

Online Teaching During the Covid-19 Pandemic: Turkish Student Teacher and Teacher Experiences from Biology and Preschool Education Fields

Nazlı Ruya TAŞKIN BEDİZEL¹

Balıkesir University

Sinem GÜÇHAN ÖZGÜL²

Balıkesir University

Abstract

This research presents a qualitative case study that investigates the biology and preschool student teachers' and teachers' experiences of online teaching during the Covid-19 pandemic. The study utilizes the diffusion of innovations theory to understand the adoption and application of online teaching as an innovation. The participants in the study consisted of eight senior biology teachers, four biology teachers, nine senior preschool education student teachers, and three preschool teachers. Data collection was conducted through online surveys administered to the participants at the end of the 2021 school year. Additionally, the researchers, who also served as student teachers' supervisors, took observation notes during the online teaching practice to complement the survey data. The findings of the study reveal insights into the adoption of online teaching and learning processes as an innovation among teachers and student teachers. Analysis of the participants' responses regarding their readiness and experiences indicates that student teachers exhibit higher levels of perception in adopting and applying online teaching compared to the teachers. Interestingly, the experiences of the participants from different fields did not significantly differ in terms of adopting the innovation. This study emphasizes the need to increase the relative advantages of online teaching, minimize its complexity, and be prepared for similar situations. Incorporating online lesson planning and management courses in teacher education programs and providing in-service training can enhance educators' knowledge and experiences in online teaching, contributing to the adoption of online education as an innovation. Additionally, further research is needed to explore the role of parents in online learning environments. Engaging stakeholders from various fields will provide valuable data for a deeper understanding of online teaching and learning.

Keywords: online teaching, teacher education, Covid-19 pandemic, biology education, preschool education, diffusion of innovations (DIT)

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¹Dr., Necatibey Faculty of Education, Balıkesir University, Balıkesir, Türkiye, ORCID: 0000-0001-6027-719X

Correspondence: nazliruya@balikesir.edu.tr

²Dr., Necatibey Faculty of Education, Balıkesir University, Balıkesir, Türkiye, ORCID:0000-0002-5702-2150, Email:sinem@balikesir.edu.tr

Introduction

The emergence of the Coronavirus (Covid-19) pandemic in Wuhan, China, in December 2019 had a profound global impact. On March 11, 2020, the World Health Organization declared it a global pandemic, leading to significant changes in the economy, social life, and education practices worldwide. This process has increased the importance of online working and online education worldwide, and business and education fields have undergone irreversible changes with digitalization efforts reaching the highest level (Durak & Çankaya, 2020). The Covid-19 pandemic has posed the most significant challenge to national education systems at all levels, surpassing the growth experienced in education over the past 50 years (Daniel, 2020; Flores & Gago, 2020).

In Türkiye, as well as in many other countries, the pandemic led to the closure of almost all educational institutions, including primary, secondary, and universities, starting from March 2020. In response, emergency distance education measures were implemented to mitigate the spread of the disease (Ezginici, 2020; Telli & Altun, 2021; Yılmaz, Güner, Mutlu, & Arın Yılmaz, 2020). The pandemic has affected students' lives differently, depending on their level of education and program of study (Daniel, 2020). Transitioning to online learning in the middle of the academic year presented its own set of challenges (Verma, Campbell, Melville, Park, 2020). Teachers and instructors across all educational institutions had to adapt to new technologies and innovative teaching and learning models (Donitsa-Schmidt & Ramot, 2020). In addition to adjusting to online education, they faced significant hurdles in maintaining effective communication with students and supporting their learning and development (König, Jäger-Biela, & Glutsch, 2020). As highlighted by Flores, Machado, and Alves (2020), the main challenges in this transition included limited interaction with students, inadequate involvement in the learning process, insufficient training in online teaching, lack of suitable equipment, time constraints, and limited support from parents.

During the initial phase of the Covid-19 epidemic, Turkish universities encountered obstacles in sustaining educational activities. While some universities quickly adopted online education, others relied on open-source learning management systems like Moodle. Eventually, most universities shifted to virtual collaboration platforms such as Microsoft Teams and Zoom for online education in the fall and spring terms of 2020-2021. However, the absence of practical experience remained a challenge, particularly in fields like medicine (e.g., Hari et al., 2020; Sahi, Mishra, & Singh, 2020) and teacher training (e.g., Donitsa-Schmidt & Ramot, 2020; Durak & Çankaya, 2020). Practical experience plays a crucial role in shaping the professional identities of student teachers and is widely recognized as a vital component of teacher training programs (Allen & Wright, 2014; Caires, Almeida, & Vieira, 2012). During this period, student teachers either began to cancel their weekly visits to schools or make online observations and teaching practices in virtual classrooms. Therefore, the absence of online

practical experiences can be regarded as an indicator of the quality of teacher training programs (Flores et.al, 2020).

The rapid shift to online education implemented by schools and universities during the Covid-19 pandemic aimed to provide students with the highest quality education possible. Assessing whether this goal was achieved requires understanding the unexpected challenges and beneficial aspects of the sudden transition from face-to-face to online teaching. As teachers and student teachers, who facilitate this process, are relatively new to online environments, their strategies to help students make the most of these digital platforms are crucial for teacher education literature. These strategies not only contribute to filling the gap in the literature but also support future teacher training practices. Additionally, while researchers worldwide have examined the experiences of teachers and student teachers during online education in the Covid-19 pandemic (e.g., Aizenberg, 2022; Aktan-Acar et al., 2021; Bakioglu & Çevik, 2020; Croft et al., 2020; Erbaş, 2021; Ersin, Atay, & Mede, 2020; Erumit et al., 2021; Hartshorne, Baumgartner, Kaplan-Rakowski, Mouza, & Ferdig, 2020; Muliadi et al., 2021; Nel & Marais, 2020; Sariođlan et al., 2020), further research is needed to gain a better understanding of how these experiences vary and evolve across different student levels, study fields, and contexts.

This study focuses on the fields of biology and preschool teaching due to their distinct and unique characteristics. While the biology curriculum follows a structured approach with direct and standardized teaching methods, the preschool curriculum is more flexible, incorporating active learning and child-centered activities. Consequently, these two domains differ from each other and offer diverse perspectives on the research questions examined in this study. Evaluating online education practices in biology and preschool teaching necessitates capturing the opinions of practitioners regarding their experiences. Therefore, this study collects and analyzes the viewpoints of teachers and student teachers based on the perceived characteristics of an innovation (relative advantage, complexity, trialability, compatibility, and observability) in Roger's Diffusion of Innovations Theory (refer to Section 1.1.2. Diffusion of Innovations Theory). This approach allows researchers to examine practitioners' initial awareness and evaluation of online teaching, as well as their disposition to adopt or reuse online teaching in the future.

Theoretical Framework

Research on Online Teaching during the Covid-19 Pandemic

The Covid-19 pandemic has brought about a significant shift in education, leading to a surge in online teaching and making it a popular subject of research. Researchers from various countries have conducted studies involving teachers and student teachers from diverse fields to gain a comprehensive understanding of this process. For instance, some studies (e.g., Durak & Çankaya, 2020; Erumit, Özçelik, Yüksel & Tekbıyık, 2021; Karakaya, Arık, Çimen, & Yılmaz, 2020; Muliadi, Prayogi, Bahalwan, Nirmala, & Verawati, 2021) have explored factors such as perceptions,

expectations, experiences, motivations, and challenges of online education during the Covid-19 pandemic among student teachers. These studies have revealed that student teachers expressed various concerns regarding online education. They perceived the process as ineffective and limited in terms of interaction, discussion, collaboration, feedback, and response (Muliadi et al., 2021). Furthermore, they faced challenges due to a lack of knowledge and experience in utilizing technology. For example, Erümit et al. (2021) found that student teachers held negative beliefs about online science education and considered it useful only for theoretical courses. Karakaya et al. (2020) investigated the views of biology student teachers on distance education and identified pros related to technology use, empathy, and positive attitudes toward lessons, as well as cons associated with technical issues and knowledge gaps.

