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Investigating the digital skills of undergraduate students in terms of various variables

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Highlights

- Digital skills of the students who take IT courses in secondary and high school increase significantly
- Even if they have an equal level of IT education, male students have significantly higher digital skills than female students.
- Students who work with teachers who are expert in IT education in secondary and high school have significantly higher digital skills.

Article Info: Research Article

Keywords: *Digital literacy, Digital skills, Information technologies course, Information technologies teachers, Gender digital divide*

Abstract

It is argued that, young people growing up surrounded by digital technologies intuitively acquire digital skills and therefore do not need digital education or training. For this reason, with the belief that students already have digital skills, digital literacy education courses are reduced or removed in educational institutions. Therefore, it is necessary to emphasize the importance of development of digital skills in the education. The purpose of this research is to examine the digital skills of students in terms of various variables. This research was conducted as a survey research. The participant group of the research consists of 423 undergraduate students who have just started to study at a university. According to the results of the research, the digital skill levels of the students who attend the IT courses are significantly higher than the students who do not. Digital skills were significantly higher for the male students than for the female students. In addition, the digital skills of the students who took the IT courses from the teacher trained in teaching digital skills were significantly higher than the students who took the course from teachers from other professions.

1. Introduction

The 21st century is a period in which the transition from an industrial society to an information society is experienced and in this transition process, the importance given to information has increased. As a result of the increase in the usage of information and communication technologies (ICT), the facilitation of access to information, the increase in the amount of information that can be accessed and the facilitation of communication are among the most important reasons for this change in society. In order for societies to keep up with this process of change, students should be provided with various skills, and one of these skills is digital literacy.

According to a functional definition provided by Buckingham (2015), "digital (or computer) literacy often appears to amount to a minimal set of skills that will enable the user to operate effectively with

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software tools, or in performing basic information retrieval tasks" (p. 23). Digital literacy is more than the capability to use a digital device or software, and includes many skills that can be used in digital environments. Digital literacy includes the capacity to read and understand text, graphics and audio data in digital media, to create new data by processing this digital data, and to interpret and use new knowledge acquired in digital environments (Hargittai, 2008; Jones-Kavalier & Flannigan, 2006). It is believed that the date of birth is an important factor on students' digital skills and that young people can develop these skills more easily (Kubiatko, 2010; Lankshear & Knobel, 2008). Prensky (2001) defines the new generation who grew up with new technologies as "digital natives", and individuals who were not born in the digital world but later adapted to this world as "digital immigrants". It is argued that individuals included in the digital native group have advanced knowledge and skills related to information technologies (IT) and digital literacy (Bennett et al., 2008). However, rather than determining the date of birth as the main factor for predicting students' digital skills, the student's familiarity and experience with using ICT is more important (Brown & Czerniewicz, 2010; Selwyn, 2009). This also lays the groundwork for a misconception about digital natives. According to this misconception, young people growing up surrounded by digital technologies instinctively acquire digital skills and therefore do not need teaching or digital education (ECDL, 2015). Several studies in different countries have revealed that young people or digital natives do not inherently have digital skills (Ariuet et al., 2014; Csernoch & Biró, 2014; Fraillon et al., 2014; Johnson et al., 2014; Kennedy et al., 2010; Kirschner & De Bruyckere, 2017; Li, 2010; Smith, 2012). Just as young people's digital skills are misinterpreted by others, young people themselves misjudge and overestimate their digital skills (ICDL, 2018; Sciumbata, 2020). These false beliefs about the digital skills of digital native students have also led to false ideas about the importance of the education and training that students should receive on digital literacy. However, research has shown that younger students are not likely to develop their digital skills without an education in digital literacy (Aydin, 2021; Brand-Gruwel et al., 2005; Ng, 2012; Van Deursen & Van Dijk, 2009). In fact, with the belief that students already know digital skills, digital literacy education courses are reduced or removed in educational institutions (Denholm, 2014; English, 2016; Eynon, 2010). As a result of students being deprived of digital literature education, young people will not have the digital skills they need for the workplaces and businesses will not have the skilled employees they need (ICDL, 2019; Murray & Pérez, 2014).

