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Examination of Digital Literacy Levels of Science Teachers in the Distance Education Process

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Abstract

Digital literacy skills could make important contributions to teachers' learning and teaching process and professional skills. The purpose of this article is to examine the level of science teachers' digital literacy skills in terms of gender and the duration of professional experience. The sample of the study consisted of 88 science teachers working in various districts of Turkey. Digital literacy scale and distance education evaluation interview form were used as data collection tools. The results showed that, no statistically significant difference was found in the digital literacy levels of female and male science teachers. However, digital literacy of teachers with less professional experience is more positive than teachers with more professional experience. Also, science teachers mostly prefer lecturing during distance education. The results show that distance education should be strengthened in terms of infrastructure, implementation, quality in Turkey. Within the scope of the research, it was suggested to organize various trainings to improve the digital literacy levels of teachers, to enrich the content of EBA used in the distance education, and to increase the in-service trainings to improve the distance education skills of teachers.

Keywords: Coronavirus pandemic, digital literacy, distance education, science teachers

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Introduction

Throughout history, various disasters have emerged that have destroyed living life. The latest of these disasters was the Coronavirus pandemic, affecting the whole world at a global level. Accordingly, it was decided to temporarily close schools and learning areas. This affected 94 percent of the world's student population, up to 99 percent in low- and middle-income countries (UNESCO, 2020). As an alternative to face-to-face education, countries have decided to urgently transform the teaching process into distance education (DE) so that the crisis could be managed and education was not interrupted.

DE is defined as the web-based delivery of education with the support of internet technologies. Students are distinct from teachers in terms of time and place in the planned and organized learning and teaching process (Newby, Stepich, Lehman & Russell, 2006). DE is an educational field that focuses on teaching methods and technology to provide teaching on an individual basis to students which are not physically present in traditional educational environments such as classrooms (Bušelić, 2012). According to UNESCO (2002), DE has many technical, social and economic advantages and pedagogical values. Accordingly, DE reveals different ways of knowledge production and acquisition. DE supports the quality and diversity of existing educational structures and strengthens existing capacity. DE provides easy access to many technologies from home. DE, due to its flexibility, allows students to participate in lessons individually at any time (Franklin, Yoakam & Warren, 1996).

In order to ensure the continuity of education in the world, some countries have taken measures such as equipping schools with digital platforms and tools for DE, lending digital devices to less well-off students, and educating school staff about DE methodology and techniques (Schleicher, 2020). In Turkey, it has been decided to continue DE practices through TV channel and Education Information Network (EIN), an online social education platform offered free of charge to students by the General Directorate of Innovation and Educational Technologies. DE courses generally consist of basic courses (Turkish, mathematics, science, history). Therefore, it is seen that not all teachers at all levels of education are included in DE. Thus, it is important to determine science teachers', who are participating in DE, views toward DE.

The most important issue related to DE is the readiness of teachers for DE. For as much as many studies prove that educational initiatives fail because of teacher's beliefs and practices (Niederhauser & Stoddart, 2001). The other issue is related to students. If students do not see technology as useful, they will not be open to DE (Christensen, Anakwe & Kessler, 2001). Therefore, it is the responsibility of teachers to support positive views of the students and to develop their digital competencies.

The development of digital competencies is also possible with educational activities that increase the level of digital literacy. Thus, it is important to determine teachers' digital literacy. According to Gilster (1997), digital literacy is defined as the ability to understand, evaluate and use information from a wide variety of sources from the computer environment. Tyger (2011) stated that digital literacy is more than the knowledge, skills and ability required to use information technologies and internet. According to Ng (2012), digital literacy has a very broad definition that covers the technique, cognitive and social-attitude areas of learning with both online and offline digital technologies. Ng's (2012) digital literacy model proposes that digital literacy consists of technique, cognitive, social-emotional dimensions. The technique dimension requires having the necessary technical and operational skills to use information communication technologies in learning and daily activities. The cognitive dimension, on the other hand, requires critical thinking skills to be able to evaluate and select appropriate software programs to learn or perform a specific task. The social and attitude dimension refers to internet responsibility for communication, socialization and learning. This dimension includes communicating with appropriate languages and words, as well as face-to-face communication, protecting individual security and privacy, and being aware of how to deal with threats with respect and by avoiding misinterpretation and misunderstanding.