Studies conducted during teaching practicum with student teachers (Altan, 2021; Güven & Uçar, 2021; Akmeşe & Kayhan, 2021; Nel & Marais, 2020) also reported difficulties encountered in online practicum, including technical problems, challenges with technology use, and classroom management issues. These studies emphasized that relying solely on online education for teaching practice would lead to a lack of practical experience. Conversely, Ersin, Atay, and Mede (2020) stated that student teachers in their study found online teaching practicum to be a valuable experience in terms of addressing online teaching anxiety. Aizenberg (2022) examined the challenges faced by kindergarten student teachers during teaching practicum after the lockdown and identified varying abilities to cope with this professional experience during times of stress and crisis, categorized as survivor, adaptive efficacious, and leader.

Studies involving schoolteachers have highlighted various challenges and advantages of online teaching during the Covid-19 pandemic. For example, studies with science teachers in Türkiye have reported both challenges and advantages experienced during their teaching practice. Sarıoğlan, Altaş, and Şen (2020) indicated that conducting online experiments presented challenges related to student motivation, engaging students, and material and technical limitations, although it was considered safer and more appealing for certain experiments. Ünal and Bulunuz (2020) identified teachers' main problem as limited access to computers, the internet, and smartphones. They also found that teachers viewed online education primarily as a supplementary approach to face-to-face instruction. Bakioğlu and Çevik (2020) reported issues of accessibility, concerns regarding communication with students, low student engagement and knowledge, pressure from school administration, and difficulties in completing the curriculum and practical activities. Additionally, the teachers in their study expressed positive attitudes toward expanding their knowledge of educational technologies to enhance their teaching abilities. Noor, Isa, and Mazhar (2020) conducted a study with Pakistani schoolteachers, shedding light on the challenges faced in delivering online lessons. They identified challenges such as expensive internet packages, uncooperative students, low participation, teachers' lack of confidence and technological expertise, limited access to educational resources, and weak network infrastructure.

However, they also highlighted the creative and dedicated efforts of teachers to provide enriching learning opportunities despite these constraints.

Diffusion of Innovations Theory (DIT)

The Covid-19 pandemic has brought about an unforeseen shift to the online realm, leading to the widespread adoption of digital technologies among individuals (Yan, 2020). This global crisis has opened up new possibilities for online learning, benefiting both educators and students. In order for teachers to effectively navigate the online teaching landscape, they have had to transition from traditional teaching methods to approaches that are compatible with technology (Lapitan, Tiangco, Sumalinog, Sabarillott, & Diaz, 2021). The decision-making process undertaken by teachers and aspiring teachers to embrace this rapid change in online teaching aligns with the principles of Diffusion of Innovations Theory (DIT) proposed by Rogers (Rogers, 2003). DIT encompasses four key elements: innovation, communication channel, time, and social system. In this context, innovation refers to an idea, application, or object perceived as "new" by individuals or organizations. It doesn't necessarily have to be entirely novel; it can still be considered innovative if it hasn't been previously utilized by the individual or organization (Berger, 2005). From the standpoint of teachers and student teachers, the transition from face-to-face to online teaching during the Covid-19 pandemic can also be seen as an innovation due to their limited prior experience. According to Rogers (2003), the decision-making process for adopting an innovation unfolds in five sequential stages: information, persuasion, decision, implementation, and confirmation. Figure 1 depicts these five stages in the innovation-decision process (Rogers, 2003).

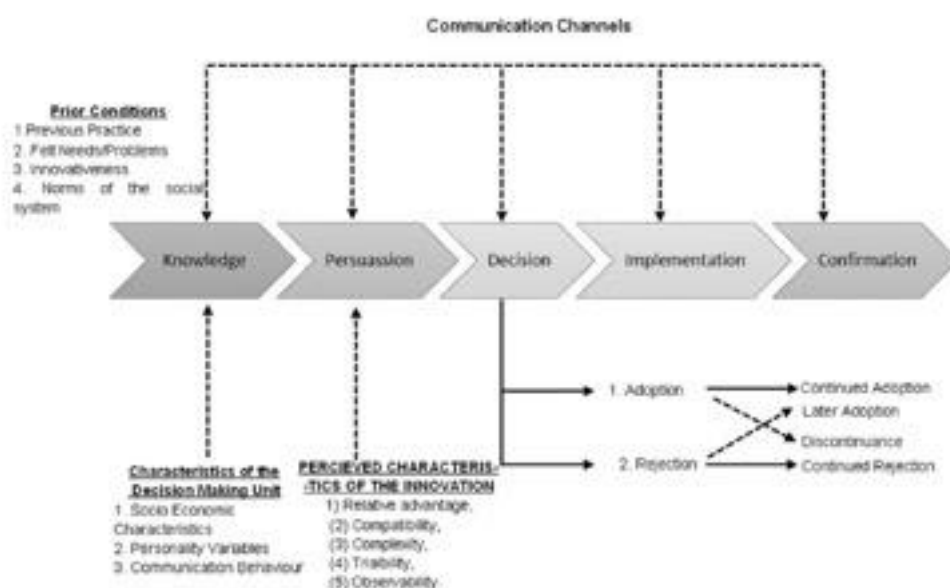


Figure 1. The Model of Five Stages in the Innovation-Decision Process (Source: Diffusion of Innovations, Fifth Edition by Everett M. Rogers. Copyright (c) 2003 by The Free Press. Reprinted with permission of the Free Press: A Division of Simon & Schuster.)

The model presented in Figure 1 illustrates the progression of individuals through the Five Stages of the Innovation-Decision Process according to DIT. The process begins with preconditions, including past experiences, perceived need, and innovativeness, which influence the individual's journey. In the knowledge stage, individuals seek to understand the innovation's meaning, how it works, and its underlying rationale (Rogers, 2003). This cognitive aspect is influenced by socio-economic characteristics, personality variables, and communication behaviors. It is important to note that an individual's positive or negative attitude towards the innovation is shaped by their knowledge about it, but this does not necessarily guarantee adoption (Sahin, 2006). The persuasion stage plays a crucial role in engaging individuals more effectively in the innovation-decision process. The components of the innovation, namely relative advantages, compatibility, complexity, trialability, and observability, drive the persuasion process. In the context of this study and previous research (e.g., Lee, Hsieh, & Hsu, 2011), these characteristics can be summarized as follows: relative advantage refers to the benefits derived from online teaching compared to face-to-face instruction; complexity relates to the degree of alignment between online teaching and participants' existing values, needs, and prior experiences; compatibility involves comparing the challenges of implementing online learning in a classroom to those of face-to-face instruction; observability pertains to the ease with which practitioners can discern the differences between online and face-to-face teaching; and trialability refers to the extent to which online teaching can be experimented with. Numerous studies have highlighted the significant role of these characteristics in the adoption of information technologies (Surry, 1993; 1997). Additionally, Rogers (2003) emphasized that these five attributes explain a substantial amount of the variance (ranging from 47 to 87 percent) and provide crucial insights. These components also enable the online teaching process to view the innovation adoption process from the majority's perspective (Wilson & Stacey, 2004). After progressing through the knowledge and persuasion stages, individuals make the decision to either adopt or reject the innovation. As Rogers (2003) noted, "full use of an innovation as the best course of action available" signifies adoption, while "not adopting an innovation" indicates rejection (p.177). The implementation stage, where the innovation, such as online teaching, is put into practice, entails some degree of uncertainty. Implementers require technical assistance, support from faculty and peers, and training efforts (Shea, Pickett, & Li, 2005).

