students taking a material design course at university designed and used materials simultaneously. Although they took the course and had the necessary technical knowledge, half of the participants did not use digital materials in university education.

Another question is related to the situation that the participating teachers became familiar with the use of digital materials during their university education courses. The importance of this question is linked to whether the participating teachers have an opinion on using digital materials effectively during the university course.

5.1.2.3 Evaluation of the data for the third part of the questionnaire

The differentiation status was examined by considering whether a material development course was taken in university. By looking at the related data, it is understood that the questions in this section do not show any differentiation in line with this factor. This indicates that teachers learned about digital materials at different times and in other ways throughout their education and teaching life.

As a result of the analyses considering the in-service training status, there appears to be no differentiation in this factor. These results indicate that the ideas of the participating teachers about digital materials may vary due to many factors. In other words, their views on digital materials are shaped and cannot be attributed to a single element.

The data shows the participants agree that science teachers give importance to technology literacy (Karakuş & Ocak, 2019). This reveals the participating teachers have a favourable view of technology being a part of the science lesson. It is understood that science teacher have positive thoughts on adapting digital materials to their classes. The answers demonstrate that the teachers think digital materials are necessary but do not find themselves sufficient to use them.

Proposition 16 underlines teachers' views on the increase of digital materials intended for the permanence of the lesson. It turns out that most participants responded, "I agree", showing that science teachers think digital materials can increase permanence.

These data show that while the participating teachers thought positively about the necessity and usefulness of digital materials, they gave different answers due to other teaching experiences and competency.

5.1.2.4 Evaluation of the data for the fourth part of the questionnaire

Therefore, the participating teachers had a positive idea about digital materials before the COVID-19 pandemic. In addition, it is found that teachers are undecided about changing their perspectives on using digital materials.

Another study result is how much the teachers have improved during this period. This shows that the participating teachers learned more about digital materials during this process. It can be said that the frequency of use of digital materials among teachers increased during web-

based distance education.

Science teachers preferred ready-made materials. This is because ready-made materials do not fully comply with the subject described or are incorrect. Although the use of materials affects course participation, it cannot be seen as the only reason. Since participation in web-based distance education depends on different factors, it is thought that teachers could not fully evaluate this situation. Accordingly, it can be said that teachers are undecided about measuring student motivation, but they still think positively about it.

The "Videos-Animations-Movies" option was the most preferred in the data obtained from this question. The ease of such materials and the fact that the students like them affect the teachers' preferences. Presentations appear to be the second most preferred option. That teachers can prepare this material on their own could be the reason why it is preferred.

5.2 Conclusion

In this part of the study, the results based on the findings are included. Suggestions for further studies are included in this section, too. This section consists of three parts. The findings from the interview form constitute the first part, the results from the questionnaire study and the second part. The recommendations form the third part.

5.2.1 Results Regarding the Findings Obtained from the Interview Form

The purpose of the interview form is to discover science teachers' ideas about digital materials during web-based distance education. Six sub-problems were created for the interview form, and 13 questions were designated for these problems. The findings obtained from these six sub-problems are interpreted.

As a result of the findings related to the first sub-problem, it is understood that teachers attach importance to technology literacy. This is an essential concept for science education and students' educational adventures throughout their lives. Although teachers hold different views on technology literacy, it is a crucial skill for those who keep up with the developments of the period they live in.

As part of the second sub-problem, the difficulties faced by the teachers during this period were disclosed. Notably, the problems faced are dealt with in two dimensions. In addition to

pedagogical challenges, such as the teachers and students not being used to distance education, the issues in parent-teacher relations, less interest of students in the course, and challenges in technical infrastructure, such as lack of equipment and technical malfunctions, were frequently seen. Although the teachers themselves came up with solutions to the challenges on these dimensions, there was no precaution that teachers could take against technical malfunctions and lack of materials.

From the point of view of science lessons, the positive effect of the laboratory environment cannot be ignored. In this case, although the teachers used different digital backgrounds during the web-based distance education, the lack of labs is attention-drawing. The use of digital materials positively affected student attention, but this waned quickly as students mostly used technological tools to play games.

The third sub-problem questions the change in the frequency of digital material use before and during web-based distance education. It is noteworthy that during this process, EBA is mainly used. Teachers preferred EBA as a platform they could accept as a starting point in this process for which they are not well-prepared. Also, although different sources are commonly used, the opinion of the teachers on this subject varied greatly. It can be said that the reason for the change in the frequency of use of digital materials among most teachers is that they feel more competent as they deal with digital materials.

