

Digital Competence: A Study from the Perspective of Pre-service Teachers in Turkey

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ABSTRACT

This study aims to know the opinions of pre-service teachers on their digital competence and to determine whether these opinions vary according to gender, branch and perceived level of digital competence. In this study, a cross-sectional survey model was used. In such a context, the study was conducted with 518 pre-service teachers who were studying in different provinces of Turkey. The study used a digital competence questionnaire as a data collection tool. When the results were evaluated, it can be said that the digital competence of pre-service teachers is moderate and that it varies significantly according to gender, branch and perceived level of digital competence. It is thought that the results of this study will guide the researchers as they reveal the needs of the pre-service teachers and contain information about what should be focused on the training or activities to be organized to meet these needs.



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1 INTRODUCTION

The increasing relevance of technology in business life and employment makes it increasingly important for teachers to integrate technology into their learning-teaching practices (Tondeur et al., 2017). Today's teachers are expected to integrate digital technologies to improve the quality of their learning-teaching activities (Guillén-Gómez, Mayorga-Fernández, Bravo-Agapito, & Escribano-Ortiz, 2020) as well as to become role models for students in the use of digital technologies (Ferrari, 2012; Siddiq, Hatlevik, Olsen, Thronsen, & Scherer, 2016). Although many pre-service teachers were born in an environment where digital technologies are heavily used, this does not mean that they are digitally self-sufficient (Li & Ranieri, 2010).

Nowadays, digital competence is characterized as an indicator of quality education understanding in the 21st-century (Maderick, Zhang, Hartley, & Marchand, 2016), and its importance in being involved in the societies and economy of the 21st century is growing (Napal-Fraile, Peñalva-Vélez, & Mendióroz-Lacambra, 2018). Digital competence has

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to do with: technical information on the use of digital technologies, formal and informal digital environments of information in screening, assessment and management, communication and collaboration, digital content creation, digital media, providing safety, and problem-solving, job, employment, community inclusion, learning about digital technology to achieve the goals of critical, creative thinking, and in a confident manner (Ferrari, 2012). Ilomäki, Paavola, Lakkala, and Kantosalo (2016) state that digital competence encompasses technical skills, the use of digital technologies in business and everyday life, a critical assessment of digital technologies, and participation in digital culture. Digital competence includes taking advantage of the possibilities of digital technologies as well as dealing with their disadvantages (Napal-Fraile et al., 2018).

Different models and frameworks have been developed to date in the measurement and diagnosis of digital competence. In America, the International Society for Technology in Education (ISTE) standards and performance indicators serve as an important guide for teachers to implement technology in their teaching practices (Tondeur et al., 2017). DigEuLit model aims to define, structure and select tools related to digital competence for educators and students and funded by European Commission (Amaro, Oliveira, & Veloso, 2017). DigiLit Leicester has been developed by Leicester City Council to enable middle school teachers to transform classroom practices, leveraging technology to improve their professional development and identity (Fraser, Atkins, & Richard, 2013). Indicator Model for Assessing Student Digital Competence has been designed for measuring and identifying the digital competence of students in Spain (Muñoz-Repiso, Casillas-Martín, & Gómez-Pablos, 2020). Besides, Digital Competence Building Blocks (Janssen et al., 2013), Digital Competence Framework (Calvani, Cartelli, Fini, & Ranieri, 2008), and the five-skill holistic conceptual model for digital literacy (Eshet-Alkalai, 2004) have also been proposed for the development of the digital competence. In Europe, the DigComp framework for digital competence, which is seen as one of the eight key competences in the education process, has been developed (Carretero, Vuorikari, & Punie, 2017; Vuorikari, Punie, Carretero, & Brande, 2016).