When the relevant literature is examined, it is seen that although digital literacy studies generally focusing on prospective teachers and undergraduate students (Bennet, Maton & Kervin, 2008; Hargittai, 2010; Ng, 2012; Ocak & Karakuş, 2019; Özerbaş & Kuralbayeva, 2018; Yazıcıoğlu, Yaylak & Genç, 2020; Yontar, 2019) there are a limited number of studies investigating the digital literacy level of teachers (Arslan, 2019; Korkmaz, 2020; Öçal, 2017). It is the teacher who has the greatest responsibility and critical importance in preparing students for the future in the DE process. Therefore, in the present study, teachers' digital literacy and DE from the perspective of teachers were evaluated. Öcal (2017) found that primary school teachers felt very sufficient in terms of digital literacy. In his study, he did not see any difference in digital competence perceptions depending on gender, but he found that digital literacy levels of primary school teachers decreased as their ages increased. Karavidas, Lim and Katsikas (2005) found that women have a higher level of digital anxiety than men and that men are more successful than women in digital skills However, Van Deursen and Van Diepen (2013), Tomczyk (2020) and Gnambs (2021) did not reveal gender differences on internet skills in their study. Arslan (2019) found that teachers working in primary and secondary schools have high levels of digital literacy and emphasized the importance of using digital tools correctly and effectively to keep up with the digital age. Korkmaz (2020) found that the digital literacy levels of male classroom teachers were higher than the digital literacy levels of female classroom teachers. In addition, he found that as the age of classroom teachers increased, their digital literacy levels decreased. However, unlike Öcal (2017) and Korkmaz (2020) studies, Tomczyk (2020) did not detect a significant difference between secondary school teachers' digital literacy skills

depending on the duration of their professional experience. According to Bakioğlu and Çevik's (2020) research, it was determined that science teachers felt inadequate in the DE process. Burke and Dempsey (2020) stated that teachers feel pressure to realize online learning and worry about being able to timely train curricula after the reopening of schools.

In the present study, science teachers' digital literacy levels and views toward DE was investigated. The reason of this is that determining the digital literacy levels of teachers will contribute to determining the needs of teachers in educational practices in pandemic. Thus, online and face-to-face in-service trainings for teaching will be reshaped. The studies conducted with students to evaluate the DE. Teachers are also primarily responsible for the positive development of students' perspectives on online learning in DE (Ottenbreit-leftwich & Ertmer 2010). In the present study, interviews were conducted with teachers, who are the most important part of DE, and it was evaluated. Bakioğlu and Çevik (2020) conducted a semi-structured interview about pandemic, problems experienced in DE, the science teachers' opinions about the teaching process and the teaching profession. However, different from this study, in the present study, science and technology teachers' DE views were examined in line with their digital literacy skills.

In the present study, the reason for studying the science teachers' DE views and digital literacy skills is that science and technology education has a meaningful partnership in this century. The work of scientists encompasses a range of technologies, and great achievements in science are often accompanied by complex applications of technology. As a result, a complete science education includes both a tool for learning science content and process skills and a commitment to incorporating technology into education (American Association for the Advancement of Science (AAAS), 1996; National Research Council (NRC), 1996). Thus, these elements became a part of the education of science teachers (Flick & Bell, 2000). Therefore, considering that science and technology develop with the support of each other, science teachers also have a greater responsibility. The unexpected transition to online learning with the Covid-19 pandemic requires more initiatives to improve the quality of science teachers' education and create a safe learning environment for students. The literature is insufficient in terms of evaluating the current situation of pandemic DE practices and digital literacy studies for science teachers who are the main responsible of education in DE. The current study will shed light on addressing these shortcomings, revealing the digital literacy skill level, a necessary skill for future global citizens, for science teachers and contributing to the ongoing development of DE. In the present study, unlike these studies, a digital literacy scale related to digital literacy of teachers was used.

Given the direct and indirect contribution of digital literacy skills to teachers' learning and teaching process and professional skills and contribution of society to the development of the education system, it is important to consider the current level of digital literacy skills of teachers.

Therefore, the aim of this research is to determine the digital literacy skills of science teachers in terms of various variables. For this purpose, the research questions of the study are follow:

1. Do the digital literacy skills of science teachers differ statistically significantly according to the gender?

2. Do the digital literacy skills of science teachers differ statistically significantly according to the duration of professional experience?

3. What are the views of science teachers on DE during the pandemic?

Method

This study was conducted with a mixed methods approach. The mixed method is a type of research that combines elements of qualitative and quantitative research approaches for the broad purposes of breadth and depth of understanding and corroboration (Burke Johnson, Onwueegbuzie & Turner, 2007). Mixed methods approach is one of the most extended modalities in Western educational research (Johnson & Christensen, 2012). In the quantitative part of the study, survey was used. The qualitative part was carried out using semi structured individual interviews with the teachers who participated in the questionnaire.

Sample

The sample of the study consists of science teachers working in public schools in various regions of Turkey in the fall semester of the 2020-2021 academic year. The questionnaire was administered via the internet. The link to the questionnaire has been directed to social media groups and science teachers' mailing groups. The study was conducted with a total of 88 (63 female, 25 male) science teachers who volunteered to participate in the study who filled the online questionnaire. Participating teachers were divided into two groups as less and more professional experience. The descriptive statistical results of science teachers are given in Table 1.

Table 1. Descriptive statistical results of science teachers by duration of professional experience.