However, due to the misperceptions of both the students themselves and in the authorities who decide on education policies, the necessary importance cannot be given to the courses that will provide digital skills, and the students cannot receive the training they need. In order to demolish these misperceptions and to ensure that the courses and training that will provide digital skills reach the required level, the importance of these courses in acquiring digital skills to students should be proven by scientific studies. On the other hand, a systematic understanding of how courses on digital skills in compulsory education contribute to students' digital literacy is still lacking. In Turkey, the course hours of IT courses, which are expected to provide students with digital skills, have been reduced or they have been turned into elective courses. In addition, the effects of factors such as gender (Aydin, 2021; OECD et al., 2020; Özoğlu & Kaya, 2020; Suwana & Lily, 2017; Üstündağ, 2021), access to specialist IT teachers (DATTA Australia, 2019; Devier, 2019), and school type (Hohlfeld et al, 2017; Ramalingam & Kar, 2014; Valadez & Duran, 2007), which are stated to be effective on students' digital skills in the literature, should also be investigated. The purpose of this research is to examine the digital skills of students who have just started undergraduate education in terms of various variables.

2. Literature

2.1. Digital Literacy Models and Frameworks

The models and frameworks proposed to explain the content of digital literacy, which first appeared in the literature in the mid-1990s, have changed considerably over time. While the first models focused more on ICT, later on, digital literacy models were included in many different competencies and skills. In recent

models, skills related to creativity and content production are frequently included (Feerrar, 2019). Skills related to topics such as online collaboration, communication, critical thinking and evaluation are also common parts of digital literacy models (Hall et al., 2014; Jisc, 2018; Sparks, 2016). Van Deursen and Van Dijk (2009) identified four distinct digital skills in their proposed framework: functioning skills to operate digital tools, formal skills to handle online environments, information skills to search, select and evaluate information and strategic skills to use data in digital media for a purpose. Some researchers have defined the scope of digital literacy with competencies. Ferrari (2012) has gathered these competencies under seven subtitles: "information management, collaboration, communication and sharing, creation of content and knowledge, ethics and responsibility, evaluation and problem-solving and technical operations" (p. 4). According to the framework created by Ng (2012), "digital literacy has three dimensions: cognitive, technical and social-emotional" (p. 1067). Jisc (2018) Digital Capability Framework, which was created in the UK more recently, is quite comprehensive and consists of the following sections: "ICT proficiency; information, data and media literacies; digital creation, problem solving and innovation; digital communication, collaboration and participation; digital learning and development; and digital identity and well-being" (p. 41). The ICT proficiency element is at the center of the proposed Framework and is used as a basic tool for all other skills. In many digital literacy structures, different literacy areas such as ICT, computer, information, media, visual and technology literacy are emphasized and its relationship with digital literacy is stated (Alexander et al., 2017; Covello, 2010; Feerrar, 2019; Ng, 2012).

Digital skills can also be explained on the basis of certification (Certiport, n.d.; ICDL, 2020). ECDL/ICDL (European/International Certificate of Digital Literacy) is an institution focused more on certification and measurement of digital competencies. It later changed its name to ICDL. More than 14 million people in 41 languages in 148 countries have participated in the ICDL Foundation certification programs (ICDL, 2020). ECDL (2019) has defined three different profiles - Base, Standard, and Advanced- to represent different levels of digital literacy. The ECDL Basic Profile is defined as a certificate of an individual's digital literacy and includes four modules: online essentials; computer essentials, spreadsheets and word processing. ECDL Standard Profile consists of all of the base modules and any three out of the nine standard modules. Standard modules are listed as: using databases, presentation, image editing, web editing, online collaboration, project planning, IT (Information Technology) security, health information systems usage and 2D computer aided design. In order to obtain a certificate in the advanced profile, it is necessary to complete three of the advanced modules.

In the literature, there are many assessment instruments developed in line with different digital literacy frameworks with the aim of assessing digital literacy. Sparks (2016) stated that there are three categories of assessments for the digital literacy of university students and adults based on their format and focus. The first category focuses on information literacy, the second focuses on technology literacy and the third focuses on digital information literacy. While constructed response items and multiple choice are used in the first two categories, performance based tasks are used in the third category. Carretero, Vuorikari and Punie (2016) reviewed assessment tools developed in line with the DigComp framework and grouped them under three groups. Participants are expected to perform a series of tasks within the performance assessment category. In the knowledge-based assessment category, test items are used for evaluation. Finally, the participants' evaluation of their own skills through questionnaires was included in the self-assessment category. Most of the digital literacy assessment tools include multiple choice questions (Certiport, n.d.; Goebel et al., 2013; ICDL, 2020; Ivanitskaya et al., 2006; Madisson Assessment, 2014; Rizal et al, 2020; The Project SAILS, n.d.), but there are also assessment tools that include performance and simulation tasks (Katz et al., 2018; Klein et al., 2007; PIAAC, 2009). In accordance with UNESCO's digital literacy global framework, "the DSI survey by EuroStat", "the DigComp test for 9th and 12th grade in Estonian schools", "the PIX test in France", "the Digital Competence Wheel in Denmark" was

determined to be the most appropriate assessment tools for assessing digital literacy in various aspects (Laanpere, 2019).