Research Questions

The aim of the present study was to examine biology and preschool student teachers' and teachers' online teaching experiences during the Covid-19 pandemic using the diffusion of innovations theory. The research questions that guided the present study were as follows:

1. What are the experiences of biology and early childhood student teachers and teachers regarding student/child participation, involvement, and interests in virtual classrooms?

2. What are the advantages and contributions of the online/distance teaching process, as perceived by the participants?

3. What are the disadvantages, problems, and challenges encountered during the online/distance teaching process, according to the participants?

4. How do the participants engage in participation and utilize teaching strategies during online lessons?

Method

Research Model/Design

In the present study, a qualitative case study design (Baxter & Jack, 2008; Yin, 2013) was explicitly used to examine the biology and the preschool school student teachers' and teachers' experiences of online teaching during the Covid-19 pandemic using diffusion of innovations theory. According to Baxter and Jack (2008), researchers can use the qualitative case study method to examine complicated phenomena in their contexts (pp. 544). Therefore, exploring student teachers' and teachers' experiences through identifying and conceptualizing different factors interacting with each other (Debout, 2016) enabled the researchers to explore the online teaching process during Covid-19 as a complex phenomenon.

Researcher Reflexivity

Given the qualitative nature of this research, it is important to acknowledge the positionality of both authors in this study. The first author is an experienced biology educator with a substantial background in teaching and research in teacher education. Similarly, the second author brings her expertise as an early childhood educator with extensive experience in teaching and research in teacher education. Both authors possess a combination of online and face-to-face teaching experience in their respective fields. The authors' diverse experiences, including online tutoring, teaching practicum, and research, played a vital role in establishing a strong rapport with the participating teachers and pre-service teachers during the data collection phase. Their positionality allowed for a deeper understanding of the relevant literature, enabling them to gain valuable insights from the data during observations and analysis. Recognizing that the authors' role as student teachers' supervisors could potentially hinder open discussion, proactive measures were taken to overcome this barrier. The authors actively worked towards establishing a collegial and supportive relationship with the participants. It was emphasized that the research sought to comprehend and learn from their experiences, rather than evaluate or criticize their teaching practices. This approach fostered a collaborative atmosphere where participants felt at ease sharing their challenges and successes. By adopting a supportive and non-judgmental stance, the authors created an environment conducive to open dialogue, ensuring that participants felt comfortable discussing their experiences without fear of

authority. This approach promoted a comprehensive exploration of the participants' perspectives and contributed to the overall quality of the research findings.

Participants, Context, and Consent to Participate

The study comprised eight senior biology teachers, four biology teachers from two different schools (with 16 to 35 years of experience), nine senior preschool student teachers, and three preschool teachers from two different schools (with 12 to 26 years of experience). The student teachers were enrolled in a teaching practicum course in their final year at an Education Faculty in the western region of Türkiye during the data collection phase. The teachers in the study supervised the student teachers throughout the teaching practicum course. In Türkiye, the teaching practicum course is typically offered to senior student teachers in faculties of education. Its purpose is to provide student teachers with opportunities to observe the school environment, apply their acquired knowledge, skills, and habits, and enhance their professional competencies in preparation for their teaching careers. The course spans 14 weeks and is conducted during the fall and spring terms, requiring eight hours per week, with six hours spent in a public school. Each student teacher is assigned a faculty member and a supervisor teacher within their specific field of study. The student teachers make weekly visits to the supervisor teachers' classrooms for six hours per week, during which the supervisor teacher assists them in gaining practical experience and shares information on their professional development with the supervising faculty member. The supervising faculty member also visits the school to observe the student teachers' teaching or microteaching sessions. However, due to school closures during the fall and spring terms of the 2020-2021 academic year, only 12th graders in high schools and 8th graders in elementary schools were allowed to attend face-to-face education, while the rest had to rely on online education. Consequently, the teaching practicum course was also transitioned to an online format. The student teachers attended classes, made observations, and contributed through online platforms such as the Educational Informational Network (EIN), Zoom, and Microsoft Teams. The researchers of the present study served as the supervising faculty members of the student-teacher participants, which facilitated systematic observations for grading student teachers and collecting data to validate their self-reported experiences with online teaching.

All participants were provided with comprehensive information about the study and its procedures. Their participation was entirely voluntary, and they had the freedom to withdraw from the study at any point without facing any negative consequences. Prior to observations and online surveys, informed consent was obtained from all participants, ensuring their agreement to participate. A labeling system was utilized to code the participants, maintaining the confidentiality of their information, and presenting the data in an easily understandable manner. The labeling system consisted of the participants' field (biology or preschool), their position (student teacher or teacher), and participant numbers. For instance, PST1 represents Preschool Student Teacher 1. Only the

researchers involved in the study had access to the research data. The study adhered to the principles outlined in the Declaration of Helsinki to ensure the ethical conduct of the research.

Data Collecting Tools and Procedure

The study utilized online surveys and researcher observations as data collection tools to gather information about the experiences of biology and preschool teachers, as well as student teachers. Researcher observation notes were collected during the teaching practicum course in the spring term of 2020-2021, while online surveys were conducted at the end of the term. Both biology teachers and preschool teachers delivered their teaching through Zoom, and researchers observed each student teacher for four sessions, each lasting 40 minutes. Figure 2 presents a screenshot from an observation of an online biology lesson.



Figure 2. Screenshot from an observation of an online biology lesson

Separate survey forms were specifically tailored for teachers and student teachers from different departments, with questions designed to target the aspects of the study objectives (refer to Table 1). This approach allowed researchers to conveniently collect data considering the constraints imposed by the pandemic. Additionally, the online surveys used in the study were developed by the researchers after conducting a literature review in the field. The question forms of other studies and the theoretical framework of Rogers' Diffusion of Innovations Theory (perceived characteristics of an innovation) were reviewed to generate online survey questions that were easy to answer and focused on revealing participants' experiences.

The data collection tool first gathered demographic information from the participants (such as age, school, professional experience, etc., as outlined in Table 1), followed by ten open-ended questions and one multiple-choice question. The surveys were distributed to participants via the

Google Forms platform, and participants were given sufficient time to respond. Table 1 presents the questions included in the online surveys, aligning with the research questions and the perceived characteristics of online teaching as an innovation.

Table 1. Questions in Online Surveys in Terms of Research Questions

	Survey questions for biology/preschool teachers	Survey questions for biology/preschool student teachers	Related perceived characteristic of online/distance teaching as an innovation
Demographic Questions	University/department you got your degree from? How many years have you been working as a biology/ preschool Teacher? What is the name of the school you teach at?	In which school do you attend teaching practice 2 course? Name of your supervising teacher at school? Name of your supervising faculty member?	
General Questions	Can you evaluate being a biology/preschool teacher in general terms during the Covid-19 pandemic? When you think from the beginning of the Covid-19 pandemic until today, how ready did you feel for distance/online teaching/how much do you feel at present? Please explain.	Can you evaluate being a biology/preschool student teacher in general terms during the Covid-19 pandemic?	
R.Q.1. Student/child participation, involvement and interests in virtual classrooms	What are your perceptions regarding student participation during the Covid-19 pandemic? Please explain. What do you think your students' perceptions of distance/online teaching are? Please explain.	In your opinion, what are the perceptions of the students in the classes you follow in teaching practicum regarding distance/online teaching? Please explain.	Complexity Trialability
R.Q.2. Advantages and contributions of the online/distance teaching process	What do you think are the advantages of the distance / online teaching process from the Covid-19 pandemic process? Please explain. What do you think are the most important advantages of biology/ preschool student teachers who continue the teaching practice course at your school during the Covid-19 pandemic, in terms of teaching practice? Do you think your online practice teaching experience has contributed to your development in terms of the teaching profession? In what ways and how?	What are the most important advantages of the teaching practicum course this semester for you?	Relative Advantages Trialability Compatibility Observability
R.Q.3. Disadvantages,	Which of the following options did you encounter difficulties while teaching during the Covid-19 pandemic?		Complexity Trialability