Duration of professional experience	f	%
1-5 years	44	50.0
6+ years	44	50.0
Total	88	100.0

Data Collection Tools

Digital Literacy Scale was used for the determination of science teachers' digital literacy levels. Distance Education Evaluation Teacher Interview Form was used for the determination of science teachers' opinions about DE. The form was developed by the researchers. Digital Literacy Scale was developed by Ng (2012) and adapted to Turkish by Hamutoğlu, Güngören, Uyanık and

Erdoğan (2017) by conducting a validity and reliability study. The scale was completed by all 88 science teachers. The scale is a 5-point Likert-type scale consisting of 17 items (I Strongly Disagree, I Disagree, I am uncertain, I Agree, I Strongly Agree). The highest score that can be obtained from the scale is 85 and the lowest score is 17. The scale has four dimensions: “attitude", “technique", “cognitive” and “social”. The Cronbach Alpha internal consistency coefficient calculated based on the research data is 0.89. Since it is between $0.80 \leq \alpha \leq 1.00$, the scale is highly reliable.

“Distance Education Evaluation Teacher Interview Form" developed by the researchers was used to determine the opinions of science teachers about DE. The questions are given in the Appendix. The interview technique was preferred because of its features that allow the participants to obtain in-depth information on any topic and to express the participants’ opinions without being influenced by any effect (Cohen & Manion, 1994). A list of interview questions has been developed based on the relevant literature (Kaden, 2020; Koçoğlu & Tekdal, 2020; Putri et al., 2020). The interview form consists of nine semi-structured questions. Within the scope of validity and reliability studies, the interview form was presented to three science education and measurement and evaluation experts. In addition, pilot study was carried out with two science teachers. After expert opinions and pilot study, the final form of the scale was developed. The participants to be interviewed were selected on a voluntary basis. Face-to-face and telephone interviews were conducted with ten teachers who responded the scale.

Data Analysis

Prior to data analysis, histogram, coefficient of variance, skewness kurtosis values, Detrended Normal Q-Q Plot were used to check whether the data showed normal distribution and parametric statistics were used in the analyses. Independent samples t-test was conducted for whether there was a statistically significant difference on science teachers’ digital literacy levels in terms of gender and duration of professional experience.

The data obtained from the interview form were also categorized and subjected to content analysis. Content analysis method was used to analyze the data obtained from the interview form. In the content analysis, the data were read by two researchers and codes were created according to the research questions. Reliability in coding was calculated with the formula Reliability= Consensus/ (Consensus+ Disagreement) proposed by Miles and Huberman (1994). As a result of the calculation, the reliability of the research was calculated as 90%. Categories and themes were created. The findings were supported and interpreted with direct quotations from the participants.

Results

The results are given in terms of the research sub-problems.

Do the Digital Literacy Levels of Science Teachers Show a Statistically Significant Difference in terms of Gender?

The results of the independent samples t-test are presented in Table 2.

Table 2. Independent Samples t-Test Results

Dimensions	Gender	N	X	S	df	t	p
Attitude	Female	63	29.52	3.76	86	.18	.85
	Male	25	29.36	3.71			
Technique	Female	63	24.28	3.24	86	.66	.50
	Male	25	24.80	3.37			
Cognitive	Female	63	8.61	1.11	86	1.12	.26
	Male	25	8.32	1.14			
Social	Female	63	7.38	1.61	86	.68	.49
	Male	25	7.64	1.55			
Digital Literacy	Female	63	69.80	8.20	86	.16	.87
	Male	25	70.12	7.75			

According to Table 2, there is no statistically significant difference between male and female science teachers' digital literacy [t(86)=.16 p>0.05] and digital literacy dimensions [t(86)=.18 p>0.05; t(86)=.66 p>0.05; t(86)=1.12 p>0.05; t(86)=.68 p>0.05]. Although the total digital literacy scores of men were higher than female teachers, this difference was not enough to create a significant difference between them.

Do the Digital Literacy Levels of Science Teachers Show a Statistically Significant Difference in terms of Professional Experience Duration?

The results of the independent samples t-test are presented in Table 3.

Table 3. Independent Samples t-Test Results

Dimensions	Duration of professional experience	N	X	S	df	t	p
Attitude	1-5 years	44	29.84	4.03	86	.91	.36
	6+ years	44	29.11	3.40			
Technique	1-5 years	44	25.36	3.36	86	2.77	.00
	6+ years	44	23.50	2.92			
Cognitive	1-5 years	44	8.61	1.06	86	.66	.51
	6+ years	44	8.45	1.19			
Social	1-5 years	44	7.81	1.68	86	2.9	.03
	6+ years	44	7.09	1.41			
Digital Literacy	1-5 years	44	71.63	8.77	86	2.0	.04
	6+ years	44	68.15	6.89			

When Table 3 is examined, digital literacy of science teachers shows a statistically significant difference in terms of the duration of professional experience [t(86)=2.0 p< 0.05]. Digital literacy of teachers with less professional experience is more positive than teachers with more professional experience. While there is a statistically significant difference between 1-5 years and 6+ years of professional experience of science teachers in terms of technique ([t(86)=2.77 p< 0.05]) and social

dimensions ([t(86)=2.9 p< 0.05]); there is no statistically significant difference between 1-5 years and 6+years of professional experience of science teachers in terms of attitude and cognitive sub-dimensions. Digital literacy of science teachers with less professional experience are more positive than teachers with more professional experience in terms of technical and social dimensions.