2.2. Factors Affecting Digital Skills

There are many factors that affect students' digital skills, and the differences observed in students' digital skill levels for different reasons are defined as "digital divide". Main factors affecting the digital skills and causing a digital divide is their access to digital tools and internet (Ertl et al., 2020; James, 2019). Training with digital technology is needed to develop digital skills. For this reason, it is thought that students who have more access to digital tools and the internet will have better digital skills. In the literature, there are some factors that affect students' access to digital tools and the internet, and thus their digital skills. One of these factors is the digital divide between countries. In addition to the differences in the digital skills of students between developed countries and underdeveloped countries, there are differences between students' digital skill levels because there are differences in students' access to digital tools even within developed countries (Bayrakdar & Güveli, 2020; Hatlevik & Gudmundsdottir, 2013; Van Deursen & Van Dijk, 2019; Yeo & Lee, 2020). There are also studies showing that gender is an important factor affecting students' digital skills and this situation is called gender digital divide. The impact of gender on digital skills is different and dependent on the generation one was born in, as women's access to digital tools has changed over time (Ertl et al., 2020). For this reason, while most studies show that male students' digital skills are better (OECD et al., 2020; Özoğlu & Kaya, 2020; Suwana & Lily, 2017), there are also studies that show that female students' digital skills are at a higher level (Aydin, 2021; Üstündağ, 2021). Lower education attainment, lack of access, social norms, skills and technical literacy are cited as the causes of gender-based digital divide (OECD et al., 2020). Also, besides her age, educational level, marital status, internet usage and place of residence affect women's digital literacy score (Özkan et al, 2021).

School type can be shown among the factors that affect students' internet access and therefore their digital skills (Hohlfeld et al, 2017; Ramalingam & Kar, 2014; Valadez & Duran, 2007). The main reason for this distinction is stated as the different level of access to digital tools and the internet in schools, and the different socio-economic structure of schools. Hohlfeld et al. (2008)'s pyramid model created to define digital separation in schools: “The first level is hardware, software, the internet, and technology support in the school, the second level is technology use by teachers and students in the classroom, and empowerment of students is at the third level” (p. 1649).

2.3. IT Teachers

Although there are various studies on the evaluation of teachers' and prospective teachers’ digital skills (Aslan, 2021; Ahmad et al., 2016; Demir et al., 2022; Markauskaite, 2007; McGarr & McDonagh, 2021; Özcan, 2022; Siddiq, 2016), little research has been done on the competencies required of teachers to be appointed to teach students digital skills (Claro et al., 2018). The skills that teachers who will give digital literacy education should have and the digital skills that they should have as a requirement of the teaching profession are at different levels. Teachers who conduct courses that will provide students with digital skills are given different names such as IT teacher and technology teacher. It is seen that the number of technology teachers in different countries is insufficient and teachers from different branches attend technology courses that are expected to provide students with digital skills (DATTA Australia, 2019; Devier, 2019; Ernst & Williams, 2015; Love & Love, 2022; Moye, 2009; Noble-Rogers, 2020; Reinsfeld & Lee, 2021). In order for the courses aimed at providing students with digital skills to be effective, these courses should be given by teachers who are experts in teaching digital skills. In addition, the lack of technology teachers leads to problems such as the reduction of technology lesson hours in schools (Reinsfeld & Lee, 2021) and less directing of students to careers in technology (Love et al., 2016). Due to the lack of technology teachers in some schools in Turkey, teachers from other branches other than

technology teachers can attend IT classes. Within the scope of the research, the digital literacy skills of students who attend IT courses and those who do not will be examined.

It is important to reveal the effects of variables such as the number of IT course hours and the conduct of IT courses by IT teachers on students' digital skills, to eliminate misconceptions about IT courses and to establish correct policies for digital skills training. In addition, examining the effect of gender, which is an important variable on digital skills in the literature, on digital skills in the context of IT education will contribute to the literature and provide a more accurate interpretation of the factors that reveal the concept of "gender digital divide". The purpose of this research is to examine the digital skills of students who have just started undergraduate education in terms of different variables. For this purpose, answers to the following research questions will be sought:

1. Is there a significant difference between the digital skills of university students who have not taken and have taken courses aimed at gaining digital literacy skills in secondary and high schools?
2. How do students' digital skills differ by gender?
3. Is there a significant difference in digital skills between students, who have taken the IT course, and those whose teachers are experts in their fields and those who are not?

