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Research Article

Distance Education in Science Education: Teachers' Experiences Regarding Field-Specific Skills

Fen Eğitiminde Uzaktan Eğitim: Öğretmenlerin Alana Özgü Becerilere İlişkin Deneyimleri

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ABSTRACT

This study examines teachers' experiences of their students acquiring subject-specific skills included in the 2018 science education curriculum through distance learning. Structured interviews were conducted using a qualitative case study approach with ten participants, including eight science teachers and two elementary school teachers working in primary and middle schools with good socioeconomic student potential (i.e., those with computer and internet access during distance education). The study aimed to explore the students' development of field-specific skills (scientific process skills, life skills, engineering, and design skills) within the 2018 science curriculum during distance education from the teachers' viewpoints. The collected data were analysed descriptively and thematically. Data analysis revealed that teachers believe distance education methods do not sufficiently facilitate the achievement of desired learning outcomes. Participants indicated that the decreasing level of interaction in the distance education environment significantly hindered the development of scientific process skills and engineering-design skills, which are field-specific skills in science. Chemistry and Physics were identified as the most impacted sub-domains. To support the acquisition of field-specific skills in distance education, participants recommended the use of multimedia tools. Participants also stated that when a science curriculum compatible with the distance education process is prepared, field-specific life skills can be acquired.

Keywords: COVID-19 pandemic period, distance education, field-specific skills, science curriculum.

ÖZ

Bu çalışma, 2018 fen bilimleri öğretim programında yer alan alana özgü becerileri öğrencilerinin uzaktan eğitim sürecinde edinmelerine yönelik öğretmenlerin deneyimlerini incelemektedir. Durum çalışması yöntemi kullanılarak yapılandırılmış görüşmeler, sosyoekonomik durumu iyi olan öğrencilerin bulunduğu (uzaktan eğitim sırasında bilgisayar ve internet erişimine sahip olan) ilk ve ortaokullarda görev yapan sekiz fen bilimleri öğretmeni ve iki sınıf öğretmeni olmak üzere toplam on katılımcı ile gerçekleştirilmiştir. Çalışmanın amacı, uzaktan eğitim sürecinde 2018 fen bilimleri öğretim programı içerisindeki bilimsel süreç becerileri, yaşam becerileri ve mühendislik-tasarım becerileri gibi alana özgü becerilerin öğrencilerdeki gelişimini öğretmenlerinin gözünden değerlendirmektir. Toplanan veriler betimsel ve tematik analiz yöntemleriyle incelenmiştir. Veri analizi, öğretmenlerin uzaktan eğitim yöntemlerinin istenen öğrenme çıktılarına ulaşmayı yeterince kolaylaştırmadığına inandığını ortaya koymuştur. Katılımcılar, uzaktan

eğitim ortamındaki etkileşim düzeyinin azalmasının, fen bilimlerindeki alan özgü beceriler olan bilimsel süreç becerileri ve mühendislik-tasarım becerilerinin gelişimini önemli ölçüde engellediğini belirtmişlerdir. Kimya ve Fizik en çok etkilenen alt alanlar olarak belirlenmiştir. Katılımcılar, uzaktan eğitimde alana özgü becerilerin edinilmesini desteklemek için multimedya araçlarının kullanımını önermişlerdir. Ayrıca katılımcılar, uzaktan eğitim süreciyle uyumlu bir fen bilimleri müfredatı hazırlandığında alana özgü yaşam becerilerinin edinilebileceğini belirtmişlerdir.

Anahtar Kelimeler: Alana özgü beceriler, COVİD-19 pandemi dönemi, fen bilimleri öğretim programı, uzaktan eğitim.

INTRODUCTION

The COVID-19 pandemic, which started in China in December 2019 and showed its impact in Turkey in March 2020, interrupted face-to-face education. Furthermore, prompt measures were taken to make the distance education process more efficient. Therefore, synchronous lessons were implemented over the Ministry of National Education [MoNE] (n.d.) platform to ensure the continuity of the education process in our country in Türkiye. This has highlighted the fact that education is not solely confined to the school environment. However, whenever students are away from school and academic, social, and emotional opportunities at school, it is expected to emerge as an invoice whose economic and social costs we cannot yet calculate (Turkish Education Association [TED], 2020).

Distance education is a term that encompasses various educational approaches based on the use of technological tools (Gewin, 2020). During the pandemic, the education of students in Türkiye was provided through distance education. Distance education separates students and teachers in terms of time and place, forcing teachers to switch to contactless teaching methods throughout all stages of education (Faridah et al., 2021). Implementing education in a new format has cast doubt on whether the curriculum and pedagogical approaches designed for face-to-face education and training are valid and effective for distance education (Tanpoco et al. 2022). Distance education has also led to sudden changes by necessitating new learning activities (e.g., strategies and assessments) (Jansem, 2021).

The pandemic has brought to light the unpreparedness of the education system, thereby exposing the existing disparities in educational opportunities. In this period, the design of synchronous and asynchronous activities, the use of concrete and discrete technologies that eliminate time-space limitations in the learning-teaching process, the process-oriented assessment approach in the sense of measurement, the technological infrastructure, and the necessary investments in educational technologies have gained importance (Bozkurt, 2020). The current pandemic has stimulated the immediate implementation of educational technologies at all levels, making the digitalization of education a primary objective of the state's social policy (Nikolaevna et al., 2021). In response to the sudden change, many schools and education districts (a term that determines the economic status of schools and their distance from the city center) worldwide have adopted video conferencing technology to provide courses to students as an economical solution. However, it has been observed that teachers often lack training in utilizing instructional technology, so they need to be adequately prepared when they need to transfer their experiences in face-to-face or distance education into this alternative environment (Rehn et al., 2018).

The study, which examined educational responses within the framework of risk and resilience to the closure of schools during the COVID-19 epidemic in South Korea, showed that distance education disrupts students' ideal learning while also potentially reducing the quality of general education (Byun & Slavin, 2020). The COVID-19 pandemic, which caused individuals to maintain social distance, hindered students' mental health and academic success (Fontana, 2020). During the period when schools were closed, the increase in the learning losses experienced and the problems of basic skills deficiency were predicted to impact the lives of

individuals negatively growing like a snowball (TED, 2020). Examining the development of reading and math skills among 1st to 4th-grade children in Finland before and after the onset of the COVID-19 pandemic revealed learning losses in reading skills due to school closures (Lerkkanen et al., 2023). Examining the impact of this pandemic on the acquisition of field-specific skills in the science curriculum is therefore important.

1.1. Field-Specific Skills in the Curriculum in the Face-to-Face Education Process

The 2018 science curriculum in Turkey, prepared for face-to-face education, aims to make every student scientifically literate. In this context, field-specific skills are named as follows:

> a. Scientific Process Skills: This field covers the skills that scientists use during their work, such as observing, measuring, classifying, recording data, forming hypotheses, using data and creating a model, changing and controlling variables, and experimenting.
>
> b. Life Skills: This field covers basic life skills such as analytical thinking, decision-making, creativity, entrepreneurship, communication, and teamwork in accessing and using scientific information.
>
> c. Engineering and Design Skills: This field enables students to create products using the knowledge and skills they have acquired and to develop strategies on how to add value to these products by integrating science with mathematics, technology, and engineering, with an interdisciplinary perspective on problems, by bringing students to the level of invention and innovation (MoNE, 2018, pp. 9-10).