It is seen that there is no definite opinion about the ready use of digital materials or the teacher's preparation. That ready-made materials should not be used as they are and should be evaluated in terms of age and suitability is worth the attention as an idea adopted by teachers. Teachers have become more willing to prepare their materials during this process. It was noticed by the interviewed teachers that they were confident in preparing materials and that this confidence stemmed from the fact that they earlier took a material preparation course.

The fourth sub-problem focuses on the impact of digital material use on students and teachers. In this process, it is noteworthy that teachers sharing the digital material were more in number, and they became more willing to research. In addition, it was noticed that teachers had a very positive perspective of these materials. Participating teachers stated during the interview that they received positive student feedback. In addition, the reusability of these digitally prepared materials brought a positive result for both teachers and students. That students can reuse most materials allows them to repeat these materials and provides them with the opportunity to learn at their own pace. This enables students with different learning paces to follow the same course together.

The fifth sub-problem aims to reveal what types of digital materials were recognized more positively by teachers. It is seen that the materials aimed at gamification attracted more attention. Also, among the remarkable results, the animations used during the lesson raised the student's interest in the class. Despite all these, it is agreed by most teachers believe that the use of games and animations is not compulsory. It can be concluded that the materials should be differentiated according to the course, student needs and subject.

According to the results from the interviews, digital materials made the science lesson positive and fun. It is understood that when the student is distracted by the lecture technique, the teachers can benefit from these materials to restore the student's attention. Besides all these benefits, teachers frequently mentioned technical failures and limitations. The most obvious limitation is the difference in student perspectives of materials. Since students identify the concept of games with computers today, they can ignore the educational dimension if gamification exercises are excessive within digital materials. Another point is that some materials are too complex and useless for students and teachers. Thus, it can be said that the effect of material choice on the student is very high.

The sixth sub-problem aims to investigate how the effects of this process will be when face-to-face education returns. The positive and negative effects of this process on teachers are disclosed. Based on the results, it can be said that teachers have gained different, positive perspectives on digital material at the end of this process. However, the negative impacts on teacher motivation cannot be ignored.

At the end of this period, teachers with a more positive approach to designing and finding materials showed that this process was challenging since it was considered within the scope of the middle school science course. Attention is drawn to the difficulty of motivating and supervising the students in front of the camera due to the shorter attention span of secondary school students and quicker distraction from the lesson.

5.2.2 Results Regarding the Findings Obtained from the questionnaire

In this part of the research, the results of the answers to the questions are evaluated. The questionnaire was analysed by dividing it into four sections, and therefore, the conclusion part will be explored in four separate areas.

5.2.2.1 Evaluation of the data for the first part of the questionnaire

This part of the questionnaire includes the personal information of the participating teachers. 80.1% of the participating teachers are female, and 19.9% are male. Looking at the groups grouped by age, the highest rate of participants is 30.8% between the ages of 25-30. Participants between 30-35 represent the second highest group at 29.5%. Considering these data, it can be stated that more than half of the participants are aged between 25-35. In other words, it can be said that the average age is young. In this case, it can be concluded that they may be more interested in digital materials and technology.

Another data in this section shows the professional experience of the participating teachers. Six groups were formed to determine the teaching years of the participants, and the participants were asked to choose among themselves. Given the data, the participants with professional experience of 0-5 years stand at 29.5%, and it is between 5-10 years for 30.8%. While these two groups comprise the largest group, teachers with 14.4 to 15-20 years of experience come third.

As for the type of educational institutions where the participants work, most of the participating teachers work in public schools. 91.8% of the participants work in public schools, and 8.2% in private schools. Participants joined this study from 36 different cities. Ankara, Bartın and Istanbul are the residential cities of most teachers.

5.2.2.2 Evaluation of the data for the second part of the questionnaire

In this part of the questionnaire, there are questions about the educational background of the participating teachers. Data on university education and in-service training are evaluated.

The status of taking material courses at university is one of the factors learned as part of this section.

This course taken at the university enables teachers to have prior knowledge of digital materials. Thus, it was included in the questionnaire. Looking at the questionnaire results, it is seen that 76% of the participants took a material design course while at university. This shows that the participants are knowledgeable about these materials and can evaluate the related questions accordingly.

Another question in this section is about designing and using digital materials at university.

Given the data, 49.3% of the participants stated that they had created and used digital material before, and 50.7% had not. When compared with the data in the previous question, it is understood that not all the students taking a material design course at university designed and used materials simultaneously. Although they took the course and had the necessary technical knowledge, half of the participants did not use digital materials in university education.