3. Methodology

3.1. Research Model/Design

This research was conducted as a survey research. There are two types of survey research, longitudinal and cross-sectional. In longitudinal studies, a group is examined at different time intervals, while in cross-sectional studies, measurements are made only once in a time interval (Creswell, 2002). Since the purpose of the study is to examine the digital skills of students who have just started their university education in the context of various variables, the data will be collected only in a certain period. Therefore, the study fits the cross-sectional type of survey studies.

3.2. Sampling or Study Group

Convenience sampling method was preferred in determining the study group of the research. With this method, participants who are close and easy to reach are included in the study group. The participant group of the research consists of 423 undergraduate students who have just started to study at a university in the 2018-2019 fall semester. The distribution of the participants by gender, type of high school they graduated from and the amount of IT course hours they have taken before is given in Table 1. As seen in Table 1, there are 423 participants, 129 male and 294 female, in the study.

Table 1.

Distribution of participants by demographic characteristics

Feature	N	f
Gender		
Male	129	30.5%
Female	294	69.5%
Total	423	100%
Type of high school they graduated from		
Science High School	5	1.2%
Social Sciences High School	4	.9%
Anatolian High School	263	62.2%
Vocational and Technical High School	44	10.4%
Imam Hatip High School	28	6.6%
Multi-program High School	9	2.1%
Sport High School	15	3.5%
Others	55	13.0%
IT course hours in K12		
0	95	22.5%
1	181	42.8%
2	42	9.9%
3	81	19.1%
4	11	2.6%
5	13	3.1%
IT teacher in secondary school		
Yes	224	73.0%
No	83	27.0%
IT teacher in high school		
Yes	90	69.2%
No	40	30.8%
Education on digital literacy apart from IT courses		
Yes	24	5.8%
No	293	94.2%

During the period when the students participating in the study took IT courses, IT courses were elective course for three years with one course hour in secondary schools, while in high school IT course can only be selected for one year and the course hour is two (MEB, 2005). The IT course curriculum applied in the first year in secondary school consists of very basic level subjects outside the scope of the DST and digital literacy skills. Therefore, students who take an IT course for one hour and never take IT courses constitute the group of students who do not take IT courses, while students who take two hours or more of IT courses constitute the group who take IT courses. In order for students to remember their experiences with IT courses more easily, the courses they took in secondary and high school were asked separately in questionnaire, and then the researchers combined the total course hours in the table. The number of students who answered the questions of IT teacher in secondary school and high school is less than the total number of students, because some of the students have never taken an IT course in secondary or high school.

When the school types of the students are examined, it is seen that the most of the students graduated from Anatolian High Schools. It is an involuntary and random situation that the majority of students gather in a single school type. For this reason, considering that an accurate statistical analysis could not be made, the type of school was excluded from the variables examined. In addition, it was asked whether

there was an IT teacher in secondary and high school. Finally, it is seen that only 24 students received digital literacy training apart from IT courses.

3.3. Data Collecting Tools

Two different tools were used to collect data within the scope of the study: IT Education Questionnaire and Digital Skills Test (DST). With the "IT Education Questionnaire", it was aimed to collect data about the IT education that students received during the k12 education process. During the development process of the questionnaire, first of all, the duration of the IT courses that the students attended during the secondary and high school years were examined. In addition, information such as gender, age, type of school graduated from high school, IT teacher and other trainings on digital literacy were collected. The opinions of two field experts were taken about the questionnaire and the questionnaire was given its final form.

DST was developed by the researchers in order to determine the participants' digital skills. The framework created by ECDL for the training of digital skills was used in the development of the test. ECDL approaches digital skills on a certificate basis and therefore describes digital skills in a more concrete way. Therefore, it constitutes a very suitable structure for a test to be developed to measure digital skills. ECDL has created three different profiles to describe digital skills. Among the three ECDL profiles, the standard profile was used as the basis for the development of the test because ECDL standard profile is the most flexible of the recommended ECDL profiles. With the base modules within the profile, core ICT skills can be documented, and then the competency of the person relevant to their career or interests can be demonstrated in other modules (ECDL, 2019). The ECDL standard profile consists of three modules to be selected among the standard modules in addition to the four base modules. While determining the three standard profiles, the selection of modules included in the curriculum of the courses students took in the past was taken as the main criterion. As a result, the modules used to create the questions of the test are presented in figure 1.