While the curriculum emphasizes the creation of learning environments in which students can freely express themselves both orally and in writing and engage in discussions with their peers, it is the teachers who facilitate and guide this process (MoNE, 2018, p. 11).

Upon analysis of the curriculum's learning outcomes, it has been determined that there are 215 for improving communication skills, 122 learning outcomes for improving decision-making skills, 98 for developing analytical thinking skills, 61 for developing creative thinking skills, 34 for developing teamwork skills, and 27 for developing entrepreneurship skills (Deveci et al., 2018). According to the findings, 91.7% of the learning outcomes in the Science curriculum are associated with at least one scientific process skill, and the most relevant skills are classification, observation, interpretation, and inference skills, respectively (Başar, 2021). In addition, the present study revealed that 47 learning outcomes were identified for the experimentation skills, with the highest number observed in the 5th and 6th-grade levels.

1.2. Impacts of Distance Education Process on Science Education

With the transition to distance education, both students and teachers have encountered a series of structural and pedagogical challenges. These include issues with internet connectivity and a lack of familiarity with technology-integrated teaching methods (Altawalbeh & Al-Ajlouni, 2022). The pandemic has demanded a flood of adjustments, from how teachers approach curriculum choices and how children interact to how they share classroom materials (Phelan vd., 2024).

Science teachers had to exert additional efforts to establish virtual learning environments that were accessible to all students throughout the period of distance education (Rodríguez et. al., 2021). Although teachers have learned to use technology in their classrooms, the majority of them stated that their level of preparation in designing and implementing distance education is insufficient and that they encounter difficulties in attracting students' attention, connecting with students, and creating an environment (Many et.al., 2022). Teachers also reported declining students' engagement and enthusiasm for the course during distance education (Bakioğlu & Çevik, 2020). The lack of direct contact required by teachers to supervise children and counsel

parents while performing their duties negatively impacted students' emotional well-being due to the lack of communication (Kruszewska et al., 2020).

In the distance education process, students have positive views, such as not falling behind on the subjects and having the opportunity to access different resources (Pınar & Dönel Akgül, 2020). However, they have also stated their negative opinions, such as not being able to experiment, not being able to get instant answers to their questions about the subject, and technological inadequacies. Compared with urban students, students in rural schools showed less active academic engagement due to the lack of independent online learning habits (Yu et al., 2023). Another uncertainty that should be considered is whether students can acquire the necessary competencies and skills without being in a laboratory environment due to the pandemic (Pintarič & Kravanja, 2020). Students expressed positive opinions about distance education due to the increase in their use of audiovisual materials during the distance learning process (Stefanidou et al., (2022).

In the 2022 Global Workforce Hopes and Fears Survey, workforce planning at both short- and long-term scales was discussed with a focus on future skill needs. According to the report, 29% of respondents stated that their countries lack individuals equipped with essential competencies—such as digital literacy, creativity, analytical thinking, and entrepreneurship—to meet current job requirements. Survey respondents also stated that the sectors with the highest skills shortages are healthcare (including pharmaceutical companies), technology, media, and telecommunications (Price Waterhouse Coopers [PwC], 2022). There is a strong need for skills needed now and in the future, as well as social skills such as leadership, resilience, and global intelligence, in order to keep up with technology, the environment, social management, and the changing world (Moritz, 2022). In their study on life skills training during the COVID-19 pandemic, Velasco et al. (2021) observed the usefulness and applicability of the life skills education curriculum but stated that teachers remained silent about the implementation of this curriculum. In 2021, Aktan noted that the pandemic has brought to light various issues that were not previously on the subject. These include the technical competence of schools, the health status of educators, and the maintenance of learning in various conditions. He also noted that the curriculum, which serves as a guiding framework for all education systems, has also come under renewed discussion.

It is seen that the majority of studies in the literature generally focus on the participants' views on distance education (Adıgüzel, 2020; Arslan et al., 2021; Bakioğlu & Çevik, 2020; Balaman & Tiryaki, 2021; Han et al., 2021; Kabapınar et al., 2021; Kantos et al., 2022; Kurnaz et al., 2020; Phelan et al. 2024; Stefanidou et al., 2022; Yu et al., 2023). It is also noticed that there are studies determining teachers' opinions regarding the change in workload, professional satisfaction, and the effects of the distance education process (Altınsoy & Erdoğan, 2022; Bakırcı et al., 2021; Habala, 2022; Izmagambetova et al., 2022; Kaymaz, 2021; Kazu et al., 2021; Menabo et al., 2022; Sarışık et al., 2022). Education systems and curricula, digital infrastructure, and teachers' and students' digital skills vary, leading each country to make its own decisions regarding school closure duration and teacher practices related to distance learning (Lerkkanen et al., 2023). However, very few studies have attempted to answer how the COVID-19 pandemic has affected the skills that need to be acquired in education (Fontana, 2020; Lerkkanen et al., 2023; Velasco et al., 2021).

1.3. Purpose of the Study

To the best of our knowledge, there is currently no extant literature investigating teachers' opinions and experiences regarding the impact of distance education on students' acquisition of field-specific skills within the context of the 2018 science curriculum. Therefore, this study may enable a better understanding of how the distance education process affects students' acquisition

of field-specific skills and more effective decision-making in policies and practices regarding the development of science skills in distance education.

This research aims to investigate teachers' views and experiences on the impact of the distance education process on field-specific skills in the 2018 Science Curriculum.

The research questions can be expressed as follows:

1. What kinds of challenges do teachers experience in implementing the science curriculum during the distance education process?
2. What kinds of field-specific skills do teachers consider feasible to be acquired in a science curriculum adapted for distance education?
3. How do teachers experience the use of multimedia-based learning environments in supporting life-skill acquisition during distance education?

METHOD

Qualitative research involves interpreting the world and understanding its functioning by using various tools such as interviews, field notes, photographs, and records (Denzin & Lincoln, 2005, p. 3). This type of research is in line with the social constructivist perspective that explores "multiple realities constructed by people and the effects of these constructions on their own lives and interactions with others" (Patton, 2014, p. 96). This study, which aims to understand the experiences and opinions of science and elemantary school teachers about their students' acquisition of field-specific skills during the pandemic period, was conducted based on the case study model within the scope of the qualitative research method. The case study approach is a qualitative research method employed to investigate phenomena or events that are beyond the researcher's control, emphasizing the exploration of how and why questions (Yıldırım & Şimşek, 2011).

2.1. Participants

Participants were selected by a purposive sampling method. Purposeful sampling is a method that facilitates research by deliberately selecting situations or cases that are information-rich and tailored to the specific goals of the research (Şahan & Uyangör, 2021). The teachers in the study group had at least five years of professional teaching experience and had taught in both face-to-face and distance education contexts. Prior to the interviews, they were already familiar with field-specific science skills and had practical experience teaching these skills in face-to-face. They also had some experience teaching these skills in a distance education environment. The purpose of establishing this study group was to obtain more comprehensive and detailed data on the acquisition of field-specific skills in the science curriculum by selecting teachers who implemented and mastered the science curriculum during the pandemic period. Ten participants, including eight science and two elementary school teachers working in primary and middle schools with good socioeconomic student potential (i.e., those with computer and internet access during distance education) participated in this study to examine the impact of the distance education process on field-specific skills in the science curriculum. Participants were anonymized and coded as P1 to P10 for confidentiality purposes. The participants' details are provided in Table 1.