The DigComp framework is based on 15 previously designed frameworks related to digital competence. It is one of the most up-to-date and comprehensive frameworks developed today regarding digital competence (Siddiq et al., 2016). The DigComp framework was developed to help shape digital competence improvement policies and to be an instrument for planning education and training initiatives (Vuorikari et al., 2016). DigComp encompasses meta-cognitive skills unlike other frameworks and models (Janssen et al., 2013). DigComp divides digital competences into five different areas: information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving (Ferrari, 2013). In this context, “Information and data literacy” covers information requirements determination, the information in digital environments, search for content and data, critical evaluation, comparison, interpretation, analysis, storing, organizing, and processing digital information, content, and data. “Communication and collaboration” reflects interaction through digital devices and applications, sharing information, data, and content with different people, knowledge about resource representation and citation. It

additionally includes the need to know that digital technologies can be used in official transactions with institutions, to be able to find social media, as well as digital and community networks digital content taking advantage of collaboration tools in facilitating the development process, how to pay attention to ethical principles when publishing the information, one or more of the benefits of having a digital identity, and knowing how the online and offline lives are linked with each other. “Digital content creation” refers to the ability to create digital content in different formats, to be able to express yourself through multimedia technologies, covers to be able to make changes to content created by others in accordance with the copyright, alongside knowing how to develop simulations, programming skills and software. “Safety” emphasizes being aware of the risks of digital technologies, paying attention to information privacy, being aware of privacy issues, and knowing the physical and psychological health and environmental impacts caused by the intensive use of digital technologies. “Problem-solving” requires to solve the problems in the digital environment, to choose the most appropriate digital technology, to be aware of the potential of digital technologies to create information and self-expression, and to have knowledge and expertise about the main technologies used in the field.

Today, the number of studies conducted to comprehensively determine the digital competences of pre-service teachers is limited (Alarcón, del Pilar-Jiménez, & Vicente-Yagüe, 2020; Gutiérrez-Portlán & Serrano-Sánchez, 2016; Lázaro-Cantabrana, Usart-Rodríguez, & Gisbert-Cervera, 2019). In the studies conducted, Casillas-Martín, Cabezas-González, and García-Peñalvo (2019) examined how 332 pre-service teachers in Spain assessed their digital competences. Hinojo-Lucena, Aznar-Díaz, Cáceres-Reche, Trujillo-Torres, and Romero-Rodríguez (2019) investigated whether the digital competences of 140 teachers in Spain vary according to variables such as age, gender, experience and branch. Following the digital competence training given to 30 pre-service teachers in Turkey, Çebi and Reisoğlu (2019) determined whether the change in pre-service teachers’ perceptions of digital competence varies according to the branch. Napal-Fraile et al. (2018) analyzed the perceptions of the digital competence of 43 secondary school teachers who had a master’s degree in Spain. Krumsvik, Jones, Øfstegaard, and Eikeland (2016) investigated whether 2477 teachers in Norway had a relationship between their digital qualifications and their demographics. Keskin and Yazar (2015) studied whether the digital competences of 286 teachers in pedagogical formation in Turkey vary according to their gender and branches. As a result of the research conducted, it was determined that digital competence training supported the development of pre-service teachers in different branches (Çebi & Reisoğlu, 2019). According to the branch, the digital competences of teachers (Hinojo-Lucena et al., 2019) were found to differ significantly. In addition to the fact that gender predicts digital competence (Krumsvik et al., 2016), or in other saying, that pre-service teachers’ digital competence varies according to gender (Casillas-Martín et al., 2019), there are also results showing that they do not (Hinojo-Lucena et al., 2019). In some of these studies, the digital competences of the pre-service teachers were examined in the context of their ability to use basic computers, the internet, to obtain information in digital media, and to know whether they have knowledge about technologies that have developed in recent