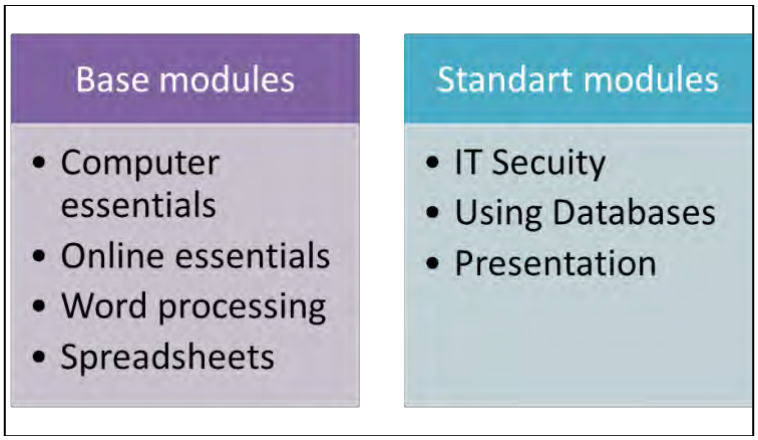

Fig. 1. ECDL Standard profile modules that make up the content of the DST

Various analyzes were carried out in order to increase the validity of the DST. For the item analysis of the developed test, the reliability of the test was examined with the Kuder-Richardson-20 (KR-20) technique used in binary scored tests (Crocker & Algina, 1986). The KR-20 reliability coefficient of the computer usage skills test was found to be 0.92. A reliability coefficient of .70 and higher is generally considered sufficient for the reliability of test scores (Büyüköztürk, 2008). Item difficulty is defined as the percentage of correct answers to a question by the participants. Items with a difficulty level of less than or equal to 0.30 were classified as "difficult", items with a difficulty value greater than 0.30 and less than or equal to 0.70 were classified as "moderately difficult" and those with a difficulty value greater than 0.70 were classified as "Easy" (Bichi, 2015). According to this classification, 11 items are in the easy category, 27 items are in the moderately difficult category, and 62 items are in the difficult category. The average

difficulty value of all the items in the test was calculated as 0.35. The difficulty level distributions of the items in the test are given in Table 2.

Table 2.

Difficulty index distributions of the items in the DST

Item Difficulty Index (*p*)	Total Item
Easy (>.70)	11 (11%)
Moderately difficult (>=.31 and <=.70)	27 (27%)
Difficult (<=.30)	62 (62%)

Item discrimination indicates the ability of a test item to differentiate among students based on how well they know the subject being tested. Item discrimination compares those with low and high scores among respondents who answered correctly to an item (McCowan & McCowan, 1999). In Table 3, the discrimination values of the items found in the DST are given. It is recommended to develop and use items with a discrimination of less than 0.30 (Özçelik, 2013). The questions below the 0.30 value were examined by the researchers and necessary changes were made. Due to the fact that some of the students did not have any training on the content of the test, 12 items were left in the test by taking the opinion of field experts (Crocker & Algina, 1986).

Table 3.

The discrimination values of the items in the DST

Item No	Value	Item No	Value	Item No	Value	Item No	Value
1	0,340	26	0,605	51	0,461	76	0,369
2	0,452	27	0,338	52	0,512	77	0,585
3	0,448	28	0,471	53	0,600	78	0,536
4	0,625	29	0,537	54	0,434	79	0,452
5	0,516	30	0,554	55	0,542	80	0,649
6	0,365	31	0,516	56	0,087	81	0,526
7	0,498	32	0,597	57	0,508	82	0,213
8	0,557	33	0,225	58	0,616	83	0,406
9	0,593	34	0,426	59	0,425	84	0,484
10	0,574	35	0,494	60	0,442	85	0,592
11	0,583	36	0,133	61	0,630	86	0,483
12	0,239	37	0,678	62	0,688	87	0,320
13	0,416	38	0,658	63	0,707	88	0,316
14	0,617	39	0,645	64	0,278	89	0,471
15	0,349	40	0,379	65	0,701	90	0,178
16	0,303	41	0,597	66	0,688	91	0,444
17	0,114	42	0,310	67	0,211	92	0,397
18	0,408	43	0,547	68	0,620	93	0,412
19	0,404	44	0,289	69	0,586	94	0,430
20	0,371	45	0,442	70	0,414	95	0,269
21	0,493	46	0,354	71	0,457	96	0,377
22	0,428	47	1,592	72	0,327	97	0,428

23	0,539	48	0,386	73	0,712	98	0,443
24	0,601	49	0,389	74	0,470	99	0,413
25	0,261	50	0,447	75	0,411	100	0,382

As a result of the analysis, the final version of the DST consisting of 100 questions with five answer choices was created.