What are the Views of Science Teachers on DE During the Pandemic?

Distance Education Evaluation Teacher Interview Form consisted of nine questions. The responses to the questions were evaluated in three themes: quality of DE, technique and equipment, and teaching method.

Science Teachers' Opinions on the Quality of DE

Science teachers were asked about the general evaluation of DE, its positive/negative aspects and whether they would continue DE practices after the pandemic. The answers given by the teachers were coded and presented in Table 4.

Table 4. Science Teachers' Opinions on the Quality of DE

Sub themes	Codes	f
Quality of DE is good	Student participation	1
Quality of DE is moderate	Pandemic	1
Quality of DE is poor	Student follow-up	4
	Communication with family	1
	Hardware	3
Positive aspects of DE	Health	4
	Continuity of education	1
	Cost reduction	2
Negative aspects of DE	Technology	2
	Reaching the student	5
	Getting feedback from students	2
	In-class communication	1
Advantage of DE	Health	7
Disadvantage of DE	No learning by doing	3
I am considering DE after the pandemic	Reinforcing topics/problem solving	4
I am not considering DE after the pandemic	Efficiency	6

As can be seen in Table 4, science teachers generally evaluated the quality of DE as good, moderate and poor. Two science teachers stated that it was quite good for the students who constantly follow DE courses; 1 science teacher stated that it was moderate because it was not very fruitful; 4 science teachers stated that it was poor because each student could not be reached and teachers could not follow them; 1 science teacher stated that it was poor because there was not enough communication with the families and 3 stated that it was poor because of insufficient internet and technological equipment for both the student and the teacher.

Science teachers stated the following aspects as positive aspects of DE ensuring the continuation of education (1), not risk for teachers' and students' health during the pandemic (4),

reducing the cost of teaching by providing the opportunity without leaving home (2). They also expressed the following aspects as the negative aspects of DE: not every student and teacher has enough technology at home (2), not every student in the classroom can attend online lessons (5), not enough feedback from students (2) and preventing students' in-class communication and socialization (1).

While 7 of the science teachers see DE as an advantage in terms of health factor during the pandemic, 3 of these see DE as a disadvantage because it does not provide learning by doing.

Four science teachers stated that they could continue DE after the end of the pandemic period in order to compensate students' deficiencies and to reinforce their understanding; while 6 teachers stated that they would not continue DE after the end of the pandemic, because of the lack of efficiency. Some answers to these questions are as follows

Teacher (female, 6+years experience): DE is not as good as the quality of the education provided at school. It's impossible to reach all students.

Teacher (male, 6+years experience): I can assess the quality of DE as inadequate. Teachers, students and parents do not have sufficient knowledge and equipment about DE and the use of technological devices. It is up to the parents to follow the students, and most parents fail to do so. DE has serious shortcomings in infrastructure. Most students either don't have the device or have difficulty accessing the internet.

Teacher (female, 1-5 years experience): DE is positive because we are safe during the pandemic, however DE is negative because not every student has access to computers and the internet.

Science Teachers' Opinions on the Technical-Equipment of DE

Under this theme, firstly, science teachers were asked which device they use in the lessons in DE. While 6 of the teachers stated that they taught the lessons with computers, 5 stated that they taught the lessons with phones and 2 stated that they taught the lessons with tablets. Some teachers stated that they used both devices. Science teachers were also asked whether they had sufficient information about the technical problems they experienced during the DE and their solution, the practices they used and the problems they experienced, and whether EIN supported DE. Teachers' answers are presented in Table 5.

Table 5. Science Teachers' Opinions on the Technical-Equipment of DE

Sub-themes	Codes	f
I am familiar with the solution of technical problems.	Hardware problems	3
	Connection problems	2
I am not familiar with the solution of technical problems.	Technique	4
	Connection problems	1
EBA	Connection problems	3
	Material upload	2
	Communication problems	3
	Difficulties during writing	2
ZOOM	Connection problems	3
	Material upload	2
	Communication problems	3
	Difficulties during writing	2
I think EBA supports DE.	Assessment- evaluation	1
I do not think EBA supports DE.	Infrastructure problem	3
	Lecturing	4
	Assessment- evaluation	5

As can be seen in Table 5, 3 of the science teachers stated that they had hardware problems during DE, 2 stated that they had connection problems and 4 stated that they had technical problems. While 5 of the science teachers stated that they were informed about technical problems, 5 of them stated that they were not informed. The problems experienced by teachers who have knowledge about the solution of technical problems are generally hardware problems (difficulty in writing) (3) and problems in connecting to the internet (2).