years (Casillas-Martín et al., 2019). In the studies carried out based on the DigComp framework, the digital competences of the pre-service teachers were examined descriptively (Napal-Fraile et al., 2018) and the relationship of variables such as gender, age and professional experience with the digital competence was investigated (Hinojo-Lucena et al., 2019). One or more areas linked to digital competence were evaluated. In a limited number of studies, all dimensions of digital competence have been taken into account, and studies have often been conducted within specific countries. For this reason, studies that comprehensively address the digital competences of the pre-service teachers, and which specifically express the deficiencies of the pre-service teachers and which areas are different according to variables such as gender, branch and perceived level of digital competence are required. Within this framework, the deficiencies in the scope of digital competence can be identified and suggestions can be made on how the content of training should be aimed at addressing these deficiencies. These studies must be carried out within the scope of different countries because the policies of each country regarding teacher training programs are different. In this way, each country can undertake necessary activities and initiatives in accordance with its own needs. In this respect, the research questions discussed in the study are as follows:

1. What is the opinion of the pre-service teachers regarding their digital competences?
2. Do pre-service teachers' opinions on digital competences vary *a)* according to gender?; *b)* according to branch?; *c)* according to the perceived level of digital competence?

2 METHOD

In this study, a cross-sectional survey model was used. The cross-sectional survey model is a research model which aims to know individuals' opinions on the subject being examined at a given time (Fraenkel, Wallen, & Hyun, 2012).

2.1 Participants

The survey involved 587 pre-service teachers from 51 provinces of Turkey who are studying in 63 different universities and who apply online for digital competence education. However, 69 questionnaires were not filled out properly and were not included in the study. The study was conducted within the framework of data obtained from 518 pre-service teachers. 79.2% of the study participants were female (n=410) and 20.8% were male (n=108). The average age of pre-service teachers was calculated as 22.06 ($SD=2.39$). The branches of pre-service teachers were distributed as follows: 22.0% computer education and instructional technologies (CEIT) (n=114), 24.3% primary school teaching (n=126), 12.9% social studies teaching (n=67), 10.8% pre-school teaching (n=56), 10.4% science teaching (n=54), 7.5% psychological counselling and guidance (PCG) (n=39), 4.6% mathematics teaching (n=24), 4.4% Turkish language teaching (n=23), and 2.9% other teaching branches (n=15). Finally, pre-service teachers were asked about the levels of perceived digital competence, and the perceived digital competence level of 17.2% has been identified as low, 68.5% as moderate

(n=355), and 14.3% as high (n=74).

2.2 Data collection tool

Digital competence questionnaire developed by researchers based on the DigComp framework was used as a data collection tool in the study. The questionnaire was prepared to cover five dimensions of digital competence (“Information and data literacy”, “Communication and collaboration”, “Digital content creation”, “Safety”, and “Problem-solving”). In the development of the questionnaire, a guide for DigComp prepared by Carretero et al. (2017) was used. Two faculty members working in the field of digital competence were asked for an opinion on the evaluation of the questionnaire prepared in terms of scope and expression. According to the feedback from the experts, revisions were made on the items. Afterward, opinion was received from the expert in Turkish language teaching to evaluate whether the form was linguistically understandable. In addition, this questionnaire was used in the study conducted by Çebi and Reisoğlu (2019) and was used in this study by making minor revisions on some items. It was a 5-point Likert-type questionnaire ranging from 1 (“strongly disagree”) to 5 (“strongly agree”).

2.3 Data analysis

Descriptive and predictive analysis methods were applied in the examination of the obtained data. The assumptions about the analysis were tested before the analysis began. In this context, the normality distributions of the responses to each item were examined. Skewness and kurtosis values for each item were determined to be in the range between -1.361 to +1.464. Since these values were in the ranges specified by Tabachnick and Fidell (2013), it can be said that the normal distribution assumptions were met. Likewise, whether there was a normal distribution for each sub-group was checked in the analyses. The mean and standard deviation values of the attendance status of the pre-service teachers for each item were calculated. Besides, if there was a difference between the opinions of the pre-service teachers according to gender and branch was tested with the independent t-test and if there was a difference between the level of digital competence was tested with one-way ANOVA. In the analysis of the data, intergroup comparisons were made using the Bonferroni correction and the analyses were carried out with the IBM SPSS 25.0 software.