problems, and challenges of the online/distance teaching process	<ul style="list-style-type: none"> ○ Technical issues ○ Lack of support from parents ○ Ensuring student participation ○ Maintaining social interaction with students, parents, and school ○ Differentiating classroom activities 	<ul style="list-style-type: none"> ○ Online/distance teaching ○ Online/distance assessment ○ Giving feedback ○ Presenting new learning content ○ Teaching motivation ○ Lack of support from school management ○ Lack of support from colleagues ○ (Other) 	Compatibility Observability
When you think from the beginning of the Covid-19 pandemic until today, what are the most important challenges in your online teaching experience? Please explain.	When you think from the beginning of the Covid-19 pandemic until today, what are the most important challenges in your online teaching practicum experience? Please explain.		
What do you think are the most important problems that biology/preschool student teachers who continue their teaching practicum course at your school may experience in the name of teaching practice during the covid-19 pandemic process? What are the problems that hinder productivity?	What do you think are the problems that hinder productivity in the teaching practicum course this term?		
R.Q.4. Participation and teaching strategies during the online/di lessons	What are the strategies you use to reach all your students and ensure their participation during the Covid-19 pandemic? Please explain.		Trialability Compatibility Observability

Data Analysis

Prior to organizing the data in the study, the participants' responses to the questions were downloaded from the online form tool and edited. In this study, online learning experiences were considered as an innovation for students, student teachers, and teachers. The collected data from the participants were analyzed based on the "Perceived Characteristics of the Innovation" dimensions of the Diffusion of Innovations Theory, which is widely recognized in the literature (refer to Table 1). The qualitative data analysis was conducted in line with the four dimensions specified in the research objectives, taking into account the perceived characteristics of the innovation components: relative advantage, compatibility, complexity, trialability, and observability.

The analysis employed content analysis, descriptive analysis, and thematic coding methods. In the qualitative analysis process, the following steps were followed: creating a framework for descriptive analysis, processing the data according to the thematic framework, defining the findings, and interpreting the findings, as outlined by Yıldırım and Şimşek (2008).

Initially, initial codes were generated based on the perceived characteristics of the innovation components. These initial codes were then reviewed and combined in accordance with the research questions. Categories and subthemes were created based on the participants' responses. Finally, the themes were interpreted and supported by both observation notes and participants' excerpts. In some instances, participants' responses provided additional information beyond the specific question asked. These responses were cross-coded and analyzed in relation to relevant questions. Consequently, certain excerpts in the findings section may cover additional data pertaining to other research questions.

Validity and Reliability

In order to enhance credibility in line with the qualitative nature of the research, information meetings were conducted with student teachers and teachers via Zoom, aiming to establish a trusting relationship. This approach aimed to elicit accurate and comprehensive answers from the participants. Credibility was further ensured by providing a clear explanation of each step in the research process. Additionally, researcher observations during the student teachers' teaching activities contributed to confirmability, reducing bias and limitations associated with self-report surveys. When presenting the findings, participant statements were provided as examples to provide a more detailed understanding of their responses. The data were separately analyzed by a specialist in biology education and a specialist in preschool education. The themes, codes, and categories derived from the analysis were then discussed to reach a final consensus. Finally, the authenticity of the study was upheld by linking the findings with existing literature in the field, thereby establishing a connection between the study's outcomes and previous research.

Results

The findings and discussion section presents the participants' responses to the research questions, analyzing them from four different perspectives and discussing the findings in relation to existing studies. Prior to examining these perspectives, an overview of the participants' views on being a teacher or student teacher during the pandemic and their readiness for online teaching was attempted through two general questions. When asked to evaluate their experience of being a teacher or student teacher during the pandemic in general terms, most participants described it as challenging for various reasons. Biology teachers found it difficult because students asked numerous health-related questions during biology lessons, assuming that teachers possessed all the answers (N=3), and they were not adequately prepared for online teaching (N=1). Preschool teachers (N=3) also perceived this process as challenging because they believed online teaching did not align with the nature of preschool education (N=2), and national education practices made them feel excluded (N=1). Six out of eight biology student teachers considered this process to be demanding. They cited reasons such as a preference for face-to-face teaching practice rather than online (N=3), the substantial effort required

(N=2), and the decreased lesson effectiveness due to students not activating their cameras or responding to questions (N=1). The remaining two biology student teachers acknowledged that although the process initially seemed difficult, they considered the experience gained to be valuable and productive. All nine preschool student teachers found the process challenging due to difficulties in effective communication and classroom management with children (N=8), and the inability to make practical preparations for their profession (N=1). Regarding their preparedness for online teaching, all participants, except for one preschool student teacher who felt completely ready, fell into two categories: those who were initially unprepared but now felt more prepared (N=14), and those who were not ready at the beginning and still did not feel prepared (N=9).

Student/Child Participation, Involvement and Interests in the Virtual Classrooms

This subsection aims to explore the experiences of participants regarding the complexity and trialability of the online teaching process during the pandemic. The involvement and interest of students/children in lessons are crucial factors that can influence teachers' acceptance and implementation of online teaching as an innovative approach. Participants' responses to the first question in this subsection, which pertains to participation, revealed that 15 out of 24 participants reported low levels of student participation. The remaining nine participants noted that student participation varied based on factors such as technical resources, family support, activity type, class level, school, and other variables. These factors will be further discussed in the subsequent subsection focusing on problems and challenges. With regard to student/child involvement and interest, three sub-themes emerged, as illustrated in Table 2.

Table 2. Student and Child Involvement and Interests in the Virtual Classrooms

Themes	Subthemes	Categories	<i>f</i> (categories)	<i>f</i> (subthemes)	Quotes
Complexity Trialability	Positive student/child interests	Interested/enthusiastic/c urious	4 (PST1,2,3, PT3)	12	“...students who attended showed very efficient and effective participation in online education.” (PST3)
		skilled	1 (PST6)		
		adapted	5 (BST2, BT3, PST3, 5, 6)		
	having fun	2 (PST9, PT3)			
	Diversified student/child interests	depending on the teachers’ efforts	2 (PST4,6)	4	
		depending on the students’ willingness	2 (BT2,3)		
Negative student/child interests		not adapted	7 (BST1,5,6,8, PST7, PT1,2)	29	“...”I think students were not very involved in this process.” (BT1) “...”The children constantly asked when the school
		not taking seriously	5 (BST4,5, BT1,2, PST4)		
		not having fun	2 (PST8, PT2)		
		lack of socialization	3 (BT2, PST7, PT1)		

poor attention span	6 (BST3, BT4, PST 2,4,6,8)	<i>would open. They certainly did not want to be online.” (PT1)</i>
distracted	5 (BST 2,4,8, BT4, PST5)	
shy	1 (PST1)	

PST=Preschool Student Teacher, PT=Preschool Teacher, BST=Biology Student Teacher, BT=Biology Teacher

As depicted in Table 2, the participants' statements regarding student/child involvement and interests in virtual classrooms were examined, resulting in three sub-themes: positive (f=12), diversified (f=4), and negative (f=29) student/child interests. These categories revealed that both positive and negative interests were expressed by participants across various classes, teachers, and schools. Preschool student teachers noted equal instances of positive and negative interests among children in their classrooms, including expressions of curiosity, enthusiasm, and skill. In the "diversified student/child interests" sub-theme, some preschool student teachers highlighted the efforts of the teachers, while biology teachers emphasized the willingness of students. It is worth noting that participants predominantly emphasized negative interests, such as students being easily distracted and not taking online lessons seriously. For instance, BST4 expressed, "Since the students I observed in the 9th and 11th grades were not tested to pass the biology course during this process, I believe they are not interested and do not take the online education process seriously." Additionally, in preschool, children's developmental characteristics, such as a limited attention span, contribute to their difficulties in sitting in front of a screen for extended periods. Observer notes also supported this observation, highlighting that student participation and interest were hindered in preschool classes due to the ongoing development of skills such as listening, waiting in line, and remaining still. In biology classrooms, interest and participation were reported to be higher during lessons that involved solving calculation questions or discussing current topics like the pandemic, whereas interest was considerably lower at other times. Although the reasons may differ, the negative interests of students and children appeared to be similar in preschool and biology lessons.