Another question is related to the situation that the participating teachers became familiar with the use of digital materials during their university education courses. The importance of this question is linked to whether the participating teachers have an opinion on using digital materials effectively during the university course. 40.4% of the participants did not use digital materials in their university courses and knew how to use them. 33.6% of the participating teachers think that digital materials are used in the lessons but insufficiently, and these materials should be used more. Only 26% of the participants stated that they were using digital materials sufficiently. The age interval of the participants is expected to be higher; however, it doesn't appear so.

The last question of this section is about the teachers' participation in an in-service course about digital materials during their profession. 54.1% of the participants stated that they had received in-service digital materials, which shows that teachers are interested in them.

5.2.2.3 Evaluation of the data for the third part of the questionnaire

This section evaluates the data obtained by analysing in line with various factors and views of teachers on digital materials. A total of six questions are included in this section. While exploring the averages of the answers, the differentiation status by gender, in-service training and taking a material design course at university will be investigated. A differentiation situation by age groups and professional experience is also sought.

First, the differentiation status by gender is seen from the answers to the questions in this section. When the answers to Questions 12, 13, 14 and 16 are analysed, it is seen that there is no significant difference by gender. "I think digital materials are useful for students to understand the lesson in science class." There is a substantial difference in the answers given to the proposition considering gender. Furthermore, it is understood that there is a considerable difference in Question 17, considering gender.

The differentiation status was examined by considering whether a material development course was taken back in university. By looking at the related data, it is understood that the questions in this section do not show any differentiation in line with this factor. This indicates that teachers learned about digital materials at different times and in other ways throughout their education and teaching life.

As a result of the analyses considering the in-service training status, there appears to be no differentiation. These results indicate that the ideas of the participating teachers about digital materials may vary due to many factors. In other words, their views on digital materials cannot be attributed to a single factor.

Separate factor analyses of the questions were examined. The answer, i.e. "Science teachers' technology literacy level should be very high; they should follow technological developments and integrate them into their lessons", is given by 4.48% of the participating teachers. The participants agree with this proposition, showing that science teachers emphasise technology literacy. This reveals that the participating teachers have a favourable view of technology being a part of the science lesson.

Given the analysis of the answers to the 13th question, it is seen that the participants do not find their literacy level sufficient. Most of the answers the participants gave appeared to be "I am undecided".

"I think digital materials are necessary for science class." The participants seemed to agree with this proposition when the answers were examined. It is understood that science teachers have positive views on adapting digital materials to their lessons.

The proposition, "I think that digital materials will be useful for students to understand the lesson in science class", was agreed upon by the participants.

Proposition 16 underlines teachers' views on the increase of digital materials intended for the permanence of the lesson. It turns out that most participants responded, "I agree", showing that science teachers think digital materials can increase permanence.

The last proposition on this subject gives an insight into the adequacy of digital materials during lessons. When the answer average is analysed, it is seen that the participating teachers are undecided on this issue. The answers demonstrate that the teachers think digital materials are necessary but do not find themselves sufficient to use them.

Finally, the data were analysed in line with the differentiation of the questions by years of teaching. It is seen that there is a significant difference in Questions 13 and 17. There is no significant difference in other questions, though. These data show that while the participating teachers thought positively about the necessity and usefulness of digital materials, they gave

different answers due to different teaching experiences and competencies.

When the differentiation by age is analysed, there appears to be a significant difference in the 17th question only.

5.2.2.4 Evaluation of the data for the fourth part of the questionnaire

This part of the questionnaire is shaped around the comments from the answers to the questions about the use of digital materials during the web-based distance education period. As in the third chapter, the results obtained will be differentiated by gender, in-service training and material design course at the university. Also, the differentiation situation by age group and professional experience is evaluated, and eight questions are included in this section.

First, the data were analysed considering the gender factor. By evaluating the differentiation in using digital materials based on gender, it is seen that there is significant differentiation in Questions 21, 23 and 24. There is no significant difference in other questions.

When answers to the questions related to the material course at the university were analysed, no significant difference was observed in any of the questions.

No significant difference appears when the answers to the questions are evaluated considering the status of receiving in-service training on digital materials.

The data obtained were analysed by looking at the mean values of the answers to the questions separately. Firstly, the responses to the 18th proposition in the questionnaire were evaluated. The average of the answers given to the proposition, "My perspective towards digital materials has completely changed in the web-based distance education process", stands at 3.55%. From the answers, it is seen that most of the participants answered, "I am undecided". Therefore, the participating teachers had a positive idea about digital materials before the COVID-19 period. In addition, it is found that teachers are undecided about changing their perspectives on using digital materials.