3 RESULTS

3.1 Pre-service teachers' opinions on digital competences

Table 1 summarized the responses of pre-service teachers to the questionnaire on digital competence in the areas of information and data literacy, communication and collaboration, digital content creation, safety and problem-solving.

When the data in Table 1 were examined, it was seen that the average response of the pre-service teachers to the items in the areas of “information and data literacy” and “communication and collaboration” was 3.8 and above. However, both “digital content creation”

Table 1 Results of the descriptive analysis of the digital competences of pre-service teachers (n=518)

Digital competence areas	Digital competence questionnaire items	Mean	SD
Information and data literacy	I identify my needs when searching for data, information or digital content in online environments.	4.08	0.78
	I use information search strategies to access data, information, and digital content in online environments.	3.81	0.88
	I critically evaluate the accuracy of the data, information or digital content I access.	3.91	0.89
	I access the data, information and digital content I need in online environments.	3.99	0.77
	I investigate from different sources whether the data, information or digital content I access is reliable.	4.04	0.92
Communication and collaboration	I pay attention to source and citation representations when sharing data, information or digital content.	4.04	0.95
	I easily organize and store data, information and content in online environments.	3.78	0.92
	I use digital technologies to communicate in online environments.	4.23	0.82
	I share data, information or digital content using different digital technologies.	3.82	1.00
Digital content creation	I use digital technologies to collaborate in online environments.	3.80	0.98
	I comply with behavioral norms (ethical rules) when interacting in online environments.	4.51	0.71
	I develop content in simple forms using digital technologies.	3.22	1.11
	I can develop content in different formats (video, visual, animation, etc.) using digital technologies.	3.42	1.14
Safety	I pay attention to copyrights and licensing when developing digital content.	3.76	1.12
	I produce digital content by making changes to ready-made content.	3.31	1.11
	I know what to look out for when creating a digital identity (profile) in online environments.	4.07	0.97
	I am aware that I leave a digital footprint when I navigate online environments.	3.98	1.11
	I am aware of the risks and threats in online environments.	4.14	0.96
	I take different measures to protect my digital device and content.	3.56	1.05
	I take precautions about safety and privacy in online environments.	3.84	0.97
	I protect personal data and privacy in online environments.	4.20	0.85
	When sharing my personal information online, I take precautions to protect the personal data of others (not to tag them in a photo without permission, etc.).	4.39	0.84
	I am aware of the effects of digital technology use on health (physical, psychological).	4.25	0.83
	I am familiar with data policies (how to use personal data) of the digital services that I am a user of (social networking, etc.).	3.87	1.00
Problem-solving	I am aware of the environmental impact of using digital technologies.	4.22	0.87
	I know how to deal with online threats.	3.20	1.10
	I identify the causes of technical problems I encounter when using digital media and devices.	3.25	1.04
	I solve the technical problems I encounter when using digital media and devices.	3.13	1.01
	I use different digital technologies to create innovative solutions.	3.41	1.06
	I identify opportunities for the development of my digital competences.	3.61	0.96
	I develop my digital competence by following new developments.	3.81	0.95

and “problem-solving” areas of items had a relatively lower response average than other items. “*I develop content in simple forms using digital technologies*” item in “digital content creation” has the lowest average ($M=3.22$; $SD=1.11$). In the “problem-solving” area, “*I solve the technical problems I encounter when using digital media and devices*” has the lowest average ($M=3.13$; $SD=1.01$). When the means of items related to “Safety” were evaluated, it was determined that pre-service teachers generally pay attention to their and others’ privacy and personal data, and the mean scores of their opinions on awareness of the effects of digital technologies on health and environment were high. However, their response to deal with online threats ($M=3.20$; $SD=1.10$) as well as to protect the digital device and its content

($M=3.56$; $SD=1.05$) was found to be relatively low. In general, when all item averages were evaluated, it can be said that pre-service teachers' digital competence was above the average.