2.2. Data Collection

As a data collection tool, an open-ended structured interview form was utilized. This form consists of two questions aiming to gather participants' demographic information and five questions specifically addressing the impact of the distance education process on the field-specific

skills outlined in the science curriculum. While preparing the interview questions, care was taken to ensure that the questions were not directive in line with the research topic and the sub-problems investigated and that they were open-ended, understandable, and clear, allowing the participants to express themselves.

Table 1

Demographic Information About the Participants

Professional Experience	Participant(s)	Number	Education Level	Participant(s)	Number
1-5 year	P9	1	Bachelors	P3, P4, P6, P7,P8	5
6-10 year	P3, P4, P5, P6, P8, P10	6	Master's Degree	P1, P2, P5	4
11-15 year	P2	2	PhD	P9	1
21-25 year	P1	1			

Questions 1, 2, and 3 within the interview form were designed to assess any differences between the implementation of the curriculum in the distance education setting compared to face-to-face education. Additionally, these questions aimed to gain insight into the impact of distance education on field-specific skills and science sub-learning fields. Questions 4 and 5 were included to obtain information about the restructuring process of the curriculum in the distance education process. Expert opinion has been sought regarding the validity of the interview questions.

Before the interview, the participants were informed about the research, and it was emphasized that the interviews would be used only for scientific purposes and that their confidentiality would be protected. The first author conducted the interviews in the spring of 2023 after the COVID-19 pandemic, which lasted 15-30 minutes. Table 2 presents the detailed interview questions directed to the participants regarding the research questions.

2.3. Data Analysis

Descriptive and content analysis were used to analyze the qualitative data. Data analysis in qualitative research is a technique that aims to discover the patterns and variations in your observations. This process enables researchers to identify actions and consequences systematically, thereby facilitating a comprehensive review of their observations (Timmermans & Tavory, 2022). The researcher needs to create themes that genuinely represent the data while allowing the researcher to constantly interact with the data to maintain the context of the information they are analyzing (Kristanto & Padmi, 2020). The answers to the interview questions constituting the research findings were received in written form. The first author created the content analysis of the responses to the structured interview form, and the content analysis was revised and given its final form in line with the opinions of the second and third authors, who are expert lecturers in the field of qualitative research. Then, in addition to the content analysis in which the researcher determined the categories and codes, a descriptive analysis was carried out by including the direct answers of the participants. For the opinions of elementary school and science teachers, 12 categories and 37 codes were determined. Within the scope of descriptive analysis, participant opinions were presented in the findings section through direct quotation and coding.

Table 2

Distribution of Sub-Problem Questions to Interview Questions

Sub-problems	Interview questions
1. What kinds of challenges do teachers experience in implementing the science curriculum during the distance education process?	Interview question 1: Can you evaluate the aspects of the 2018 science Curriculum that are incompatible with distance education? Interview question 2: How has the distance education process affected the acquisition of field-specific skills in the 2018 science Curriculum? Interview question 3: Which sub-learning fields (Physics, Chemistry, Biology, Astronomy, Earth Science) do you think will negatively affect teaching field-specific skills in the distance education process? Why?
2. What kinds of field-specific skills do teachers consider feasible to be acquired in a science curriculum adapted for distance education?	Interview question 4: If a science curriculum is prepared for the distance education process, which field-specific skills can be included? Why?
3. How do teachers experience the use of multimedia-based learning environments in supporting life-skill acquisition during distance education?	Interview question 5: Can life skills be acquired using multimedia environments such as animation, simulation, and virtual laboratory in distance education? Can you give an example?

2.4. Validity and Reliability

In qualitative research, validity is to measure the feature to be measured as objectively as possible (Kirk & Miller, 1986). In the case study, in terms of construct validity, internal validity, external validity, and reliability, it provides data diversity, how the researcher reaches the results and presents these results in a way that others can understand, analytical generalization can be made, and it is a guide for future research by making documentation (Aytaçlı, 2012; Yin, 2003). In this context, in order to ensure data diversity, a study group consisting of teachers working in official schools as well as teachers with curriculum literacy was formed in the study group. The expert view was obtained from two doctoral students for the open-ended questions in the data collection tools. Among the structured interview questions, two questions about which learning outcomes to be acquired in the distance education process were not used in the analysis because the participants only gave the acquisition codes and did not explain. In order to ensure the transferability of the results, the content analysis method was also used to make a detailed description. In the analysis of qualitative data, the agreement rate (Reliability = Consensus / (Agreement + Disagreement) among the coders was found to be 0.86 (Miles and Huberman, 1994).

2.5. Ethical Issues

During the research, the rules and principles of interview and publication ethics were followed, the participants supported the research voluntarily, and the identities of the participants were kept confidential. Permission was received to carry out the study.

FINDINGS

In our study, in which we investigated teachers' views on the impact of the distance education process on the field-specific skills in the 2018 Science Curriculum, the findings were presented in order according to the research questions.

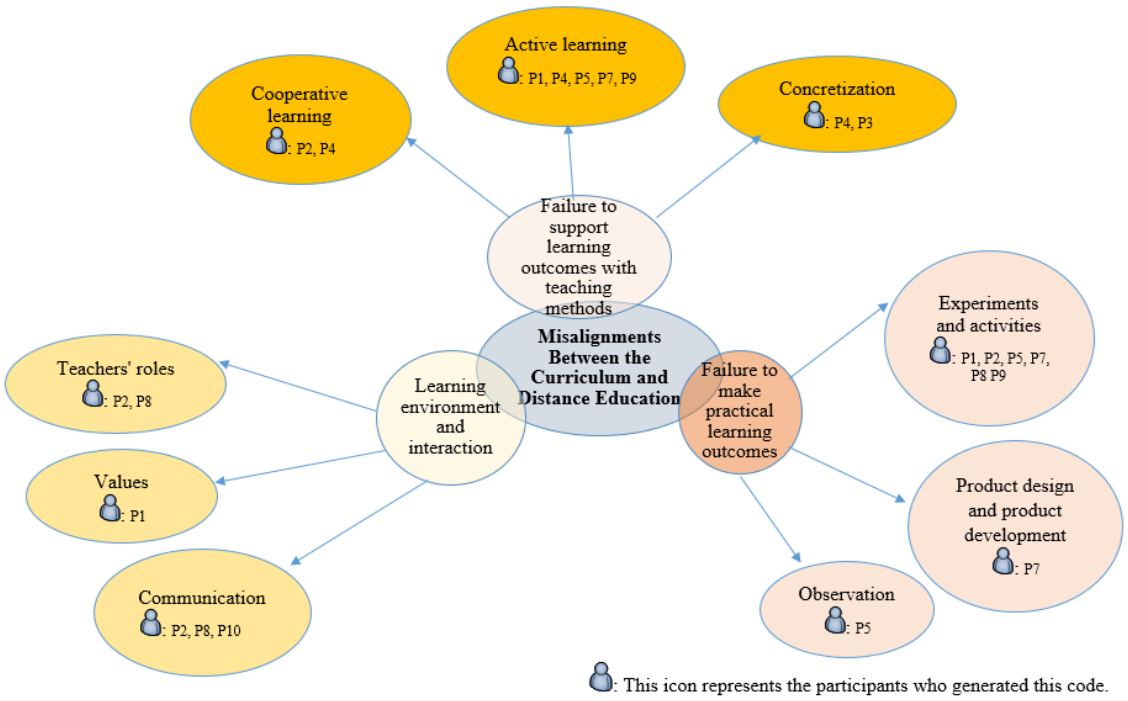
3.1. Teachers' Challenges in Implementing the Curriculum During Distance Education

Within the scope of the first research question, the challenges experienced by teachers in implementing the 2018 science curriculum during the distance education process were analyzed through content analysis. Guided by the interview questions, the data were organized into three main themes: 1) misalignments between the curriculum and distance education, 2) the impact of distance education on acquiring field-specific science skills, and 3) the impact of distance education on science sub-learning fields.