Teachers who were not informed about the solution of technical problems stated that they had technical problems (4) and connection problems (1) and that they needed technical support to solve the problems.

All 10 science teachers stated that they used both EIN and ZOOM in the DE process. Teachers generally stated that they had connection problems when using EIN and ZOOM (3) and that the system meaninglessly threw out the student or teacher during the course. Teachers stated that uploading materials to EIN (2) took a lot of time and could not upload materials in every format. They stated that they could not make eye contact with the students while using applications in DE, that some students turned off the microphone when they did not want to hear; and that they turned off the camera when they did not want to see it and this caused serious communication problems with the students.

A science teacher thinks that EIN contains sufficient exercise questions in terms of measurement and evaluation and supports DE. Nine science teachers do not think that EIN sufficiently supports DE. Science teachers stated that EIN has an infrastructure problem (3), that topic narratives are insufficient (4) and that the questions in EIN are at a simple level, that there are no

questions in LGS(The examination for secondary school entrance) format and that the number of questions is low (5). Some answers to these questions are as follows.

Teacher (male, 6+ years): We are experiencing internet connection problems in DE. Students are interrupted or unable to connect to the course. This causes them to miss certain parts of the lesson.

Teacher (male, 6+years): I'm having hardware problems, and I had hard times in writing. I do not have the necessary equipment.

Teacher (female, 1-5 years): We're having trouble writing at EIN and ZOOM. Especially most of the students can't write. For this, you need to buy extra devices, which are financially burdensome.

Science Teachers' Opinions on Teaching Methods Applied in DE and the Effectiveness of Courses

It was asked which teaching methods science teachers are taught the courses in DE and whether they prepared the course contents themselves. Teachers stated that they taught courses with direct instruction (8), ppt presentation (6), video (6), z book (3), web-2 tools (1) and experiment (1). Two of the teachers stated that they occasionally prepare the course contents themselves, two of the teachers stated that they prepare the course contents themselves and other teachers used ready-made course contents because they did not have sufficient knowledge about preparing digital content. In addition, science teachers were asked about the effectiveness of DE. Teachers' answers are presented in Table 6.

Table 6. Science Teachers' Opinions on the Effectiveness of Courses in DE

Sub-themes	Codes	f
Considering that courses are effective in DE	No answer	-
Considering that courses are partially effective in DE	Family support	2
Considering that courses in DE are ineffective	Method	2
	Course duration	1
	Material	2
	Student-derived factors	3
	Communication	1
	Internet problems	1

According to Table 6, 2 of the science teachers stated that courses are partially effective and emphasized the importance of family support. Eight science teachers think that the courses are ineffective due to the use of teacher-centered methods (2), inadequate course duration (1), inadequate materials for teachers and students (2), inability of students to participate in the course, not knowing whether they follow the course during the course (3), inability to provide two-way communication in a healthy way (1) and problems caused by the internet (1). Some answers to these questions are as follows:

Teacher (female, 1-5 years): I prepare course contents according to the content and objectives of the course. I teach courses with my own ppt presentations, videos on the subject, z-books, competitions I have prepared with web 2 tools.

Teacher (female, 6+years): DE courses cannot be as effective as face-to-face courses. It is difficult to determine whether each student attends the course or not. Adequate resources for course content are difficult to reach. There is very little concrete work done by the students.

Teacher (male, 6+years): I don't think DE lessons are effective. There is not enough communication with the students.

Discussion, Conclusion and Recommendations

In this study, it was aimed to evaluate the digital literacy levels of science teachers in terms of gender and professional experience variables. Additionally, the science teachers' opinions about DE were determined through semi-structured interviews.

This study revealed that there is no statistically significant difference between male and female teachers' digital literacy levels. This finding is similar to the findings obtained in the studies of Argelagos and Pifarre (2017), Arslan (2019), Karagözoğlu & Gezer, 2022, Kozan & Bulut Özek (2019), Ocak & Karakuş (2019), Tomczyk (2020), Van Deursen & Van Diepen (2013). However, there are also different findings (Arcagök, 2020, Aslan, 2022, Gnambs, 2021, Özerbaş & Kuralbayeva, 2018; Yontar, 2019). It could be stated that male teachers are better at using technology and that men generally have more curiosity and interest in technological tools and developments than women teachers. However, the effective participation of women in the digitalization process in recent years and the increase in projects and education programs aimed at improving the digital citizenship skills of female students and women may have positively affected women's perceptions and attitudes towards using technology. Therefore, this could be the reasons of the nonsignificance difference on digital literacy in terms of gender.