3.2 Examination of pre-service teachers' opinions on their digital competence in terms of various variables

3.2.1 Pre-service teachers' opinions on digital competence according to gender

When examining whether pre-service teachers' opinions on digital competence differed by gender, a significant difference was found in favor of male pre-service teachers in the other four areas, excluding communication and collaboration.

- In the items “*I identify my needs when searching for data, information or digital content in online environments*” ($t_{(516)}=-3.134, p<.01$) and “*I access the data, information and digital content I need in online environments*” ($t_{(516)}=-2.580, p<.05$) in the “Information and data literacy” area;
- In the items “*I develop content in simple forms using digital technologies*” ($t_{(516)}=-2.273, p<.05$) and “*I produce digital content by making changes to ready-made content*” ($t_{(516)}=-2.522, p<.05$) in the “Digital content creation” area;
- In the items “*I take different measures to protect my digital device and content*” ($t_{(516)}=-2.906, p<.01$), “*I take precautions about safety and privacy in online environments*” ($t_{(516)}=-3.201, p<.01$) and “*I know how to deal with online threats*” ($t_{(516)}=-2.288, p<.05$) in the “Safety” area;
- In the area of “Problem-solving”, differences were found in the items “*I identify the causes of technical problems I encounter when using digital media and devices*” ($t_{(516)}=-3.948, p<.01$), “*I solve the technical problems I encounter when using digital media and devices*” ($t_{(516)}=-4.142, p<.01$), “*I use different digital technologies to create innovative solutions*” ($t_{(516)}=-3.462, p<.01$) and “*I develop my digital competence by following new developments*” ($t_{(516)}=-2.753, p<.01$) in favor of male pre-service teachers.

However, the effect sizes (Cohen's d) for these significant differences were determined to vary between 0.218 and 0.445. In other words, the effect sizes, which are significant according to gender, can be said to be small.

3.2.2 Pre-service teachers' opinions on digital competence according to branch

The pre-service teachers of the CEIT branch, who have various courses in their curriculum related to digital competences, were treated as one group and the pre-service teachers of the other branch as a second group to examine whether their opinions on digital competences differ according to the branch. The courses taken by other branch pre-service teachers other than CEIT in the context of digital technologies or digital competences were similar and evaluated under the same group. As a result of the analysis, differences were determined in favor of CEIT pre-service teachers in all areas of digital competence.