The findings of this aspect indicate that students' participation in online classes was lower than anticipated, and their interests in virtual classrooms were predominantly categorized as negative due to students' perceived lack of seriousness and high levels of distraction. These findings align with previous research, such as a study conducted by Gustia and Suhartini (2021) in Indonesia, which found that high school students' interest in biology during online classes decreased significantly. Another study by Erumit et al. (2021) involving science student teachers in Türkiye highlighted the lack of interaction between teachers and students in online science education, resulting in decreased motivation and interest. In early childhood virtual classrooms, a mix of negative and positive behaviors was observed, with the primary challenge stemming from developmental characteristics such as limited attention span, the need for active and hands-on learning, and requiring assistance in

using digital tools. The low participation and negative categorization of interests among students and children in virtual classrooms can be seen as factors that contribute to the complexity and reduced trialability of the online teaching process. Consequently, these factors, resulting from children's participation challenges across different classes, negatively impact the adoption rates among teachers and student teachers. When an innovation and its implementation are perceived to have high complexity and lack trialability, prospective adopters may be more likely to reject or question them.

Advantages and Contributions of the Online/Distance Teaching Process

This subsection aims to explore participant experiences regarding the relative advantages, trialability, compatibility, and observability of the online teaching process during the pandemic. To collect data on the advantages and benefits of the online/distance teaching process, each participant was asked three questions, two of which were common, and one specific to either teachers or student teachers. These questions sought participants' opinions on the advantages of online teaching during the Covid-19 pandemic and its contributions to their professional development in the field of education. The participants' responses to these questions were analyzed collectively, leading to the identification of six sub-themes. The findings pertaining to this aspect are presented in Table 3.

Table 3. Advantages and contributions of the online/distance teaching process

Themes	Subthemes	Categories	<i>f(categories)</i>	<i>f(subth.)</i>	Quotes
Relative Advantages		learning about web 2.0 tools	1 (BST7)	22	<i>"If we were in a normal process, I wouldn't have had any experience with how to do distance education. But I experienced the online teaching process during the pandemic process."</i> (BST1)
		gaining online teaching experience	8 (BST1,3,4,5,8, PST1,2, PT1)		
Compatibility	Technology-related	increasing online communication skills	5 (BST1,4,6,7, PST1)	27	<i>"We had experience with children on how to handle and conduct the distance education process. It allowed us to use teaching techniques and how we can be efficient in online education for children."</i> (PST2)
using more technology in teaching		8 (BST1,3,5, BT1, PST1,2,3, PT2)			
gaining a different perspective		4 (BST3,4, PST, 4,6)			
Observability	Teaching profession-related	learning to cope with difficult times	3 (BST3, PST6,7)	8	<i>"...teachers push their own limits on classroom management or coursework within limited opportunities and try to improve themselves in this regard..."</i> (PST7)
		teaching motivation	1 (BST6)		
		teaching skills	10 (BST2,3,4,5,8, PST5,6,7,9)		
		creativity	1 (PST1)		
Child/student-related		knowing students/children	4 (BST1,3,6, PST4)	8	<i>"The participation of conscious, ready-to-learn students who only want to learn prevents the flow of the lesson from being disrupted and provides full motivation. In</i>
		classroom management	4 (BST2,4, PST7,9)		
		Continuity of communication	6 (BT3, PST1,2,3,4,8)		
		children prone to technology makes teachers' job easier	1 (PST7)		

	attendance of interested students	1 (BT2)		<i>this way, although the duration of the lesson is 30 minutes, it is used very efficiently." (BT3)</i>
Economic	time	5 (BT1,2,3, PST6, PT3)	7	<i>"The online internship period had some advantages. These were profits from time and distance. I spent the time at home on the computer instead of traveling. It was advantageous that he did not cause financial difficulties..." (PST1)</i>
	money	2 (PST6, PT3)		
Personal	working at the same time	3 (BST4,6, PT3)	5	<i>"From my point of view, it is easier to be involved in the processes online since I am also a nurse at the hospital. If the lessons were face-to-face, the process would have been more difficult for me." (BST4)</i>
	being with the family	1 (PST8)		
Covid-19 related	studying from home	1 (PST5)	4	<i>"I think the only advantage is that the risk of disease transmission is reduced." (PT2)</i>
	reduced infection rate	3 (BST6, PST9, PT2)		
	social distancing	1 (BST6)		

PST=Preschool Student Teacher, PT=Preschool Teacher, BST=Biology Student Teacher, BT=Biology Teacher

When examining Table 3, the participants' expressions regarding the advantages and contributions of the online/distance education process are primarily categorized into two sub-themes: "technology-related" and "teaching-profession related." It is worth noting that the technology-related advantages also encompassed the development of the teaching profession in terms of technology. Another noteworthy point is that none of the teachers mentioned teaching profession-related advantages apart from technological benefits. In other words, teacher participants did not perceive online teaching as contributing to their professional growth. However, despite the challenges, student teachers emphasized the contribution of online/distance teaching experience to their professional development in various teaching-related categories, including technology.

The other prominently expressed sub-themes in this section are "child-student related" and "economic." Under the child/student related advantages, the continuity of communication even during lockdowns emerged as a significant factor. Economic advantages were highlighted in terms of saving time and money in the distance education process.

The final sub-themes in this section are "personal" and "Covid-19 related." Under personal advantages, participants mentioned various situations such as working simultaneously, being available for sick family members, and a reduced risk of infection.

This dimension revealed that teachers and student teachers primarily emphasized gaining experience in technological and technology-related teaching aspects, as online/distance education during the Covid-19 pandemic necessitated such skills. Similar benefits were reported in Bailey and Lee's (2020) study with English as a Foreign Language Instructors in South Korea, including improved knowledge, increased familiarity with technology, and enhanced CV credentials. Burke and Dempsey (2020) also found advantages for teachers, such as saving time and gaining practical

expertise in the digital learning realm to create resources and lesson plans. Bakioğlu and Çevik (2020) reported positive aspects of the process in their study with Turkish science teachers, such as discovering different applications, utilizing online platforms, and increasing technology usage time. Similarly, in a study conducted with Turkish biology teachers by Karakaya, Arık, Çimen, and Yılmaz (2020), independent time and location, live course schedules, and enriched content and materials were emphasized as positive aspects. Time-saving during activities was also highlighted in Sarıoğlu et al.'s (2020) study, along with laboratory safety and reinforcement of topics.

Furthermore, another study by Ünal and Bulunuz (2020) drew attention to the benefits of keeping students connected to school and reducing their anxiety. These studies, along with the present study, align with pre-Covid-19 research on the advantages of online/distance learning. One of the most significant advantages of a process like this, both for pre-service and in-service teacher education, is the opportunity to enhance digital competence (König et al., 2020). Some studies suggest that understanding the benefits of technology and adopting it are closely related, and sharing experiences can facilitate the adaptation of hesitant teachers to this process (Sangeeta & Tandon, 2020).