The other result of the study is that there is a statistically significant difference between 1-5 years and 6+ years science teachers' digital literacy. As the duration of professional experience increases, digital literacy levels decrease. This may be due to the fact that new teachers have included the use of digital technologies in all areas of their lives in line with the requirements of the digital age. In addition, new teachers may have taken more courses in using digital technologies during their educational lives than teachers with a long professional experience. Again, this may be due to the fact that the internet and digital technologies entered the lives of the older teachers quite late, and this situation makes it difficult for them to adapt to the digital world. This finding obtained in the study is similar to the findings obtained in the studies of Öçal (2017), Arslan (2019), Gomez- Trigueros, Ruiz-Banuls and Ortega- Sanchez, (2019) and Korkmaz (2020). There are also different findings (Yontar,

2019; Tomczyk, 2020). In Yontar's study, the reason of no difference between 22 years and 21 and below pre-service teachers' digital literacy was explained as the ages of two groups are similar and there were no enough participants in the study.

There is no statistically significant difference between 1-5 years and 6+years digital literacy level of science teachers in terms of attitude and cognitive dimensions. This may be due to their awareness that digital technologies should be used more in line with the requirements of the age. There is a statistically significant difference between 1-5 years and 6+years digital literacy level of science teachers in terms of technical and social dimensions. This may be due to the fact that teachers with longer professional experience use digital technologies more superficially and therefore behave more shy and passive in using digital technologies in the technical and social field. This finding is similar to the study conducted by Arslan (2019). The findings obtained from the interview form were examined in three themes: quality of DE, technical and equipment and teaching method. Science teachers generally evaluated the quality of DE as good, medium and poor and 80% of the teachers generally evaluated the quality of DE as poor. This is due to the inability to follow up the students, inadequate equipment of teachers and students to participate in DE and unhealthy teacher-family communication. Science teachers mostly stated the negative aspects of DE. Science teachers who stated the positive aspect of DE mostly stated that individuals' health should not be put at risk. In the negative aspects of DE, 50 percent of teachers stated that they could not reach all students in the lessons. 50% of the teachers stated that there was not enough technology in the houses, there was not enough feedback from the students and it prevented in-class communication and socialization of the students. While 70% of science teachers see DE as an advantage in terms of health factor during the pandemic, 30% see it as a disadvantage because it does not provide learning by doing. This finding is similar to the research results of Bakioglu and Cevik (2020). In this study, it was seen that the biggest problem experienced by teachers in DE was hardware and student-related problems. Thus, it could be stated that the fact that not every student has internet and computer, that they do not have the full skills to use DE and that participation in DE is low.

While it was observed that 50% of the teachers who evaluated DE in terms of technical/equipment had knowledge about the solution of technical problems experienced in DE, it was concluded that 50% did not have knowledge. It was concluded that both teachers with and without knowledge about the solution of technical problems mostly experienced hardware and connection problems. This may be due to teachers' inadequate in-service training in using DE. These results are similar to the studies of Burke and Dempsey (2020). Researchers evaluated this situation as teachers' inadequate skills in hardware and software for DE.

It was observed that all science teachers used EIN and ZOOM. During the DE process, it was determined that teachers who teach through EIN and ZOOM mostly had problems in connection,

communication, uploading materials and writing. In addition, 90% of the teachers thought that EIN did not support DE. It was found that teachers mostly thought that EIN was insufficient in terms of measurement and evaluation. In addition, it has been stated that the topic statements in EIN are superficial and the EIN system has an infrastructure problem.

It has been concluded that science teachers mostly prefer direct instruction during DE. While it was observed that most science teachers taught the lessons with ppt presentation and z-book; very few teachers use web 2 tools, do experiments and prepare education materials. These results are similar to the studies of Çalışkan (2022). In addition, it was concluded that only 20% of science teachers prepared the teaching materials for the course themselves and that other science teachers used ready-made materials. This is likely due to the fact that science teachers do not have sufficient skills in preparing course materials by using digital tools. While 20% of science teachers who evaluate DE in terms of the effectiveness of the courses think that the courses are partially effective, 80% think that the courses are not effective. It was determined that teachers mostly thought that the courses were not effective due to student-induced factors. Other factors that prevent the courses from being effective were determined to be course materials, method/technique, course duration, and communication and internet problems.

In line with the results obtained in the research, the following suggestions and recommendations can be made:

1. The participants of this research were science teachers. Similar studies can be carried out with teachers in other branches.
2. Various trainings can be organized to improve teachers' digital literacy levels.
3. In-service trainings can be organized to improve DE skills of teachers.
4. Applications for enriching the content of the digital education platform (EIN) can be increased.

References

American Association for the Advancement of Science [AAAS]. (1996). *What do parents need to know to get involved?* Washington, DC.

Arcagök, S. (2020). Öğretmenlerin dijital vatandaşlığa yönelik algılarının incelenmesi. *Yüzüncü Yıl University Journal of Education Faculty, 17*(1), 534-556. https://doi.org/10.33711/yyuefd.693832

Argelagos, E., & Pifarre, M. (2017). Unravelling secondary students' challenges in digital literacy: A gender perspective. *Journal of Education and Training Studies, 5*(1), 42-55. https://doi.org/10.11114/jets.v5i1.1517

Arslan, S. (2019). *İlkokullarda ve ortaokullarda görev yapan öğretmenlerin dijital okuryazarlık düzeylerinin çeşitli değişkenler açısından incelenmesi* [Yayımlanmamış yüksek lisans tezi] Sakarya Üniversitesi.