For the first theme, three categories were identified based on teachers' statements: 1) failure to make practical learning outcomes, 2) failure to support learning outcomes with teaching methods, and 3) learning environment and interaction. The codes and categories associated with the first theme are presented in Figure 1.

Figure 1

The Misalignments Between the Curriculum and Distance Education



Six of the participants stated that the distance education process is incompatible with the point of providing students with practical learning outcomes such as experiments and activities in the 2018 science curriculum. For example, one participant expressed the difficulty of conducting experiments in distance education as follows:

> *"It is difficult to describe the places that need to be explained through experimentation".* (P8)

One of the participants also stated that practice-oriented learning outcomes such as product development could not be realized in the distance education process, *"...the promotion and presentation of product design and production processes and studies should take place in the school environment*" emphatically. One of the participants stated that the practical learning outcomes could not be made in terms of observation and class level:

> *"Students and teachers may have difficulties in matters that require the active participation of students, such as experimentation and observation. Especially at the 3rd and 4th-grade levels, the senses of sight, taste, and touch should be put to work."* (P5)

Five of the participants stated that they had difficulties in applying the active teaching method in teaching the learning outcomes in the 2018 science curriculum of distance education. One participant explained this situation as follows:

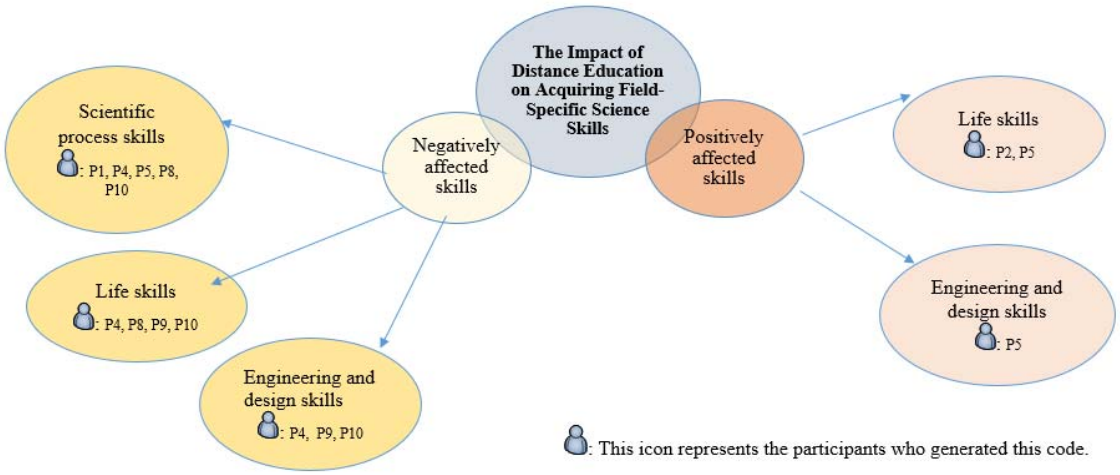
> "*The distance education process negatively affected this situation since most of the science curriculum is activity-oriented, and these activities are based on learning by doing and experiencing*."(P7)

Participants also emphasized that they could not fulfill the requirements of the 2018 science curriculum by applying the cooperative learning technique and concretizing the concepts. P6 interpreted the distance education process as temporary and stated that it should be considered an intermediate form. Participants stated students had difficulties acquiring the learning environment and communication skills defined in the 2018 science curriculum. Six participants stated that the features, such as teacher role and communication, defined in the curriculum could not be reflected in the distance education process. One participant on this subject stated that the teacher arouses the students' curiosity in the science lesson but that it is difficult to do this in distance education, while another participant stated that it is a problem to increase the motivation of the disinterested students.

For the second theme, codes related to the impact of distance education on field-specific science skills were analyzed. And two categories were derived from teachers' statements: 1) negatively affected skills 2) positively affected skills. The codes and their distribution across participants for this theme are presented in Figure 2.

Figure 1

The Impact of Distance Education on Acquiring Field-Specific Science Skills



Ten participants stated that their skills were negatively impacted, while two stated that their skills were positively impacted. Participant P5 expressed both positive and negative impacts of distance learning on their skills. The participant's positive opinion is as follows:

"I can say that life skills, engineering, and design skills can be positively developed during the pandemic thanks to the active use of technology." (P5)

Five of the participants stated that their scientific process skills, and four of the participants' life skills were negatively affected by the distance education process. Participants expressed their views as follows:

> *"Since most of the skills are practical, it has a negative impact on the acquisition of skills in the distance education process".* (P1)
>
> *"I think it may have negatively affected their scientific process skills".* (P5)
>
> *"It was observed that students had great difficulty in subjects requiring analytical thinking. Apart from this, there were difficulties in acquiring teamwork and innovative thinking skills".* (P8)

While three of the participants expressed their view that engineering and design skills were negatively affected, one attributed the positive impact of engineering and design skills, which are specific to the field, to *"...active use of technology during the pandemic process…".* Some of the participants stated that the skills most negatively affected by life skills are "*analytical thinking*" and "*teamwork.*" In contrast, others noted that life skills are positively affected by "decision making, communication, analysis and even teamwork from life skills can be acquired as long as the teacher plans the lesson well." expressed the importance of the role of the teacher in the form of emphasizing.

In addition, P7 interpreted this question as a negative effect of distance education since the science curriculum has a research-inquiry-based strategy, and students remain at the level of understanding rather than expressing the field-specific skills affected during the distance education process. While P3 and P6 did not express the skills that were affected positively or negatively, P6 answered, *"Students are social creatures, therefore face-to-face education is better for learning...*" and P3 answered, "*it should be enriched with multiple learning environments*".

For the third theme, three categories were identified based on teachers' statements: 1) the direction of impact, 2) science sub-learning fields, and 3) causes of the negative impact. The codes and categories associated with the third theme are presented in Figure 3.