- In the area of “Information and data literacy”, a significant difference was found in “*I identify my needs when searching for data, information or digital content in online environments*” ($t_{(516)}=2.451, p<.05$) and “*I access the data, information and digital content I need in online environments*” ($t_{(516)}=3.103, p<.01$) items. The effect size was determined to be small. In the “*I use information search strategies to access data, information, and digital content in online environments*” ($t_{(516)}=3.926, p<.01$) item, a medium effect size was obtained.
- In the area of “Communication and collaboration”, a significant difference was found in “*I easily organize and store data, information and content in online environments*” ($t_{(516)}=2.845, p<.01$), “*I use digital technologies to communicate in online environments*” ($t_{(516)}=3.391, p<.01$), and “*I share data, information or digital content using different digital technologies*” ($t_{(516)}=2.355, p<.05$) items. The effect size of these differences was determined to be small. In the “*I use digital technologies to collaborate in online environments*” ($t_{(516)}=4.367, p<.01$) item, a medium effect size was obtained.
- A significant difference was found in “*I develop content in simple forms using digital technologies*” ($t_{(516)}=7.871, p<.01$) and “*I can develop content in different formats (video, visual, animation, etc.) using digital technologies*” ($t_{(516)}=6.648, p<.01$) items in the “Digital content creation” area and this difference has a large effect size. Besides, the “*I produce digital content by making changes to ready-made content*” ($t_{(516)}=6.529, p<.01$) item was found to be different in favor of CEIT pre-service teachers. This difference has a moderate effect size.
- In the “Safety” area, the “*I am aware that I leave a digital footprint when I navigate online environments*” ($t_{(516)}=5.630, p<.01$) item was determined to be the item with a larger effect size difference when compared to the branch. Furthermore, the effect size of “*I know what to look out for when creating a digital identity (profile) in online environments*” ($t_{(516)}=4.467, p<.01$) and “*I know how to deal with online threats*” ($t_{(516)}=6.091, p<.01$) items was found to be moderate. Finally, in the “*I am aware of the risks and threats in online environments*” ($t_{(516)}=3.511, p<.01$), “*I take different measures to protect my digital device and content*” ($t_{(516)}=3.752, p<.01$), “*I take precautions about safety and privacy in online environments*” ($t_{(516)}=2.688, p<.01$) and “*I protect personal data and privacy in online environments*” ($t_{(516)}=2.786, p<.01$) items, it was determined that there was a significant difference in favor of CEIT pre-service teachers, but this difference had a small effect size.
- In the area of “Problem-solving”, the scores of CEIT pre-service teachers were higher in “*I identify the causes of technical problems I encounter when using digital media and devices*” ($t_{(516)}=6.107, p<.01$), “*I solve the technical problems I encounter when using digital media and devices*” ($t_{(516)}=5.764, p<.01$) and “*I use different digital technologies to create innovative solutions*” ($t_{(516)}=6.007, p<.01$) items than those in other branches and this difference had a medium effect size. Also in the “*I identify opportunities for the development of my digital competences*” ($t_{(516)}=3.936, p<.01$) and “*I develop my digital competence by following new developments*” ($t_{(516)}=3.630, p<.01$) items, there is a difference in favor of CEIT pre-service teachers. But the effect size is small.

3.2.3 Pre-service teachers' opinions on digital competence according to the perceived level of digital competence

It was determined that pre-service teachers' opinions on digital competences, as a result of the analyses to check whether the level of perceived digital competence has changed, each item in the questionnaire changed according to digital competence and teachers who have higher digital competence than the others scored higher than others. Besides, it has been determined that there is a large effect size in some items which have a significant difference according to the level of digital competence perception. The effect size of the significant difference in the "I can develop content in different formats (video, visual, animation, etc.) using digital technologies" ($F_{(2,515)}=57.810, p<.01, \eta^2=0.183$), "I produce digital content by making changes to ready-made content" ($F_{(2,515)}=50.289, p<.01, \eta^2=0.163$), "I identify the causes of technical problems I encounter when using digital media and devices" ($F_{(2,515)}=41.827, p<.01, \eta^2=0.140$), "I solve the technical problems I encounter when using digital media and devices" ($F_{(2,515)}=51.031, p<.01, \eta^2=0.165$), "I use different digital technologies to create innovative solutions" ($F_{(2,515)}=43.398, p<.01, \eta^2=0.144$), and "I develop my digital competence by following new developments" ($F_{(2,515)}=42.558, p<.01, \eta^2=0.142$) items was found to be large. In other words, it can be said that according to the level of digital competence, the status of pre-service teachers to perform actions related to the areas of digital content creation and problem-solving varies.