3.4. Data Analysis

Microsoft Excel 2016 and SPSS 22 software were used in the statistical analysis of the data. In order to determine the statistical method to be used in the data analysis process, the normal distribution of the data obtained from the DST was checked. In order to prove that the data showed a normal distribution, the skewness and kurtosis values of the scores obtained by the students from the test were calculated. In addition, the Kolmogorov-Simirnov test was used to evaluate the normality of the values. The data obtained regarding normality are presented in Table 4.

Table 4.

Data on normal distribution of DST scores

	Skewness	Kurtosis	Kolmogorov-Simirnov*
DST scores	-.019	-.359	.200

*p<.05

If the skewness and kurtosis values of the data are in the range of ±1.0, the data are considered to have a normal distribution (Büyüköztürk, 2008). In addition, the assumption of normal distribution of the data was also checked with the Kolmogorov-Simirnov test, and it was determined that the distribution of pretest and posttest scores did not differ significantly from the normal distribution at this significance level (p<.05). As a result of Levene's F test, it was concluded that the variances were equal. After it was determined that the data showed a normal distribution, it was decided to use independent samples t-test parametric statistics in the analysis of the data.

4. Findings

4.1. IT Courses in secondary and high schools

Within the scope of the study, the first variable whose effect on students' digital skills was examined was the status of students taking IT courses. The students participating in the study were divided into two groups as those who took IT courses and those who did not, according to the criteria determined before. Students who have never taken an IT course or who have only taken an IT course for one hour in secondary school form the "No IT Course" student group, students who take IT courses for two hours or more in high school and secondary school constitute the student group "IT Course". 17 students who stated that they received a different education on digital literacy apart from IT courses were excluded from the analysis. Independent samples t-test was applied to determine whether there was a significant difference between the digital skills of the two groups.

Table 5.

t-test results for DST scores of IT course and no IT course groups

Group	*N*	*Mean*	*SD*	*Df*	*t*	*Sig.*	*d*
No IT Course	257	31.09	12.17	402	-5.37	.000	.55
IT Course	147	38.12	13.48				

As can be seen from Table 5, the results of the independent-samples t-test indicated that the DST scores were significantly higher for the "IT Course group" (M = 38.12, SD = 13.48) than for the "No IT Test group" (M = 31.09, SD =12.17), $t(402) = -5.37$, $p < .05$, d = .55. The effect size for this analysis (d = .55) was found to comply with Cohen's (1988) convention for a large effect ($d >= .50$). This finding of the study can be interpreted as attending IT classes in secondary and high school increases students' digital literacy skills.

4.2. Gender of students

The second research question of the study is whether students' digital skills differ according to gender. First, the DST scores of all male and female students participating in the study were examined with the independent samples t-test.

Table 6.

t-test results for DST scores of female and male groups

Group	*N*	*Mean*	*SD*	*Df*	*t*	*Sig.*	*d*
Male	128	39.32	14.31	419	5.67	,000	.62
Female	293	31.15	11.83				

As can be seen from Table 6, the results of the independent-samples t-test indicated that the DST scores were significantly higher for the "Male group" (M = 39.32, SD = 14.31) than for the "Female group" (M = 31.15, SD =11.83), $t(419) = 5.67$, $p < .05$, d = .62. The effect size for this analysis (d = .62) was found to comply with Cohen's (1988) convention for a large effect ($d >= .50$). This finding shows that the gender variable has a significant effect on students' digital skills. However, it is thought that the effect of gender should be investigated in more depth. In order to eliminate the effect of the students' IT courses, the independent samples t-test was repeated among the students who had taken the IT course in secondary school and high school.

Table 7.

t-test results for DST scores of female and male sub-groups in IT Course group

Sub-groups in IT course group	*N*	*Mean*	*SD*	*Df*	*t*	*Sig.*	*d*
Male	54	44.07	14.32	145	4.33	,000	.72
Female	93	34.66	11.71				

As can be seen from Table 7, the results of the independent samples t-test indicated that the DST scores were significantly higher for the "Male sub-group" (M = 44.07, SD = 14.32) than for the "Female sub-group" (M = 34.66, SD =11.71) in IT course group, $t(145) = 4.33$, $p < .05$, d = .72. The effect size for this analysis (d = .72) was found to comply with Cohen's (1988) convention for a large effect ($d >= .50$). This result shows that the gender variable has a significant effect on digital skills among students who have taken IT courses. The education period of male (M = 3.00) and female (M = 2.95) students is very close to each other.