The answers to the proposition, "I learned a lot more about digital materials during the web-based education process", are examined, and the average value stands at 3.93. It is understood that although most of the teachers answered, "I am undecided", the answer, "I agree", also has a very high preference rate. This shows that the participating teachers learned more about digital materials during this process.

The answers given to the 20th question, seeking teachers' views on the change in the frequency of use of digital materials during this period, were examined. Considering the average values of the answers, it can be said that the frequency of use of digital materials among teachers had increased during the web-based distance education.

Proposition 21 aims to disclose the situation of the teachers preparing digital materials by themselves. From the answers, it is understood that the participating teachers did not prepare the materials independently. Science teachers preferred ready-made materials.

The answers to the proposition, "Digital materials have increased students' participation in the course during the web-based distance education", show that most participants are undecided on this issue. Since participation during web-based distance education depends on different factors, it is thought that teachers could not fully evaluate this situation.

The 23rd question was prepared to examine the change in student motivation for the lesson when digital materials are used. From the answers, it is understood that most teachers are undecided on this issue. However, it is seen that the second most preferred option is "I agree". Accordingly, it can be said that teachers are undecided about measuring student motivation, but they still think positively about it.

The answers to the proposition, i.e. "Using digital materials during the web-based distance education has increased the motivation of teachers", are evaluated, and it was found that most of the teachers had answered, "I am undecided". Since motivation is difficult to process to measure, teachers appeared to be undecided.

The last question in this section is a multiple-choice question, and it aims to find out the most frequently used digital materials among teachers. The "Videos-Animations-Movies" option was the most preferred in the data obtained from this question. The ease of such materials and the fact that the students like them affect the teachers' preferences. Presentations appear to be the second most preferred option. That teachers can prepare this material on their own could be the reason why it is preferred.

5.3 Recommendations

By performing more questionnaires, the first part of this study and the part that engages with the interview form could be examined in more detail, which would allow the participants to express their ideas more accurately.

This may be highlighted for future studies because increasing participation will bring more detail using analysis results. Evaluating the questionnaire results regionally may introduce

different perspectives affected by different opportunities.

A more detailed analysis can be carried out by multiplying the factors in the questionnaire. After compulsory distance education is terminated, different digital materials can be used to re-evaluate the factors within the scope of the questionnaire.

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QUESTIONNAIRE

Questioner for the Opinions of Science Teachers on the Use of Digital Materials in the Web-Based Distance Education Process

This questionnaire has been prepared for a study conducted in Bartın University Institute of Educational Sciences Department of Mathematics and Science Education Science Education. Participation in the questioner is voluntary.

Answering the questions completely, realistically and sincerely will contribute to the achievement of the purpose of this research. Your answers to the questioner will not be shared with third parties and will remain confidential. Thank you for your participation.

I would like to give a brief information about web-based distance education and digital materials for understanding the questions. Web-based distance learning; During the covid-19 outbreak, EBA live course system via the internet and courses via zoom are held. Digital materials are the general name given to visual and audio materials prepared in computer environment. The most well-known of these materials are:

•Presentations
•Movies and videos
•Animations
•Virtual labs
•Simulations
•Interactive worksheets
•Computer aided books
•Games
•Customized operation tests.

Personal and Professional Information

1. Are you participating in the questioner voluntarily?
   Yes No

2. Your Age
   20-25 25-30
   30-35 35-40
   40-45 45-50
   50-...

3. Your gender
Female Male

4. How many years have you been doing this profession?
0-5 5-10

10-15 15-20

20-25 25-...

5. Where is the province where you teach?
_____

6. The institution you work for
Public school Private school

Questions for the School of Graduation

7. In what year did you graduate from university?
_____

8. Have you taken a material design course at university?
Yes No

9. Have you designed or used a digital material during your university studies?
Yes No

10. Were digital materials frequently used in your classes during your university education?
Yes No Could be used more

11. Have you received courses or in-service training related to digital materials throughout your professional and educational life?
Yes No

Questions Regarding Digital Materials

While answering the questions in this section, please mark the options that are appropriate for you at the options' (1) ı definitely agree (2) I strongly disagree (3) ı disagree (4) ı agree (5) ı strongly agree.