When evaluating the participants' experiences regarding the advantages of online teaching as a whole, it can be observed that student teachers tend to perceive and experience the relative advantages of the process more than the teachers. This discrepancy can be attributed to the incompatibility of online teaching with teachers' past experiences of primarily face-to-face instruction over many years. Additionally, teachers' lack of eagerness to recognize the relative advantages of the innovation could decrease observability for them. Conversely, for student teachers, it created an opportunity for trial, which may explain the difference in their adoption of innovation compared to the teacher group.

Disadvantages, Problems, and Challenges of the Online/Distance Teaching Process

This subsection aims to explore participant experiences regarding the complexity, trialability, compatibility, and observability of the online teaching process during the pandemic. To gather data on the disadvantages, problems, and difficulties of online/distance teaching, participants were initially presented with a multiple-choice question regarding potential challenges they may have encountered. Subsequently, they were asked to elaborate on the most significant challenges they faced. Table 4 provides the frequencies and percentages of participants' choices for the presented challenges.

Table 4. Challenges of the online/distance teaching process

Challenges encountered in online teaching process	Participants (N=24)				Total f
	Biology		Preschool		
	ST (N=8)	T (N=4)	ST (N=9)	T (N=3)	
Technical issues	7	4	8	2	21
Lack of support from parents	3	3	5	2	13
Ensuring student participation	4	2	5	2	13
Maintaining social interaction with students, parents, and school	4	3	4	2	13
Differentiating classroom activities	2	2	4	3	11
Online/distance teaching	4	2	3	2	11
Online/distance assessment	5	3	1	2	11
Giving feedback	4	2	1	1	8
Presenting new learning content	2	1	3	1	7
Teaching motivation	2	1	2	2	7
Lack of support from school management	3	1	3	-	7
Lack of support from colleagues	2	-	2	-	4
(Other) Classroom management	-	-	1	-	1

PST=Preschool Student Teacher, PT=Preschool Teacher, BST=Biology Student Teacher, BT=Biology Teacher

According to Table 4, technical issues were the most encountered challenge by nearly all participants. This was followed by a lack of support from parents, ensuring student participation, and maintaining social interaction with students, parents, and the school. Interestingly, all biology teachers reported facing challenges related to technical issues, while all preschool teachers identified challenges in differentiating classroom activities.

When participants were asked to elaborate on the most significant problems they faced during the online/distance education process, technical issues emerged as the primary concern. These issues included internet disconnection, video or sound problems, system malfunctions, power cuts, and students having limited access to computers within their families. For example, BST7 expressed, "The most common situation in the lesson was the internet and the devices used suddenly causing trouble. Then there is no immediate response from the students to the questions."

Preschool student teachers and teachers, on the other hand, highlighted difficulties related to the lack of support, particularly from parents. They pointed out that parents did not assist in preparing the necessary materials and lacked dedication and awareness. PST7, a preschool student teacher, explained, "The most important problem I experienced in the distance teaching process during the pandemic was the missing support from the parents. There were problems such as missing materials or not being prepared by the parents before the activities we were going to do." Research also supports the notion that young children or school-age students may have limited online access or experience with online learning tools, such as computers (Fedynich, 2013; Wedenoja, 2020)., and their online learning requires adult supervision and involvement (Schroeder & Kelley, 2010; Youn et al., 2012).

The findings regarding the disadvantages, problems, and challenges of online/distance learning reported by participants indicate that technical issues, lack of support (especially from parents), limited student participation, and social interaction difficulties were significant concerns.

These issues are consistent with previous studies on online/distance education during the Covid-19 pandemic. Technical issues and the lack of healthy student interaction have been commonly reported (Durak & Çankaya, 2020; Erümit et al., 2021; Muhammed & Kainat, 2020; Noor, Isa, & Mazhar, 2020; Sariođlan et al., 2020; Ünal & Bulunuz, 2020). Muliadi et al. (2021) attributed the ineffectiveness of online learning to student teachers' lack of adequate preparation for the online learning process. Difficulties in understanding courses that involve technical terms and practical applications were also mentioned as challenges (Erümit et al., 2021). Challenges reported in Pakistan included high-cost internet packages, uncooperative attitudes of learners, reduced cooperation from students and families, low student attendance, teacher technology confidence, limited availability of educational e-resources, lack of ICT knowledge, and poor network infrastructure (Noor et al., 2020).

Considering these challenges collectively with the present study findings, it is evident that the online teaching process during the Covid-19 pandemic posed numerous challenges for teachers and student teachers across different grades, schools, and countries. These challenges highlight certain perceived characteristics of immediate online teaching, such as complexity and trialability, as they heavily rely on negative experiences and difficulties. They may also hinder observability, making it challenging for decision-makers to effectively assess the net benefits and positive aspects of the innovation. Furthermore, these challenges may reduce the expected net benefits of the innovation in terms of compatibility, as integrating immediate online teaching into existing teaching practices requires additional effort from decision-makers.

Participation and Teaching Strategies During Online Lessons

The purpose of this subsection is to investigate how participants experienced the compatibility, trialability, and observability of the online teaching process during the pandemic. To collect data on participation and teaching strategies employed by student teachers and teachers in online lessons, participants were asked about the specific strategies they utilized to engage all their students/children and ensure their active involvement. Additionally, they were encouraged to propose various solutions to optimize the online teaching process. The responses provided by the participants were analyzed collectively, resulting in the identification of three sub-themes. The findings pertaining to this aspect can be found in Table 5.

Table 5. Participation and Teaching Strategies During Online Lessons

Themes	Subthemes	Categories	<i>f</i> (<i>cat.</i>)	<i>f</i> (<i>subth.</i>)	Quotes			
Trialability Compatibility Observability	Participation strategies	Increasing accessibility	9 (BST2, BT2, PST1,2,3,7,9, PT2,3)	24	"First, everyone needs to have internet and either a phone, tablet, or computer; this is the hardest part. After getting this solution, I would prepare interesting activities that they were wondering what to do the next day and, in this way, I would ensure their active participation in the lessons." (PST1).			
		Informing/ communicating parents	8 (BT1,2, PST3,4,8,9, PT1,3)					
		Solving technical issues	3 (BST2,7, PST4)					
		Imposing sanctions	1 (BST7)					
		Turning on the cameras	1 (BST5)					
		Providing children with special studying areas	1 (PST7)					
		Keeping the love of school alive	1 (PT3)					
		Teaching strategies	Making student active			6 (BST1,2, PST 1,2,5, PT3)	33	"I think that participation can be achieved if students have sufficient opportunities to attend the course and there are no technical difficulties. In this process, the priority should be to make lesson plans that will enable the student to be active, instead of making a lesson plan where the teacher teaches only. To turn this process into an advantage, technology can be used to plan events in where everyone can actively participate. Web 2.0 tools can be preferred." (BST2)
	Using web 2.0 tools		5 (BST2,3, PST5,8,9)					
	Interesting/rich activities		5 (BST7, PST1,6,7,8)					
	Solving tests		2 (BST3,8)					
	Making quizzes		2 (BST4,8)					
	Assigning homework		2 (BST8, BT4)					
	Producing/sharing video content		2 (PST2, PT3)					
	Assigning performance tasks		2 (BT3, PT2)					
	Asking more questions		2 (BT1,4)					
	Using visuals		1 (PST5)					
	Activities to increase persistence (of the information)		1 (PST6)					
	Simplified activities		1 (BST1)					
	Making jokes		1 (BT1)					
	Playing games		1 (BST3)					
	Other strategies as suggestions		Learning more about online tools during teacher education	4 (BST7, PST 3,4)	11	"...student teachers must learn online distance education and hybrid education models and make applications in this regard." (PT1) "The online education system used should be improved, it should be a more user-friendly system so that parents can easily benefit from it." (PST2)		
			Visiting schools (for student teachers) teaching more	2 (BST2, BT1)				
		Development of the system used	2 (BT2, PST9)					
Asking everything to the supervisor teacher		2 (PST1,8)						
			1 (BST8)					