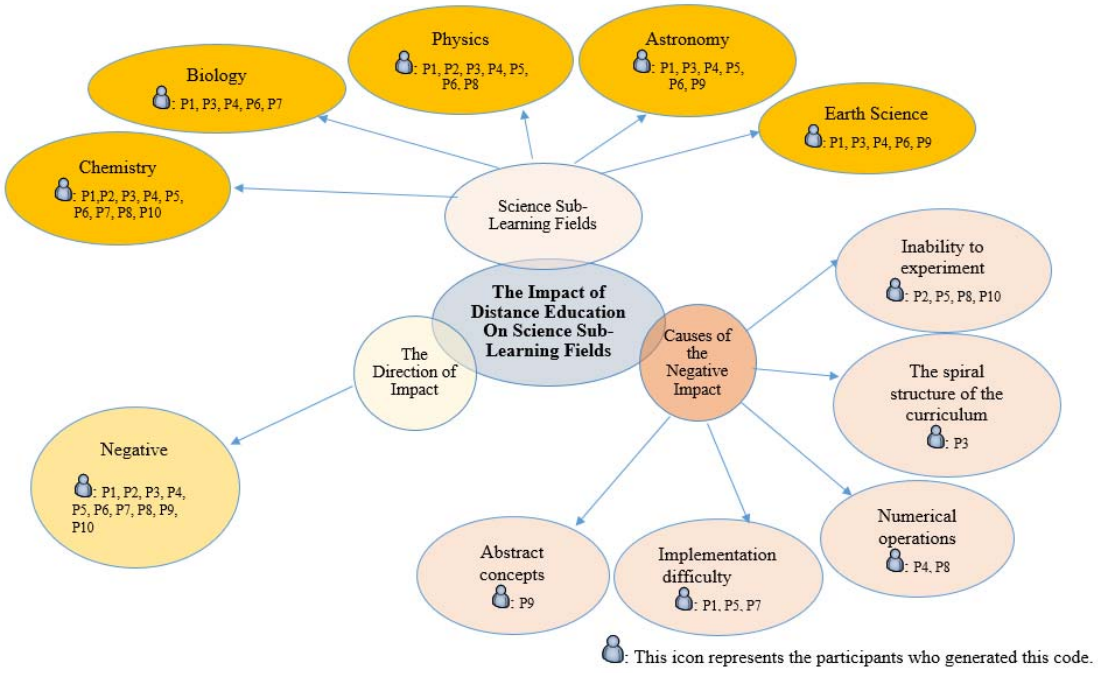
As seen in Figure 3, while ten participants stated that science sub-learning fields would be adversely affected in the distance education process, four of the participants emphasized that they could not experiment, three of them were challenging to implement, two of them were numerical operations, one of them was the spiral structure of the curriculum and abstract concepts. Two participants expressed their views on the cause of the negative impact as follows:

> *"I think that all sub-learning fields will be negatively affected. Because I think that the sub-learning fields are interconnected."* (P3)
>
> *"The teaching of subjects that require experimentation and numerical processing is adversely affected."* (P8)

Nine people stated that chemistry, seven people physics, six people astronomy, five people biology, and five people earth science were the most adversely affected by the science sub-learning fields. The participants stated that the lessons that require practice based on experimentation and observation are negatively affected, so the impact in sub-learning fields such as chemistry and physics is the highest.

Figure 3

The Impact of the Distance Education Process on Science Sub-Learning Fields



Teachers thought that distance education was structurally incompatible with the objectives of the 2018 science curriculum; they emphasized that experimentation, observation, and practice-oriented learning outcomes, in particular, could not be implemented in the digital environment. Skill-based teaching strategies such as active learning, collaborative learning, and concretization were noted to be limited in distance education, and the dynamics of the learning environment envisioned by the program, such as communication, interaction, and motivation, were not maintained on digital platforms. In their assessments of sub-learning fields, participants did not view the impact as limited to a single field; they noted that teaching subjects requiring experiments and numerical operations, in particular, presented greater challenges in the distance education process.

3.2. Integrability of Field-Specific Skills into Distance Education-Oriented Curriculum

Based on the content analysis of the participants' responses regarding which field-specific skills could be acquired in a science curriculum adapted for distance education, three categories were identified: life skills, scientific process skills, and other skills. The codes and categories are presented in Figure 4.

Four participants stated that the distance education curriculum could incorporate life skills as one of the field-specific skills. Meanwhile, one participant recommended including multimedia applications, such as virtual experiments and scientific process skills. Participants expressed their views as follows:

"*All life skills*". (P1)

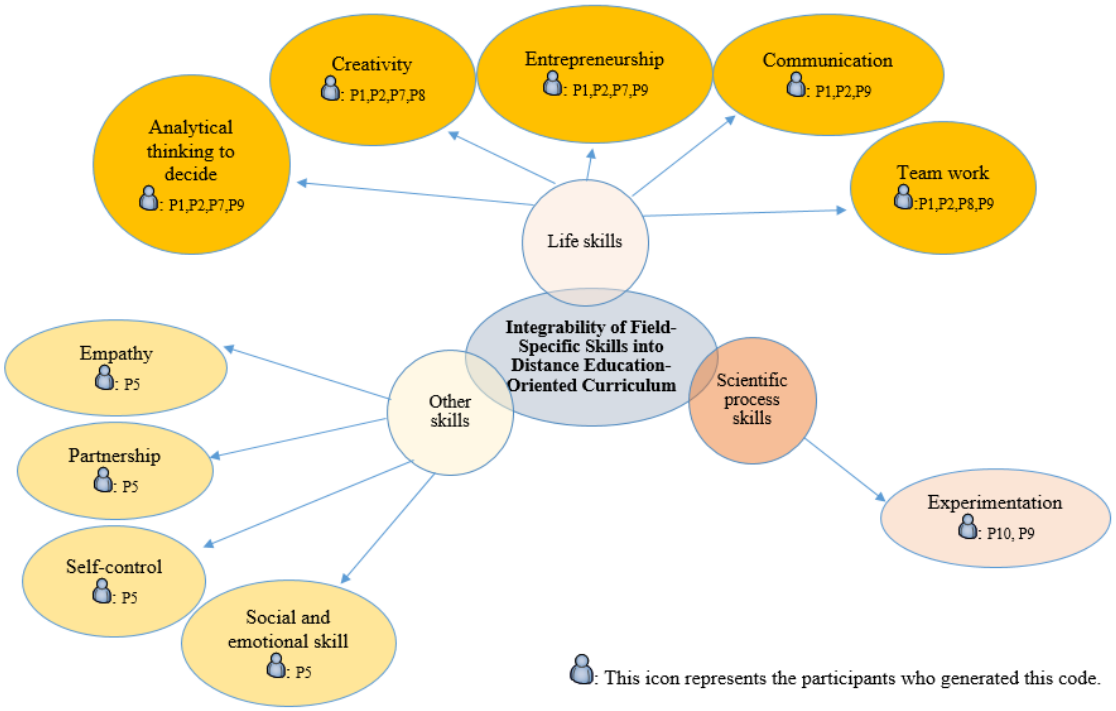
"*Basic life skills such as analytical thinking, decision making, creative thinking, and communication can be included (in the science curriculum for distance education). Life*

skills other than skills that require practice, such as teamwork and entrepreneurship, can be included in this science curriculum". (P7)

"*I would add life skills because our age needs such individuals*". (P9)

Figure 4

Field-Specific Skills That Can Be Included in the Science Curriculum Adapted for Distance Education



Four participants stated that the life skills that can be included in the curriculum that can be prepared for the distance education process are analytical thinking, creativity, and teamwork. Three of the participants stated that entrepreneurship can be included in the science curriculum. Some of the participants said, "*Social and emotional skills can be integrated into field-specific skills. Empathy, production, collaboration, self-control, etc. can be associated with existing skills in the science curriculum* ". While the other participant stated that "*Life skills and innovative thinking skills…*".