4.3. IT Teachers

The third research question is whether there is a significant difference between the digital skill levels of students who attend IT courses with IT specialist teachers and students who attend non-specialist teachers? This research question was primarily examined for secondary schools. Although the difference between the group sizes was large, it was decided to use the independence samples t-test, since the assumption of equality of variances controlled by Levene's test was met.

Table 8.

t-test results for DST scores of IT courses in secondary schools with IT teachers and other teachers groups

Groups	*N*	*Mean*	*SD*	*Df*	*t*	*Sig.*	*d*
IT teachers	98	40.91	12.83	122	3.43	.001	.73
Other	26	30.88	14.72				

As can be seen from Table 8, the results of the independent samples t-test indicated that the DST scores were significantly higher for the "IT teachers group" (M = 40.91, SD = 12.83) than for the "Other group" (M = 30.88, SD =14.72) in secondary schools, $t(122) = 3.43$, $p < .05$, $d = .73$. The effect size for this analysis ($d = .73$) was found to comply with Cohen's (1988) convention for a large effect ($d >= .50$). This result shows that the IT specialist teachers for IT courses in secondary schools variable have a significant effect on digital skills among students. Secondly, the same research question was examined for high schools.

Table 9.

t-test results for DST of IT courses in high schools with IT teachers and other teachers groups

Groups	*N*	*Mean*	*SD*	*Df*	*t*	*Sig.*	*d*
IT teachers	90	38.44	12.72	128	2.25	.026	.41
Other	40	32.60	15.67				

As can be seen from Table 9, the results of the independent samples t-test indicated that the DST scores were significantly higher for the "IT teachers group" (M = 38.44, SD = 12.72) than for the "Other group" (M = 32.60, SD =15.67), in high schools, $t(128) = 2.25$, $p < .05$, $d = .41$. The effect size for this analysis ($d = .73$) was found to comply with Cohen's (1988) convention for a medium effect ($d < .50$). This result shows that the IT specialist teachers for IT courses in high schools variable have a significant effect on digital skills among students.

5. Discussions

The first research question in this study sought to determine effect of IT courses in secondary and high school on students' digital literacy level. The results of the research show that the digital skills of the students who take these courses in secondary and high school increase significantly. These courses are called IT courses in the Turkish education system. There are opinions that argue that the new generation born after the spread of digital technologies has innate abilities in digital literacy (Brown & Czerniewicz, 2010; Selwyn, 2009). For this reason, it is argued that students belonging to this generation, which is

defined as digital natives, do not need education in digital literacy. Consequently, the course hours of the courses on digital literacy, including in Turkey, have been reduced or removed in some periods (Bilişim Teknolojileri Eğitimcileri Derneği, 2013; Denholm, 2014; English, 2016; Eynon, 2010). In accordance with the present results, previous studies have demonstrated that students need courses and training to improve their digital skills (Aydin, 2021; Brand-Gruwel et al., 2005; Ng, 2012; Van Deursen & Van Dijk, 2009). In various studies conducted in Turkey, it is emphasized that the course hours of the IT course are insufficient (Eyidoğan, 2013; Gültepe, 2018; Yeşiltepe & Erdoğan, 2013). This study has shown that IT courses are effective in providing students with education in line with the requirements of the digital age, equipping students with 21st century skills and developing their digital skills. For this reason, there is a need for IT courses to be compulsory at the K12 level and to be given in sufficient class hours.

Another important finding of the study was that gender variable has a significant effect on students' digital skills. The digital skills of male students are significantly higher than that of female students. This difference is observed among all students participating in the study and among students who have received information technology education. In accordance with the present results, previous studies have demonstrated that male students' digital skills are better (OECD et al., 2020; Özoğlu & Kaya, 2020; Suwana & Lily, 2017). One of the reasons for this difference is that female students receive less digital literacy education and public policies need to boost women's digital education and self-confidence in digital skills to allow them to succeed and be included as equals in the digital transformation (Mumporeze & Prieler, 2017; OECD et al., 2020). What is surprising is that the digital literacy education period of the male and female students participating in the study is very close. In this case, it cannot be said that the difference between the digital literacy levels between male and female students in the study is due to the digital literacy education received. Within the scope of the study, it was not investigated how long and in what way students use ICT tools in their out-of-school lives. This result may be explained by the fact that women's access to ICT and Internet is lower, especially in developing countries (Abu-Shanab & Al-Jamal, 2015; Acilar & Sæbø, 2021; Alozie & Akpan-Obong, 2017; Gargallo-Castel et al., 2010; Hilbert, 2011). It is also seen that women prefer jobs related to technology and ICT less (Corneliussen & Seddighi, 2019; UNICEF, 2021). This situation, which is called the gender digital divide, is seen as an important obstacle for women to be more active members of the information society and to benefit more from digital technologies.