PST=Preschool Student Teacher, PT=Preschool Teacher, BST=Biology Student Teacher, BT=Biology Teacher

The findings presented in Table 5 highlight the participation and teaching strategies employed by participants. These strategies encompassed ensuring student and children's engagement in lessons, utilizing various teaching approaches during online sessions, and offering suggestions for improvement. The participants' responses often encompassed both participation and teaching strategies since they were inquired about together. Regarding participation strategies, the sub-theme emphasized

accessibility and communication, particularly within the preschool field. For instance, PST4 emphasized the significance of communication with families, stating that "Communication with families is crucial. Since it is online, they have much work to prepare before the activities." This aligns with the findings of König et al.'s (2020) study, where German teachers stressed the importance of maintaining communication with students and parents. Accessibility was also highlighted in studies conducted in developing countries like Bangladesh, Pakistan, and Türkiye (Alam, 2020; Bakioğlu & Çevik, 2020; Noor, Isa, & Mazhar, 2020). As mentioned earlier in the challenges sub-theme, limited access to technological equipment and internet connectivity issues significantly impacted student participation. To address these participation challenges, Mershad and Said (2022) proposed a tool called DIAMOND for monitoring student participation in online lessons.

Regarding teaching strategies, participants emphasized strategies that promote active student involvement, the use of web 2.0 tools, and the development of engaging and enriching activities. Observation notes from virtual biology classes revealed that six out of eight biology student teachers utilized web 2.0 tools such as Kahoot, Wordwall, Quizziz, LearningApps, and one student teacher used YouTube videos in their lessons. Although participants mentioned web 2.0 tools less frequently in their statements, their self-reported experiences and online lesson observations indicate the utilization of these tools as teaching strategies in online biology classes.

In preschool virtual classrooms, all preschool student teachers were observed implementing strategies suitable for early childhood education, aiming to enhance the learning environment and capture children's attention through auditory and visual aids. Digital books, interactive software, web 2.0 tools, finger games, and physical games were frequently incorporated in virtual classrooms (refer to examples in Fig. 3). Nieto-Escames and Roldan-Tapia (2021) also highlighted the prominence of gamification strategies in STEM education during the Covid-19 pandemic, as they offer promising avenues for improved learning, teaching, and collaboration among students. However, none of the preschool participants in this study explicitly mentioned using games as a teaching strategy, and only a limited number of participants referred to digital teaching tools. This suggests that while preschool teachers and student teachers may have incorporated games and digital teaching tools as part of interesting and enriching activities, they were not explicitly highlighted in their responses when considering the frequency of these categories.

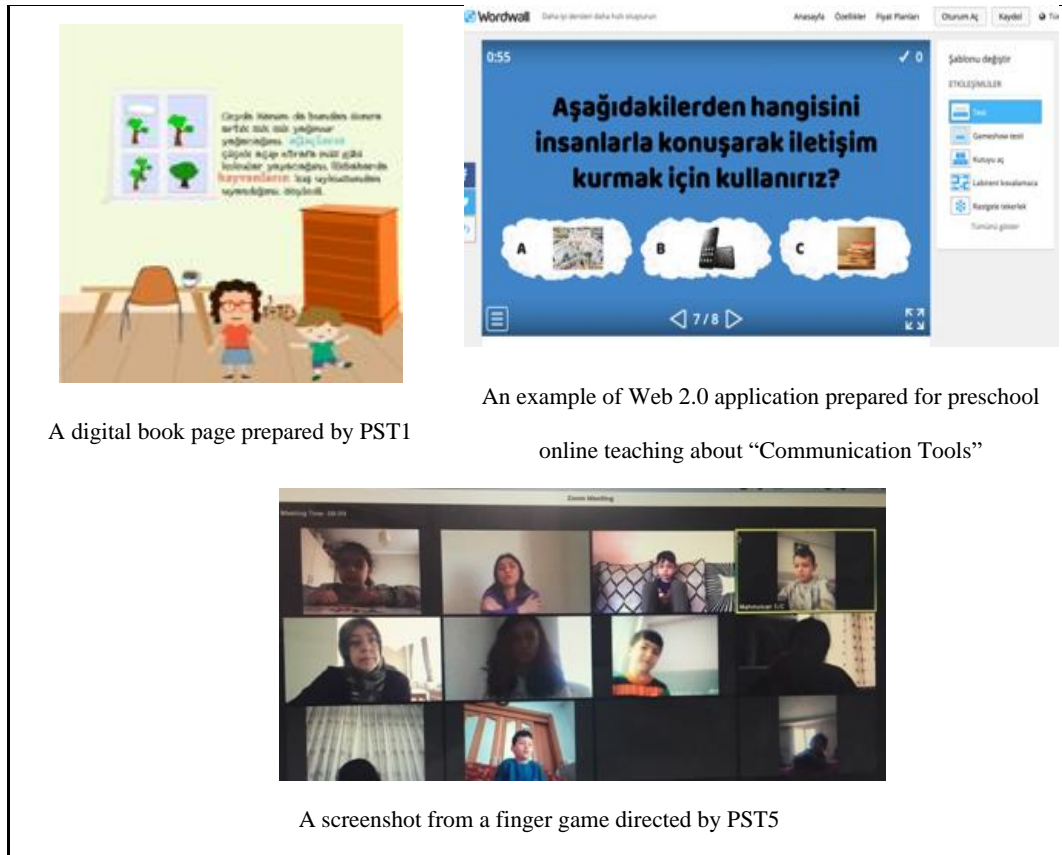


Figure 3. Examples of preschool virtual classroom activities

Some participants suggested that teacher education programs should include more training on online tools to better equip educators with the necessary skills. Here are some excerpts related to participation and teaching strategies:

"I prepared weekly activity files for each child, gave the parents a designated time, provided them with the files, and even delivered them to those who lived far away. I shared daily morning sports videos and links. I called or texted the parents of children who were absent for 2-3 consecutive days. I also had video calls with the kids from time to time. I planned online lessons with engaging activities, always striving to keep the child's love for school alive." (PT3)

"It might be motivating to have different assessments at the end of the topic since no exams are being administered to the students. In our classes, we found that using applications like Kahoot, Quizziz, and LearningApps captured students' attention." (BST4)

Studies indicate that traditional classroom participation methods have transformed due to the widespread adoption of internet-based distance education during the Covid-19 pandemic and the associated quarantine measures (Dwivedi et al., 2020). Vijayan (2021) mentioned in a review study that pedagogical strategies for online teaching had already been established before the pandemic, but the crisis expedited their implementation on a larger scale. In the present study, participants mentioned

various teaching strategies to facilitate participation and enhance online teaching; however, these strategies were mentioned with limited frequency. This finding suggests that both teachers and student teachers faced challenges in adapting online classroom activities to promote participation and effective teaching. Smith and Schlaack (2020) highlighted a similar challenge in their study on elementary student teachers' use of questioning, feedback, formative assessment, and technology engagement strategies. They found that student-teacher interactions were insufficient to motivate students to participate in class discussions, and more student-student interactions were needed. Student teachers in their study also faced difficulties with feedback, formative assessment, and technology use, as their knowledge primarily relied on face-to-face settings. Their conclusions emphasized the need for learning how to multitask while using technology. Other studies have documented teachers' use of various strategies. For instance, Lestiyawati and Widyantoro (2020) conducted a study with junior and senior high school teachers, finding that teachers primarily used online video conferences and online chat, combining these strategies in their online classes. Ametepe and Khan (2021) interviewed physics teachers about their teaching strategies during the pandemic and found that effective strategies included online live demonstrations, recorded lectures, additional tutoring sessions, participation credits, online breakout sessions, and modified labs.