The answers given by P3, P4 and P6 participants to this question were "*training should be done face to face*".

3.3. Lif-Skills Acquisition Through Multimedia-Based Learning Environments

Based on the content analysis of the participants' responses regarding the acquisition of life skills in the science curriculum of the distance education process through multimedia learning environments such as animation, simulation, and virtual laboratory were identified in Figure 5.

While nine of the participants stated that life skills could be acquired through multimedia environments, one participant expressed his views as follows:

"After explaining a subject, I observed that watching animations about its use in daily life improves thinking. I observed that when they(students) worked on simulation, they asked more questions and were more eager to try it". (P8)

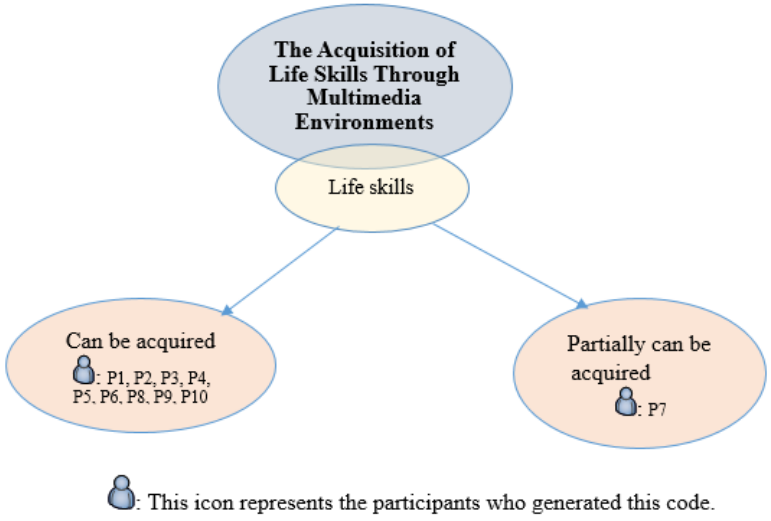
This participant, who stated that he benefited from animations and simulations in the distance education process, observed that it affected his students' learning.

"Creative thinking can be acquired with animations and virtual laboratory". (P9)

"It provides more effective learning due to its attractiveness and visual appeal, and it can be beneficial". (P10)

Figure 5

The Acquisition of Life Skills Through Multimedia Environments



Regarding that life skills can be partially acquired, one participant compared the effect of technology applications to a certain level, as long as there is no active participation in playing a computer game.

Although P4, P8, P9, and P10 participants reported a negative impact on students' field-specific skills during the distance education process, they expressed the view that multimedia applications have the potential to enhance life skills.

DISCUSSION AND CONCLUSION

In this section, we synthesize the findings from existing literature, examining how teachers experienced the influence of the distance education process on field-specific skills embedded within the 2018 science curriculum. By comparing our findings with information from similar studies, our goal is to thoroughly comprehend teachers' viewpoints and illuminate the practical and future research implications.

4.1. Discussion of Teachers' Reported Challenges in Implementing the Science Curriculum During Distance Education

The pandemic-induced shift to distance education created a new instructional context in which teachers had to navigate curriculum expectations under digital constraints. Participants

perceived distance education as an instructional condition that restricted the realization of the 2018 Science Curriculum's core pedagogical aims. Participants state that they struggle to support the 2018 science curriculum with the learning environment and the teaching methods and interactions used to achieve learning outcomes. Most participants emphasized that the distance education process created difficulties in realizing practical learning outcomes, such as experimental studies. In the study conducted by Pınar and Dönel Akgül (2020), students have negative opinions about not being able to conduct experiments and not receiving immediate answers to their questions on the subject. Students' lack of active participation may have led to a decrease in the quality of education (Byun & Slavin, 2020).

Participants expressed difficulties aligning the 2018 science curriculum with the learning environment and teaching methods necessary to achieve learning outcomes. This challenge extends to assessing students' attention and readiness accurately, with secondary school teachers particularly struggling to gauge their students' engagement and receive timely feedback (Menabo et al., 2022). Consequently, most participants tend to favor traditional methods due to their limited experience in distance education (Altawalbeh & Al-Ajlouni, 2022).

Participants also perceive negative effects on aspects such as teacher roles and communication that should be present in the instructional environment during the distance education process. Similarly, obstacles encountered in education during the COVID-19 pandemic are associated with interpersonal communication, student participation, methods, organization, and planning (Velasco et al., 2021). Moreover, students' reluctance to engage in distance education (Bakırcı et al., 2021) and teachers' overwhelming workloads (Kaymaz, 2021) could be obstacles to effective communication.

Participants' statements show that the impact of distance education on the process of acquiring field skills in the science curriculum is largely perceived negatively. Most of the participants in this study stated that the lack of experiments, observations, and applied activities negatively affected students' scientific process skills. This result was supported by studies investigating the effect of the "Bio Skills at Home" kit on students in biology courses due to restrictions in access to the laboratory environment during the COVID-19 epidemic (Rayment et al., 2022). In addition, participants stated that students' inability to design, develop, and present products in distance education negatively affects life skills such as teamwork, analytical thinking, engineering, and design. Following an active learning methodology, a classroom environment, and a hands-on teaching method are important in a science curriculum (Jeong et al., 2019). In addition, the differences in the digital infrastructure and digital skills of teachers and students have a negative impact on their views on distance education (Lerkkanen et al., 2023).

As a result of the research, participants think that science-specific skills students need to learn by doing and experiencing through active learning and cooperative learning approaches may cause learning losses because an interactive learning environment cannot be provided. It is supported by research that found that the acquisition of practical business skills and cognitive engagement in the online learning environment is quite low (Tanpoco et al., 2022). It has been stated that students can pass exams, move to upper classes, and deteriorate their performance during their education It is stated that students may experience declines in their performance in exams, during transition to higher classes, and during their education (Pintarič & Kravanja, 2020).

Participants state that it will be effective for teachers to be good role models during distance education, conduct experiments and activities in communication with their students, and use active communication skills in product development and design. It is expected that the increased motivation of students to participate online will make the role of the teacher indispensable in distance education, and teachers will be able to present the learning content interestingly and clearly (MoNE, 2018, p. 11; Rodríguez et al., 2021).

Participants did not perceive the impact of distance education as uniform across all science sub-learning domains. Instead, they reported a multi-domain vulnerability, noting that Physics and Chemistry were the most negatively affected due to their heavy reliance on experimentation, numerical problem-solving, and the need for concrete demonstrations. This aligns with previous findings indicating that abstract concepts and formula-based reasoning become harder to convey without hands-on interaction and real-time feedback (Stefanidou et al., 2022).

In conclusion, the fact that most teachers expressed predominantly negative views about teaching practices in distance education and responded to the question of integrating field-specific skills into the 2018 Science Curriculum by stating that "face-to-face education is better" suggests that teachers feel unprepared to adapt their pedagogical approaches to alternative instructional contexts. The reasons for this may be the difficulties they experience in motivating students during the distance education process and the fact that teachers think they are not competent in designing and conducting technology-based courses.