Aslan, S. (2021). The effect of the flipped classroom model on pre-service teachers' digital literacy and digital pedagogical competencies. *Educational Policy Analysis and Strategic Research, 16*(4), 73-89. https://doi.org/10.29329/epasr.2021.383.4

Bakioğlu, B., & Çevik, M. (2020). COVID-19 pandemisi sürecinde fen bilimleri öğretmenlerinin uzaktan eğitime ilişkin görüşleri. *Electronic Turkish Studies, 15*(4). 109-129. http://dx.doi.org/10.7827/TurkishStudies.43502

Bennett, S, Maton, K., & Kervin, L. (2008). The 'digital natives' debate: A critical review of the evidence. *British Journal of Educational Technology, 39*(5), 775-786. https://doi.org/10.1111/j.1467-8535.2007.00793.x

Burke Johnson, R., Onwueegbuzie, A. J., & Turner, L. A. (2007). Towards a definition of mixed methods research. *Journal of Mixed Methods Research, 1*(2), 112-133. https://doi.org/10.1177/1558689806298224

Burke, J., & M. Dempsey (2020). Maynooth University Department of Education. *Covid-19 practice in primary schools in Ireland report*. https://www.into.ie/app/uploads/2020/04/Covid-19-Practice-in-Primary-Schools-Report-1.pdf

Bušelić, M. (2012). Distance learning – concepts and contributions. *Oeconomica Jadertina*, *2* (1).

Can, E. (2020). Koronavirüs (Covid-19) pandemisi ve pedagojik yansımaları: Türkiye'de açık ve uzaktan eğitim uygulamaları. *Açıköğretim Uygulamaları ve Araştırmaları Dergisi, 6*(2), 11-53.

Christensen, E. W., Anakwe, U. P., & Kessler E. H. (2001) Receptivity to distance learning: The effect of technology, reputation, constraints, and learning preferences. *Journal of Research on Computing in Education, 33* (3), 263 – 279. https://doi.org/10.1080/08886504.2001.10782314

Cohen, L., & Manion, L. (1994). *Research methods in education* (4nd ed.). Routledge.

Çalışkan, E. F. (2022). Parental Views Regarding Distance Learning of Primary School Children and Screen Time during the Covid-19 Pandemic Process. *International Journal of Progressive Education, 18*(2), 180-192. https://doi.org/10.29329/ijpe.2022.431.12

Flick, L., & Bell, R. (2000). Preparing tomorrow's science teachers to use technology: Guidelines for science educators. *Contemporary Issues in Technology and Teacher Education, 1*(1), 39-60.

Franklin, N., Yoakam, M. & Warren, R. (1996). *Distance learning: A guidebook for system planning and implementation.* Indianapolis*,* Indiana University.

Gilster, P. (1997). *Digital literacy.* John Wiley & Sons.

Gnambs, T. (2021). The development of gender differences in information and communication technology (ıct) literacy in middle adolescence. *Computers in Human Behavior, 114*, 1-10. https://doi.org/10.1016/j.chb.2020.106533

Gomez-Trigueros, I., M., Ruiz- Banuls, M. & Ortega- Sanchez, D. (2019). Digital literacy of teachers in training: moving from ICTS (Information and Communication Technologies) to IKTS

(learning and knowledge technologies). *Education Sciences, 9*(4), 274. https://doi.org/10.3390/educsci9040274

Hamutoğlu, N., Güngören, Ö., Uyanık, G. & Erdoğan, D. (2017). Dijital okuryazarlık ölçeği: Türkçeye uyarlama çalışması. *Ege Journal of Education, 18*(1), 408- 429. https://doi.org/10.12984/egeefd.295306

Hargittai, E. (2010). Digital na(t)ives? Variation in Internet skills and uses among members of the net generation. *Sociological Inquiry, 80*(1), 92–113. https://doi.org/10.1111/j.1475-682X.2009.00317.x

Johnson, B. N. & Christensen, L. (2012). *Educational research. Quantitative, qualitative, and mixed approaches.* Sage.

Kaden, U. (2020). COVID-19 school closure-related changes to the professional life of a K–12 teacher. *Education Sciences*. *10*(6),165. https://doi.org/10.3390/educsci10060165

Karagözoglu, N., & Gezer, U. (2022). An investigation of the relationship between digital literacy levels of social studies teacher candidates and their attitudes towards distance education. *Educational Policy Analysis and Strategic Research. 17*(1) 218-235. https://doi.org/10.29329/epasr.2022.248.11.