The current study found that there is a significant difference in digital skills between students whose IT teachers are experts in their fields and those who are not. Students who work with teachers who have expertise in IT education in secondary and high school have higher digital skills. IT courses in Turkey are required to be attended by IT teachers. However, if there is no IT teacher in the school, teachers from different fields can attend IT courses. This also accords with our earlier observations, which showed that this problem is experienced in many other countries (DATTA Australia, 2019; Devier, 2019; Ernst & Williams, 2015; House of Commons Education Committee, 2017; Love & Love, 2022; Moye, 2009; Reinsfeld & Lee, 2021). In this case, it can be said that the participation of IT specialist teachers in IT courses increases the efficiency of the IT courses. Therefore, a sufficient number of teachers must be appointed to schools so that IT specialist teachers can attend all IT courses. There are various studies emphasizing the inadequacy of teachers attending IT courses in Turkey in terms of information technology education (Dursun, 2013; Erdoğan et al., 2010; Yeşiltepe & Erdoğan, 2013). This situation emphasizes the importance of conducting IT courses by experts and competent teachers.

6. Conclusion and Suggestions

With this study, it has been tried to reveal some wrong beliefs that are seen as an obstacle to information technology education in Turkey and in the world. The first of these wrong beliefs is that the new generation that grows up in digital technology does not need digital literacy education and has digital skills from birth. As a result of these false beliefs, the importance given to digital literacy education has

decreased, the course hours have been reduced, the courses have been made elective or completely removed. However, the findings obtained in the study show that students need training on these subjects in order to develop their digital skills and become digital literate. Students who take IT courses in secondary and high school have better digital skills. Students who start their undergraduate education with lack of digital skills experience difficulties in their courses. Instead, digital literacy content that should be taught in IT courses in secondary and high schools is included. These findings of the study reveal the necessity of allocating sufficient time as a compulsory course for digital literacy education in the k12 period.

Another result of the study is that it reveals findings related to Turkey on gender digital divide, which has been the subject of many studies in recent years. Gender digital divide is a frequently reported phenomenon, especially in developing countries, due to the fact that girls have less access to ICT in these countries. Within the scope of the study, it was observed that the digital skills of female students were significantly lower than that of male students. The same result was observed among students who had attended IT courses. In addition, the average duration of IT courses for male and female students is very close to each other. In this case, it cannot be said that the reason why the digital skills of female students are less than male students is the lack of education. As in other developed countries, the fact that female students have less opportunities to use ICT in their daily lives compared to male students can be shown as the main reason for this situation. The necessity of preventing gender digital divide by increasing the access of female students to ICT is among the results of the study.

Another important result of the study is the need for IT teachers. IT teachers in Turkey are mostly graduated from computer and instructional technologies education departments of education faculties. Teaching by non-expert teachers in IT courses at secondary and high school levels causes students' digital skills to not develop enough. The main reason for this result is the mistaken belief that IT courses can be taught by any teacher. The results of the study show that this belief is wrong. For this reason, the necessity of assigning IT teachers in IT lessons has been revealed within the scope of the research. Likewise, it is seen that the self-efficacy perceptions of students regarding their digital skills also differ significantly depending on the gender variable. This finding supports the findings obtained as a result of the digital skill test.

In the study, students' distributions according to the type of high school they graduated from are examined, it is seen that more than half of the participants graduated from Anatolian High School. Since this situation emerged after the data analysis process and data collection was not possible after this process, the analysis processes were carried out according to other variables. This situation stands out as a limitation of the study. In addition, students' use of ICT in their daily lives and outside of IT lessons could not be examined in depth. In future studies, it is recommended to examine the effect of this issue on students' digital literacy.

The findings of this study have a number of important implications for future practice. First, IT courses should be compulsory for all students at the secondary and high school level. More IT teachers should be employed in schools so that all IT courses are attended by IT teachers. In addition, the curricula of IT courses should be constantly updated in line with the changing digital skills in cooperation with relevant international organizations (ICDL, etc.). Another important practical implication is that continued efforts are needed to make female students more accessible to ICT. Moreover, considerably more work will need to be done to determine the causes of gender digital divide in Turkey. In addition, it should be taken into account that all students who start their undergraduate education come with great deficiencies in digital literacy after secondary and high school education. It is suggested that these deficiencies should be eliminated with the courses to be given on digital literacy in undergraduate education. For this reason, it is recommended that the IT course, which was reduced to one semester and three hours, especially in the undergraduate education of the faculty of education, should be extended to two semesters.

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