4.2. Discussion of Teachers' Experiences on the Integrability of Field-Specific Life Skills into a Distance Education-Oriented Science Curriculum

Participants stated that field-specific life skills can be acquired when a science curriculum specific to the distance education process is prepared. They stated that skills such as analytical thinking, decision-making, creativity, communication, teamwork and entrepreneurship can be gained through teacher guidance and active use of technology.

This study stated that empathy, partnership, self-control, innovative thinking, and social and emotional skills could be included in the curriculum as other skills. There are studies in the literature on teaching these skills through distance education. For example, incorporating ChemDraw as an online game for drawing molecules into an organic chemistry course helped students engage, improve their organic chemistry skills, and maintain and develop the classroom community. However, the perspective of three participants in the study, advocating for the superiority of face-to-face education, finds reinforcement in Fontana's (2020) assertion that distance education cannot fully substitute the in-person classroom experience. It has been determined that entrepreneurship skills, one of the life skills, can be gained through extracurricular activities (such as visiting experts or conducting interviews on the research topic, taking part in the markets) (Deveci et al., 2015).

The inclusive nature of efforts to redesign education is predicted to reveal the need to create equitable public school systems in the post-epidemic period (Many et al., 2022). This is possible with the learning system for both teachers and students, which includes all the strategies that can be implemented to meet the learning needs of students during the COVID-19 pandemic (Faridah et al., 2021).

4.3. Discussion of Teachers' Experiences on Acquiring Life Skills Through Multimedia-Based Environments in Distance Science Education

Participants stated that using multimedia environments during the distance education process would enable them to acquire many life skills. Schools and teachers should actively plan and design online teaching in distance education using digital tools (Velasco et al., 2021). Instead of drawing attention to the negative consequences of distance education, research efforts need to be intensified to adapt to the new era in education and eliminate inequality in education (Byun & Slavin, 2020).

When the participants used the simulation method during distance education, it was stated that students needed to ask more questions, which positively affected their analytical thinking, decision-making, and communication skills. Including elements such as activities, experiments, games, and animations in teaching within the scope of the literature unit allows students to experiment while showing interest in the lesson. It has been determined that it increases students'

knowledge and makes the lesson more fun (Çetin, 2010). It has been stated that pedagogical dimensions of digital social change and educational alternatives are temporary but necessary during the pandemic (Jansem, 2021).

Although some participants stated that distance education negatively affected students' field-specific skills, they also noted that multimedia applications can potentially improve life skills. They said that multimedia environments can provide a more effective learning experience in distance education due to their attractiveness and visual appeal. Video lectures, tutorials, videos, webinars, shared or online presentations, panel discussions, forums, business games, online tests, and case studies have been proposed as ways to organize classes using distance education technologies by offering distance education, multimedia, and internet-based teaching (Nikolaevna et al., 2021). In addition, virtual laboratories can contribute to the acquisition of practical skills in science lessons by providing students with experimental experiences (Radhamani et al., 2021).

4.4. Recommendations

In light of the information expressed in the findings, discussion, and conclusion section, suggestions for science teachers and science curriculum development experts are expressed below:

- Curricula designed to increase teaching and learning efficiency can be adapted to both distance and face-to-face education. Even if the COVID-19 pandemic ends, some students (e.g., open middle and high school students) may wish to continue their education through distance learning (due to part-time work obligations or a desire to use learning environments that are independent of time and space).
- In the distance education process, technological-based pedagogical content knowledge training can be given for teachers to acquire field-specific skills.
- Web-based applications such as animation, virtual laboratory, simulation, and virtual reality, which are thought to be easily accessible by teachers and help students acquire life skills, can be made on live lesson platforms.
- This study is limited to teachers' views only. Future studies can be evaluated by using additional data collection tools such as the views of students who have experienced the same process, observation of the distance education process, and making further measurements.

This qualitative study includes the views of teachers working in a particular region in Turkey. Therefore, the limitations of this study include the number of participants, time frame, duration, and data collection tools. However, the answers given by the participants to the structured questions are insufficient and not oriented toward the answer to the question, which constitutes a limitation of the study. Despite the limited responses, careful consideration was given to all types of data to avoid missing data in the content analysis. Results and findings are presented without any generalization.

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GENİŞLETİLMİŞ ÖZET

Giriş

Aralık 2019 yılında Çin'de başlayan ve ülkemizde Mart 2020'de etkisini gösteren Covid-19 salgını yüz yüze eğitimi kesintiye uğratmıştır. Bu yüzden ülkemizde eğitim sürecinin devamlılığını sağlamak adına EBA platformu üzerinden canlı ders uygulamasına gidilmiş, uzaktan eğitim sürecinin daha verimli geçmesi adına acil önlemler alınmaya çalışılmıştır. Bu salgın aynı zamanda tüm seviyelerde eğitim teknolojilerinin acilen uygulanmasıyla birlikte eğitimin dijitalleştirilmesini devletin sosyal politikasının ana görevlerinden biri haline getirmiştir (Nikolaevna vd., 2021). Bu durum okul ortamının ne kadar önemli olduğunu gösterdiği gibi eğitimin gerçekleştiği tek yerin okul olmadığını göstermiştir (Türk Eğitim Derneği [TED], 2020). Uzaktan eğitim, öğrencinin eğitmenden hem zaman hem de mekân olarak ayrılmasına neden olurken öğretmen eğitiminin tüm aşamalarında fiziksel temassız öğretim yöntemine kaydırmaya zorlamıştır (Faridah vd., 2021). Eğitimin yeni bir formatta gerçekleştirilmesi, yüz yüze öğretim ve öğrenim için geliştirilen öğretim programı ve pedagojilerin çevrim içi eğitim için geçerli ve etkili olup olmadığı konusunda şüphe uyandırmıştır (Tanpoco vd., 2022). Çevrim içi eğitim aynı zamanda yeni öğrenme etkinliklerinin (stratejiler ve değerlendirme) kullanılmasını gerekli kılarak ani değişimlere yol açmıştır (Jansem, 2021). Ani değişime ayak uydurmak amacıyla dünya çapında birçok okul ve eğitim bölgesi öğrencilere ekonomik bir çözüm olarak kurslar vermek için video konferans teknolojisini kullanma yoluna gitmiştir. Fakat öğretmenlerin bu öğretim teknolojisini kullanmak için nadiren eğitim aldığı, bu nedenle yüz yüze veya çevrim içi eğitimdeki deneyimlerini bu alternatif ortama çevirmeleri gerektiğinde yeterince hazırlıklı olmadığı görülmüştür (Rehn vd., 2018). Pandemideki uzaktan eğitim süreci öğrencileri de çeşitli açılardan etkilemiştir. Güney Kore'nin Covid-19 salgını sırasında okulların kapanmasına verdiği eğitimsel tepkileri bir risk ve dayanıklılık çerçevesiyle inceleyen araştırmada; öğrencilerin ideal öğrenmesini bozduğu tespit edilirken potansiyel olarak genel eğitim kalitesini düşürdüğü belirtilmiştir (Byun ve Slavin, 2020).