There was no significant difference in the "I pay attention to copyrights and licensing when developing digital content" ($F_{(2,515)}=6.300, p<.05, \eta^2=0.024$), "I protect personal data and privacy in online environments" ($F_{(2,515)}=7.612, p<.05, \eta^2=0.029$), "I am aware of the effects of digital technology use on health (physical, psychological)" ($F_{(2,515)}=5.681, p<.05, \eta^2=0.022$), and "I am aware of the environmental impact of using digital technologies" ($F_{(2,515)}=8.428, p<.05, \eta^2=0.032$) items between pre-service teachers with moderate digital competence and those with low digital competence. In these items, a difference only between pre-service teachers with a high level of digital competence and the other two groups was obtained. Finally, in the "I comply with behavioral norms (ethical rules) when interacting in online environments" ($F_{(2,515)}=5.493, p<.05, \eta^2=0.021$) and "When sharing my personal information online, I take precautions to protect the personal data of others (not to tag them in a photo without permission, etc.)" ($F_{(2,515)}=6.102, p<.05, \eta^2=0.023$) items, a difference only between groups with high and low digital competence was found to be significant.

4 DISCUSSION AND CONCLUSIONS

In this study, it was aimed to know the opinions of the pre-service teachers regarding their digital competence and to determine whether these opinions vary according to gender, branch and perceived level of digital competence. As a result of the study, it can be said that pre-service teachers' digital competence item responses to the areas of information and data literacy, communication and collaboration, and safety were higher than the areas of digital content creation and problem-solving. The knowledge and skills of the pre-service teachers,

especially in developing content in simple forms using digital technologies and solving technical problems when using digital media and devices, have a low average compared to other digital competence knowledge and skills. This may be due to the focus on theoretical knowledge in teacher training programs, lack of practices for content development and technical problems. The fact that pre-service teachers feel more advanced in the areas of information and data literacy, communication and collaboration, and safety may be due to their use of digital technologies in their daily lives in line with these areas. In the literature, it was determined that the pre-service teachers considered themselves to have a low level of competence in the areas of digital content creation (Gutiérrez-Portlán & Serrano-Sánchez, 2016; Hinojo-Lucena et al., 2019), safety (Gutiérrez-Portlán & Serrano-Sánchez, 2016; Portlán & Sánchez, 2016), and problem-solving (Esteve-Mon, Ángeles Llopis, & Adell-Segura, 2020). It was determined that pre-service teachers' competences about searching information, screening and assessment, storage, and organizing (Gutiérrez-Portlán & Serrano-Sánchez, 2016), protection from threats that may come from devices and awareness of the physical, psychological, and environmental effects of the digital technologies, were good; competences in digital content creation, its integration, copyright and licensing were lower (Napal-Fraile et al., 2018). It can be stated that the results obtained in this direction are in parallel with the literature.

In terms of gender, male pre-service teachers were better at information and data literacy, digital content creation, safety, and problem-solving. Males were found to outperform females in identifying and accessing information, data and digital content related to information and data literacy. It was determined that male pre-service teachers received higher scores than female pre-service teachers in developing content in simple forms and making changes to ready-made content in the area of digital content creation. It is understood that male pre-service teachers are better at taking safety and privacy measures online to protect digital devices and content in the area of safety. Concerning problem-solving as related to identifying the causes and finding solutions to the problems encountered when using technical devices, the use of different digital technologies to create innovative solutions and new developments male pre-service teachers were better than female pre-service teachers by following in the development of digital competence. This may be due to the fact that males are more interested in using digital technologies than females. In the literature, Keskin and Yazar (2015) found that male teachers had higher competences in basic computer use and acquiring information in digital media than female teachers. Esteve-Mon et al. (2020) confirmed that female pre-service teachers were less qualified than men in solving technical problems and programming. Besides, different studies have concluded that male pre-service teachers generally have higher digital competences than female pre-service teachers (Casillas-Martín et al., 2019; Guillén-Gámez et al., 2020). In this respect, it can be stated that the results obtained were useful in terms of paralleling the literature as well as specifically presenting the differences between male pre-service teachers and female pre-service teachers.