12. The technology literacy level of science teachers should be very high, follow the technological developments and integrate them into the lesson.
1 2 3 4 5

13. I think my technology literacy level is very good.
1 2 3 4 5

14. I think digital materials are absolutely necessary for science class.
1 2 3 4 5

15. I think that digital materials will be useful for students to understand the lesson in science class.
1 2 3 4 5

16. I think that digital materials will increase the permanence of the subject learned in science class.
1 2 3 4 5

17. I think digital materials are not used enough in science classes.
1 2 3 4 5

Questions on the Use of Digital Materials in Web-Based Distance Education

While answering the questions in this section, please mark the options that are appropriate for you at the options' (1) ı definitely agree (2) I strongly disagree (3) ı disagree (4) ı agree (5) ı strongly agree.

18. In the process of web-based distance education, my perspective towards digital materials has completely changed.
1 2 3 4 5

19. I learned much more about digital materials during the web-based training process.
1 2 3 4 5

20. In the process of web-based distance education, I started to use digital materials much more.
1 2 3 4 5

21. I prepared all the materials I used in the web-based distance education process myself.
1 2 3 4 5

22. In the web-based distance education process, digital materials have increased the participation of students in the course.
1 2 3 4 5

23. In the web-based distance education period, the use of digital materials has increased the motivation of the students towards the course.
1 2 3 4 5

24. Using digital materials in the web-based distance education process has increased the motivation of teachers.
1 2 3 4 5

25. Which of the following digital materials did you prefer to use more frequently during the web-based distance education process?

☐Videos-Animations-Movies

☐Virtual laboratories - Simulations

☐Games

☐Presentations

☐Interactive worksheets

☐Computer-aided books

☐Other.....

INTERVIEW FORM

Hello my name is Zeynep ALEMDAR ZİHNİ. I am doing my master's degree in Science Education at Bartın University. For my master's thesis, I am conducting a study examining science teachers' perspectives on digital materials during the web-based distance education period. I would like to get your opinion on this issue.

What you have to say during the interview will remain strictly confidential. It will not be shared with any other third party. Your name will not be used in the study, but instead encodings will be used.

Is there anything wrong with me recording the conversation for you? If there is a section that you do not want, we can delete it if you specify it at the end of the interview.

Participation in the interview is voluntary and I estimate that it will last approximately one hour. Do you want to continue the conversation?

So let's start talking with your permission.

Before moving on to the questions, I would like to give a brief information about web-based distance education and digital materials. Web-based distance learning; During the covid-19 outbreak, EBA live course system via the internet and courses via zoom are held. Digital materials are the general name given to visual and audio materials prepared in computer environment. The most well-known of these materials are:

1. Presentations
2. Movies and videos
3. Animations
4. Virtual labs
5. Simulations
6. Interactive worksheets
7. Computer-aided books
8. Games
9. Customized tests.

If you don't have any relevant questions, we can move on to questions.

Sub problems

1. What is technology literacy? What are the teachers' views on the relationship between technology literacy and the use of digital materials?
2. What are the difficulties faced by teachers while teaching science lessons in the web-based distance education process? What did they resort to to eliminate them?

3. Has there been a change in the frequency of using digital materials in science lessons in the web-based distance education process? Has the variety of materials used changed?
4. In this process, what is the effect of digital materials on students and teachers in science lessons?
5. Which types of digital materials have been more beneficial in terms of science lessons?
6. How will the use of digital materials change when face-to-face education returns?

Questions

1. Could you briefly introduce yourself? Can you talk about your education life so far?
1.1. Did you take a material design course at university?

2. What does technology literacy mean to you? How would you explain the relationship between science course and technology literacy?

3. Could you talk a little bit about the difficulties you encountered in the science lesson during this process? What did you do to overcome these difficulties?

4. What did you do to enrich the lessons in the web-based distance education process? Did you use these methods before, and did you discover them during this process?

5. Was there a particular type of material you preferred during the process? If yes, what is the reason for choosing this material?

6. Did you notice one type of material that particularly caught the students' attention? What do you think is the reason for this?

7. Did you prefer to use digital materials in lessons before? Has your use of digital material changed during this process?

8. Did you prefer to prepare the materials you used yourself or did you use ready-made materials? What resources did you use, if you already used it? How did you access these resources? (Your own research- friend recommendation)

9. What were the benefits of using digital materials in this process? From the student's perspective - from the teacher's perspective

10. What effect do you think digital materials for science lesson have on the teaching of the lesson? Is there any material that must be used?

11. What are the limitations of digital materials that you notice?

12. When the web-based distance education process ended and you returned to face-to-face education, was there any difference in your use of digital materials? Has your perspective on digital materials changed?

13. What are the disadvantages and contributions of this process in terms of education?

Thank you for answering the questions with care.