Bu araştırmanın amacı; uzaktan eğitim sürecinin mevcut fen bilimleri öğretim programındaki alana özgü becerilere etkisi konusunda öğretmenlerin görüş ve deneyimlerini incelemektir. Bu kapsamda araştırmanın alt problemleri şu şekilde ifade edilebilir:

1. Öğretmenler, uzaktan eğitim sürecinde fen bilimleri müfredatını uygularken ne tür zorlukları deneyimlediler?
2. Öğretmenler, uzaktan eğitime uyarlanmış bir fen bilimleri müfredatında hangi alanlara özgü becerilerin edinilmesinin mümkün olduğunu düşünüyorlar?
3. Öğretmenler, uzaktan eğitim sırasında yaşam becerileri edinimini desteklemede multimedya tabanlı öğrenme ortamlarının kullanımını nasıl deneyimliyorlar?

Yöntem

Fen bilimleri öğretmenlerinin pandemi döneminde öğrencilerinin alana özgü becerileri edinmelerine ilişkin deneyim ve görüşlerini anlamayı amaçlayan bu çalışma, nitel araştırma yöntemi kapsamında durum çalışması modeline dayalı olarak yürütülmüştür. Durum çalışması yaklaşımı, araştırmacının kontrolü dışında gelişen olgu veya olayları, nasıl ve niçin sorularını keşfetmeye odaklanarak incelemek için kullanılan nitel bir araştırma yöntemidir (Yıldırım ve Şimşek, 2011). Bu çalışmaya, Ankara'da sosyoekonomik durumu iyi öğrenci potansiyeline sahip (ör. uzaktan eğitim sürecinde bilgisayar ve internet erişimi olanlar) resmi ilkokul ve ortaokullarda görev yapan sekiz fen bilgisi öğretmeni ve iki sınıf öğretmeni olmak üzere toplam on öğretmen katılmıştır. Katılımcıların demografik bilgileriyle ilgili iki, uzaktan eğitim sürecinin mevcut fen bilimleri öğretim programındaki alana özgü becerilere etkisi üzerine beş sorudan oluşan açık uçlu yapılandırılmış görüşme formunu kullanılmıştır. Veri toplama aracındaki sorular araştırılmak istenen konu ve alt problemler çerçevesinde oluşturulmuştur. Bu süreçte alan uzmanları tarafından gözden geçirilen sorular üzerinde gerekli düzeltmeler yapılarak son hali verilmiştir. Görüşmeler ilk yazar tarafından COVID-19 pandemisinden sonra 2023 ilkbaharında gerçekleştirilmiş ve 15-30 dakika sürmüştür.

Sonuç ve Tartışma

Bu araştırmada elde edilen veriler katılımcıların COVID-19 salgını nedeniyle başlanan uzaktan eğitim sürecinin, mevcut fen bilimleri öğretim programındaki alana özgü becerilere etkisinin olumsuz olarak nitelendikleri tespit edilmiştir. Katılımcılar mevcut öğretim programının öğrenme ortamı ve etkileşimin yanı sıra kazanımları öğrencilere kazandırma amacıyla kullanılan öğretim yöntemleri ile desteklemekte sıkıntı yaşadıklarını belirtmektedir. Bu sonuç katılımcıların çoğunun uzaktan eğitimde deneyim eksikliğine bağlı olarak geleneksel yöntemleri tercih ettiklerini belirtilen araştırma sonucu (Altawalbeh ve Al-Ajlouni, 2022) ve COVID-19 sürecinde yapılan eğitimde yaşanan engellerin kişilerarası iletişim, öğrenci katılımı, yöntemler, organizasyon ve planlama ile ilgili olduğu araştırma sonucu ile uyuşmaktadır (Velasco vd., 2021).

Araştırmada katılımcıların çoğunluğu bilimsel süreç becerilerin deney, gözlem ve uygulamalı etkinliklerin yapılamamasından dolayı olumsuz etkilendiğini belirtmiştir. Bu sonuç COVID-19 salgını sürecinde laboratuvar ortamına erişimde kısıtlamalar nedeniyle biyoloji derslerinde "Evde Biyo Beceriler" kitinin öğrencilerin temel laboratuvar becerilerini uygulamalı olarak yapmalarının, öğrenciler üzerine etkisini araştıran araştırma ile desteklenmiştir (Rayment vd., 2022). Ayrıca katılımcılar yaşam becerilerinden takım çalışması ve analitik düşünmenin, mühendislik ve tasarım becerilerinin öğrencinin ürün tasarlama, geliştirme ve bu ürünü sunarak sergileyemeyeceğinden dolayı olumsuz etkilendiğini ifade etmiştir. Mevcut fen bilimleri öğretim programı bağlamında aktif bir öğrenme metodolojisinin izlemesinin, sınıf ortamının ve uygulanan öğretim yönteminin önemli olduğu belirlenmiştir (Jeong vd., 2019).

Katılımcılar uzaktan eğitimin fen alt öğrenme alanlarına etkisinin olumsuz olacağı ve en çok olumsuz etkilenen fen alt öğrenme alanlarının Kimya ve Fizik olduğunu belirtmişlerdir. Bunun nedeni olarak deney yapamama, öğretim programının sarmal yapısı, sayısal işlemler

gerektiren konular, uygulama zorluğu, soyut kavramlar yönünde görüş ifade etmişlerdir. Stefanidou vd. (2022) çalışmasında, öğrencilerin uzaktan eğitim sürecinde ev ortamının, karşılıklı bağlantı sorunlarının, öğretmen-öğrenci ve öğrenci-öğrenci iletişim eksikliğinin, azalan konsantrasyon ve azalan deneysel faaliyetlerin fizik eğitimini olumsuz etkilediğini vurgulamışlardır. Bu sonuçtan anlaşıldığı üzere fen öğretimin birbiri üzerine inşa edilen konu ve kavramlar bütünü olduğu bu yüzden anlaşılamayan konu ya da kavramın diğer öğrenme alanlarına olumsuz etkisi olacağı öngörülmektedir.

Sonuç olarak; araştırmaya katılan öğretmenlerin çoğunluğunun uzaktan eğitim sürecinde ders işleme süreçlerine ilişkin pek çok olumsuz görüş belirtmeleri ve mevcut müfredatta yer alan özel alan becerilerinin uzaktan eğitim sürecine entegrasyonu konusundaki soruya "Yüz yüze eğitim daha iyi" cevap vermeleri öğretmenlerin farklı durumlara hazırlıklı olmadığı söylenebilir. Bunun nedenleri olarak uzaktan eğitim sürecinde öğrencileri derse motive etmede yaşadıkları zorluklar ve öğretmenlerin teknoloji tabanlı ders tasarlama ve yürütülmesi konusunda yeterli olmadıkları düşünmeleri olabilir.

Çalışmada elde edilen sonuçlar neticesinde şu öneriler verilebilir: Eğitim- öğretimin verimli hale getirilmesi için hazırlanan öğretim programların hem uzaktan hem de yüz yüze eğitime uygun şekilde hazırlanabilir. Çünkü COVID-19 salgını bitse bile bazı öğrenciler uzaktan eğitime devam etmek istediği durumlar yaşanabilir, bu bir nevi açık ortaokul, liseye giden öğrenciler için verimli eğitim ortamı sunulmasını sağlayabilir.