As a result of the study, it becomes clear that CEIT pre-service teachers have higher digital competences in all areas than other branch pre-service teachers. In terms of infor-

mation and data literacy, they have higher scores than teachers belonging to other branches, especially in using information searching strategies to access information, data and digital content. It is understood that they are better at using digital technologies to work collaboratively online in the area of communication and collaboration than teachers framed within other branches. In the area of digital content creation, they were found to be better than teachers of other branches in developing simple and different forms of content using digital technologies, making changes to ready-made content and creating digital content. They are better than others in the area of safety in terms of being aware that they leave a digital footprint when navigating online environments, knowing what to look for when creating a digital identity (profile) in online environments, and how to deal with online threats. In the area of problem-solving, it was revealed that they achieved higher scores than teachers belonging to other branches in identifying the causes and finding solutions to the problems encountered when using digital media and devices, and in using different digital technologies to create innovative solutions. This may be due to the concentration of courses on digital competences in the curriculum of CEIT pre-service teachers. In the literature, [Keskin and Yazar \(2015\)](#) found that the digital competences of using basic internet tools and obtaining information from digital media vary according to the branch, though CEIT pre-service teachers were not included in their study. [Çebi and Reisoğlu \(2019\)](#) revealed that CEIT pre-service teachers were better at various competences in the lower areas of digital competence than teachers in other branches. This suggests that the results are in tune with the literature.

Significant differences were obtained in all areas of digital competence according to the perceived level of digital competence of the pre-service teachers. It was determined that the effect size of the difference in performing actions, particularly in the areas of digital content creation and problem-solving, was large. This effect has emerged in the items related to digital content creation, developing content in different formats using digital technologies, making changes to ready-made content, and producing digital content. It was determined that there was a difference in the levels of perceived digital competence, and this difference had a large effect in the areas of problem-solving, identifying the causes and finding solutions to the problems encountered when using digital media and devices, using digital technologies to create innovative solutions, and developing digital competences by following the new developments. In the literature, [Napal-Fraile et al. \(2018\)](#) found that pre-service teachers having done a master's degree did not consider themselves sufficiently qualified to develop digital content and integrate different content. [Instefjord and Munthe \(2017\)](#) pointed out that pre-service teachers were expected to perform above their current digital competence in their internship schools at the point of developing digital content. [Røkenes and Krumsvik \(2016\)](#) concluded that pre-service teachers need to be trained in digital content creation. Considering these studies in the field and the results of the current study, it can be said that pre-service teachers are lacking in the development of digital content.

5 LIMITATIONS AND SUGGESTIONS

One of the limitations of this study is that due to the collection of the data obtained through the survey, the analyses were done on an item basis and the results were evaluated through these analyses. Therefore, it may be useful to focus on the measurement studies developed to cover all areas of digital competence in future studies. Thus, research based on the cause-effect relationship could be carried out when generalizable results can be obtained regarding digital competence. Besides, it may be stated that the pre-service teachers should develop themselves in the areas of digital content creation and problem-solving in line with the results obtained from the study. In this context, in the training to be given about digital competence, the knowledge and skills to develop content in simple forms using digital technologies and to solve technical problems encountered while using digital media and devices can be given weight. In addition to these issues, it may be useful to pay attention to the information, data and identifying needs and those associated with accessing digital content, making changes to ready-made content, implementing measures to protect the digital device and contents, taking measures related to safety and privacy in the online environment, identifying the causes and finding solutions to the problems, and using different digital technologies to create innovative solutions by following the development of digital competence issues. It may be helpful to give weight to the training programs to be given other branch teachers, about using information search strategies for accessing information, data, and digital content in an online environment, using digital technologies for the purposes of cooperative work, simple and different forms of content development, producing digital content by making changes to ready-made content, being aware of leaving a digital footprint while browsing, paying attention when creating a digital identity profile in online environments, knowing how to handle online threats, identifying the causes and finding solutions to the technical problems encountered when using digital media and devices, as well as the use of different digital technologies to create innovative solutions. Practical courses and activities to support this knowledge and skills can also be added to the teacher training programs of different branches. In teaching practice courses, they may be asked to design activities that support the development of this knowledge and skills.

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