Karavidas, M., Lim, N. K. & Katsikas, S. L. (2005). The effects of computers on older adult users. *Computers in Human Behavior, 21*(5), 697-711. https://doi.org/10.1016/j.chb.2004.03.012

Koçoğlu, E. & Tekdal, D. (2020). Analysis of distance education activities conducted during COVID-19 pandemic. *Educational Research and Reviews, 15*(9), 536-543. https://doi.org/10.5897/ERR2020.4033

Korkmaz, M. (2020). *Sınıf öğretmenlerinin dijital okuryazarlık seviyelerinin belirlenmesi* [Yayımlanmamış yüksek lisans tezi]. Eskişehir Osmangazi Üniversitesi.

Kozan, M. & Bulut Özek, M. (2019). BÖTE bölümü öğretmen adaylarının dijital okuryazarlık düzeyleri ve siber zorbalığa ilişkin duyarlılıklarının incelenmesi. *The Journal of International Social Sciences, 29*(1), 107-120. https://doi.org/10.18069/firatsbed.538657

Miles, M. B. & Huberman, A. M. (1994). *Qualitative data analysis: An expanded source book* (2nd ed.). Thousand Oaks, Sage.

National Research Council [NRC] (1996*). National Science Education Standards*. Washington, D.C.: National Academy Press.

Newby, T. J., Stepich, D. A., Lehman, J. D., & Russell, J. D. (2006). *Educational technology for teaching and learning*. Pearson Merrill Prentice Hall.

Ng, W. (2012). Can we teach digital natives digital literacy? *Computers & Education, 59*(3), 1065–1078. https://doi.org/10.1016/j.compedu.2012.04.016

Niederhauser, D. S. & Stoddart, T. (2001). Teachers' instructional perspectives and use of educational software. *Teaching and Teacher Education, 17*(1), 15-31. https://doi.org/10.1016/S0742-051X(00)00036-6

Ocak, G. & Karakuş, G. (2019). Öğretmen Adaylarının Dijital Okuryazarlık Öz-yeterlilik Becerilerinin Farklı Değişkenler Açısından İncelenmesi. *Afyon Kocatepe University Journal of Social Sciences, 21*(1),129-147. https://doi.org/10.32709/akusosbil.466549

Ottenbreit-leftwich, E., & Ertmer, P. (2010). Teacher technology change. How knowledge, beliefs, and culture intersect. *Journal of Research on Technology in Education, 42*(3), 255-284. https://doi.org/10.1080/15391523.2010.10782551

Öçal, F. N. (2017). *İlkokul öğretmenleri ve velilerin kendileri ile velilerin çocuklarına ilişkin dijital okuryazarlık yeterlilik algıları* [Yayımlanmamış yüksek lisans tezi]. Gazi Üniversitesi.

Özerbaş, M & Kuralbayeva, A. (2018). Türkiye ve Kazakistan öğretmen adaylarının dijital okuryazarlık düzeylerinin değerlendirilmesi. *Muğla Sıtkı Koçman University* Journal of Education*, 5*(1), 16-25. https://doi.org/10.21666/muefd.314761

Putri, R.S., Purwanto, A. , Pramono, R., Asbari, M., Wijayanti, L. M. & Hyun, C,C (2020). Impact of the COVID-19 pandemic on online home learning: an explorative study of primary schools in Indonesia. *International Journal of Advanced Science and Technology, 29*(5), 4809 – 4818.

Schleicher, A. (2020, December 28). *The impact of COVID-19 on education - insights from education at a glance*. https://www.oecd.org/education/the-impact-of-covid-19-on-education-insights-education-at-a-glance-2020.pdf

Tomczyk, Ł. (2020). Skills in the area of digital safety as a key component of digital literacy among teachers. *Education and Information Technologies 25*, 471–486. https://doi.org/10.1007/s10639-019-09980-6

Tyger, R. (2011). Teacher *candidates' digital literacy and their technology ıntegration efficacy.* [Unpublished doctoral dissertation], The Graduate Faculty of Georgia Southern University.

UNESCO (2002*).* Open and distance learning – Trends, policy and strategy considerations, UNESCO.

UNESCO (2020). Institute for statistics data. education: from disruption to recovery. https://en.unesco.org/covid19/educationresponse.

Van Deursen, A. J. A. M. & Van Diepen, S. (2013). Information and strategic internet skills of secondary students: A performance test. *Computers & Education, 63*, 218-226. https://doi.org/10.1016/j.compedu.2012.12.007

Yazıcıoğlu, A., Yaylak, E. & Genç, G. (2020). Okulöncesi ve sınıf öğretmen adaylarının dijital okuryazarlık düzeyleri. *Ordu University Journal of Social Sciences Research, 10*(2), 274-286.

Yontar, A. (2019). Öğretmen adaylarının dijital okuryazarlık düzeyleri. *Journal of Mother Tongue Education, 7*(4), 815-824. https://doi.org/10.16916/aded.593579