Overall, the selection and implementation of diverse strategies to enhance participation and online teaching are influenced by teachers' perceptions of observability, trialability, and compatibility with the innovation. When evaluating the strategies used by participants (as observed in observation notes) or mentioned by them (based on self-report experiences) in online teaching, it can be inferred that their perceptions regarding the adoption of practices related to this innovation are positive.

Discussion, Conclusion and Recommendations

In response to the COVID-19 pandemic, teachers in school systems have had to quickly adapt to the practice of online teaching. The diffusion of innovations theory suggests that the higher the relative advantages, observability, trialability, and compatibility of innovation, the higher its rate of adoption. However, the complexity of an innovation tends to decrease its adoption rate. Considering the Covid-19 online teaching process as an innovation, the present study aimed to examine the online teaching experiences of biology and preschool student teachers' and teachers' during the Covid-19 pandemic, using the perspectives of diffusion of innovations theory. In this respect, the following results emerged from the four dimensions explained in the findings section:

The findings from this study confirm previous research and provide additional evidence that student participation and interest in online classes during the pandemic have decreased, lower than expected, and rely on mutual efforts. Previous studies have shown that recognizing children's learning styles, creating a positive environment, and utilizing various learning methods with teacher and parent collaboration can enhance children's interest and motivation in online learning settings (Alamri et al.,

2020; Chiu, 2021; Fauziddin, Mayasari, & Rizki, 2021; Robinia & Anderson, 2010; Xie & Ke, 2011; Vonderwell et al., 2007). The study also concluded that involving all students in online settings is challenging for teachers and student teachers due to the differences in classroom participation methods compared to traditional classrooms. These findings highlight the importance of student participation, involvement, and interests in the online teaching process, aligning with the complexity and trialability aspects of the diffusion of innovations theory. The challenges identified in this study contribute to the perception of online education as a complex and less applicable innovation. However, efforts focused on increasing student involvement, participation, and interest through diverse strategies have the potential to reduce the complexity of online teaching, increase its trialability, and indirectly raise the adoption rate of online teaching as an innovation.

Regarding teaching strategies, it was seen in self-report experiences and observations that participants made positive efforts utilizing their technical knowledge and experience to maximize the benefits of online teaching. However, they expressed a need for more knowledge and experience in online teaching, both in pre-service and in-service teacher education processes. It is evident that teacher education programs should go beyond traditional methods to incorporate online teaching courses that enrich the learning process. Research indicates that novice and prospective teachers face difficulties when lacking online teaching experience, highlighting the need for additional training in pre- and in-service education (Bailey & Lee, 2020; Dwivedi et al., 2020; Gözüm & Demir, 2021).

This study contributes to the existing literature on the advantages of online teaching experiences during the COVID-19 pandemic. Teachers and student teachers emphasized the benefits of gaining experience in technological and technology-related teaching issues. Taken together, most of the participants, particularly student teachers, viewed the transition to online teaching as an opportunity to develop their technology-based teaching skills. The increase in technology literacy resulting from this compulsory transition is also supported by various studies (e.g., Erbaş, 2021; Erumit et al., 2021; Bakioğlu & Çevik, 2020). However, the incompatibility of online teaching with the prior experiences of teachers and student teachers who have extensive face-to-face teaching and learning backgrounds might explain the difference in the perception of relative advantages between the two groups. Teachers were less eager to comprehend the benefits of online teaching for their profession, leading to decreased observability. In contrast, student teachers viewed online teaching as a chance to practice and develop their teaching experience in new ways. Therefore, the adoption of online teaching differs between teachers and student teachers, indicating varying adoption rates.

The online teaching process in the Covid-19 pandemic, characterized by its immediate transition, unpreparedness, and undetermined duration, presented numerous challenges for teachers and student teachers. The difficulties and disadvantages expressed by participants align with those mentioned in previous studies., with technical problems being a significant commonality. One of the

significant commonalities of these studies, including this one, is technical problems, and particularly developing countries have suffered from technical problems. However, the challenges related to parental support highlighted in this study should be examined from two perspectives: the need for parents to support the online teaching process and the necessity of providing technical support, especially for preschool children in online environments. Lack of support from parents and technical barriers pose challenges to participation, teaching quality and evaluation, affecting educators' perceptions of the complexity of online teaching. Experienced challenges and difficulties can be considered as characteristics that may affect educators' perceptions of the complexity of online teaching. In addition, these barriers can reduce trialability and observability, hindering participants' ability as decision-makers to accurately assess the clear advantages and positive features of innovation. They can also influence the expected net advantages of an innovation in terms of compatibility because instant online teaching demands more attention from the decision maker to adapt their teaching practices to the new situation.

Despite its exploratory nature, this study provides insights into the adoption of the online teaching and learning process as an innovation among teachers and student teachers. The findings suggest that student teachers have a higher perception of adopting and applying online teaching as an innovation compared to teachers. The study's focus on preschool and biology education, which are distinct fields, revealed that participants' experiences did not significantly differ in terms of adopting the innovation. This study offers important suggestions for the field of education and policymakers, emphasizing the need to increase the relative advantages of online teaching, minimize its disadvantages, and be prepared for similar situations. Improvements such as incorporating online lesson planning and management courses in teacher education programs and providing in-service training can enhance educators' knowledge and experiences in online teaching. Such steps will also contribute to teachers and student teachers' adopting online education as an innovation. In addition, parent collaboration emerged as a crucial factor, suggesting the need for further research on the role of parents in online learning environments. Engaging stakeholders from various fields would provide valuable data for a deeper understanding of online teaching and learning.

Policy Implications

Based on the study's findings, it is suggested that education systems prioritize the following strategies to enhance the efficacy of online instruction as an innovation:

Firstly, they should focus on boosting student participation, involvement, and interest. This can be achieved through recognizing and accommodating diverse learning styles, cultivating positive learning environments, and fostering collaboration between educators and parents, especially in the case of preschool children. Policymakers and educators should actively explore ways to engage parents in supporting online teaching, leveraging further research and initiatives to harness the

valuable role parents can play in online education. Moreover, efforts should be concentrated on aligning online teaching with the prior experiences and needs of both teachers and student teachers. Making online teaching more compatible with their backgrounds can enhance its adoption. Additionally, it's crucial to enhance the visibility of the benefits and positive aspects of online teaching to encourage its adoption. To equip educators with the essential skills for effective online instruction, both pre-service and in-service teacher education programs should seamlessly integrate online teaching courses. These courses are indispensable in addressing the challenges faced by novice and prospective teachers and in supporting the development of technology-based teaching skills. Furthermore, education systems need to prioritize the resolution of technical issues in online teaching. This includes tackling technical barriers and providing robust technical support to educators and students alike. Ensuring equitable access to essential resources and support systems, such as reliable internet/Wi-Fi connections and appropriate equipment, is pivotal for a successful online learning experience. Consequently, investment in a resilient technological infrastructure is imperative to facilitate seamless online teaching and learning.

Conflict of Interest

All authors declare that they have no conflicts of interest.

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Ethical Statement

This study was performed in accordance with the Declaration of Helsinki and the Nuremberg Code. All adult participants provided written informed consent to participate and for publishing identifying details in this study.

Credit Author Statement

Author 1: Conceptualization and Methodology, Writing- Original draft preparation, Visualization, Investigation, Data Curation, Formal Analysis, Writing - Review & Editing, Validation.

Author 2: Conceptualization and Methodology, Writing - Original draft preparation, Visualization, Investigation, Data Curation, Formal Analysis, Writing - Review & Editing, Validation.

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