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Research Article

Investigating digital skills among Russian higher education students

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ABSTRACT

Learning in the digital age is a pervasive idea that encompasses all aspects of a person's life, including work and leisure. As a result of the development of new teaching and learning tools, an increasing number of students are acquiring knowledge on the Internet- connected to the Internet. Therefore, all citizens must develop digital literacy as a lifelong learning skill. Studies have been conducted on students' digital skills in higher education institutions. In this context, this study aimed to investigate the skills of college students. The participants were students from a university in the Kazan region of Russia who volunteered to participate. Three hundred and eighty students completed the questionnaire online. The scale consists of a total of 25 questions and six dimensions. Since our independent variables are binary values, we applied the Bayesian t-test. We obtained the values of the Bayes factor (BF10) for each dimension and the total scale. In general, students' digital skills are well-developed. However, it was found that creating and

using digital information requires fewer skills than in other areas. The hypothesis that there is no difference based on student gender was supported to a higher degree but not to a very high degree. The hypothesis that there is no difference based on students' fields of study was supported to a greater extent, but only to a moderate extent.

Keywords: digital skills, higher education, Bayesian analysis, Russia

INTRODUCTION

Changes in technology and science affect social and educational practices and the practices themselves. For example, when the nature of available technological tools changes, this can sometimes lead to changes in learning processes and the knowledge structures to be acquired. Learning in the digital age is an all-encompassing concept that encompasses all aspects of people's lives, from study to work to leisure activities. As a result, it creates new challenges for all education stakeholders, as Fleaca and Stanciu (2019) noted. These challenges are because we live in an age of constant innovation and technological progress. Education in all its manifestations is influenced by information and communication technologies (ICT), including higher education and the vast majority of economic sectors. Students are increasingly learning in venues with internet access, and thanks to the development of new instruments for teaching and learning (Youssef et al., 2022).

Recently, the development of digital competencies among higher education students has attracted considerable research attention, emphasizing student employability and the importance of digital skills (JISC, n.d.). This attention has focused on the basic, advanced, and specialized digital skills needed in specific disciplines and fields of work (Martzoukou et al., 2021).

The Internet and other forms of digital technology are deeply embedded in people's routines and activities in the 21st century. Therefore, to achieve personal fulfillment and development, employment, social inclusion, and active citizenship, all citizens must acquire digital literacy as a critical lifelong learning skill. This literacy will facilitate personal fulfillment and development (Council of the European Union, 2018). The terms "digital competence" and "digital literacy" are increasingly used and discussed, especially in policy documents and policy-related discussions. The discussion refers to topics such as "what kinds of skills and knowledge people should have in a knowledge society," "what to teach young people," and "how to do it" (Ilomäki et al., 2016). This discussion is especially true for policy documents and discussions about "what kinds of skills and knowledge people should have" (Spante et al., 2018).

According to Martin and Grudziecki (2006), this point shows that digital literacy is the foundation on which digital competence is built. The ability to manage information, the ability to distinguish the virtual world from the real world and recognize the connections between them, the ability to use Internet-based services, and the ability to use technology to support critical thinking, creativity, and innovation are considered necessary skills (Ferrari, 2012). Several researchers have attempted to address measurement issues by developing more nuanced classifications of Internet literacy among large populations (Eshet-Alkali & Amichai-Hamburger, 2004; Helsper & Eynon, R., 2013; Livingstone, 2008; van Deursen & van Dijk, 2015). A pedagogical view often focuses on evaluating students in specific classes (Litt, 2013). This evaluation does not consider the evaluation of regular and daily use of the Internet in general by larger populations.

ICTs are driving significant changes in higher education (DeSchryver, 2009; Henderson et al., 2017; Rodríguez-Abitia & Bribiesca-Correa, 2021), encouraging the use of diverse techniques, with initiatives seeking to promote flexibility in administrative tasks and modular organization of institutions (Youssef et al., 2022). The importance of information and communication technology (ICT) knowledge and experience among higher education students have been the subject of several studies (Harerimana & Mtshali, 2019; Martzoukou et al., 2021; Polifroni Lobo & Beltrán Sánchez, 2016; Samoylenko et al., 2022), all of which concluded that such knowledge and experience contribute to the success of higher education students. This information is surprising given that competent digital skills are often considered a prerequisite for successfully using information and communication technologies in education (Ben Youssef et al., 2015; Hämäläinen et al., 2019; van Laar et al., 2017). Other conditions conducive to the effective use of ICT include mastery of the material provided, an attitude of critical questioning of the quality of the information provided to students, and the use of safe operating methods (Youssef et al., 2022).

The survey conducted by Zeidmane and Vintere Alan (2021) examined students' perspectives on the digital skills needed for the job market. The survey results show that students view the ability to use and manage information as the most valuable talent in today's job market. 69.84% of survey participants consider it indispensable. This result is followed by information assessment (67.19%), then the capacity to acquire information (65.15%). Coding and programming information was ranked as the least essential skill by just over a quarter of survey participants (26.15%).

The study by Nguyen et al. (2022) examined optometry students' digital experiences and practices concerning their profession and preparation for future employment in health care. The results suggest that this particular group of students are active and routine digital users who report having a high level of confidence in their ability to use everyday digital tools for learning and who prefer mobile devices (laptops and smartphones) to stationary desktop workstations. According to the research conducted by Perifanou et al. (2021), university students in Greece have a high level of digital abilities. Nevertheless, they perform poorly in the Develop, Apply and Modify (DAM). According to the results of a study (León-pérez et al., 2020), students use digital technology mainly in academic projects. They can use ICT for information management, develop critical thinking, solve problems, and manage mobile devices. In addition, students use digital technology mainly in academic projects. They believe participation in educational initiatives helps acquire and develop information and communication technology (ICT) skills.

In students' self-perceptions of their information and data processing skills, respondents ranked the ability to compare and integrate information from multiple sources as the most important skill (3.52), followed by the ability to adapt search strategies to a particular search engine (3.38), and the ability to select information based on one's search goals (3.30). The remarkable results of data analysis suggest that students cannot distinguish between credible and questionable sources of information (2.96). Regarding digital communication skills, respondents were most likely to value their ability to process information via email, slide presentations, and social networking (3.48). This situation was followed by the ability to share information and use the collaborative network to collect feedback via Google Drive and Dropbox (3.20). Finally, web-based collaborative services track changes and comments on documents/resources (3.12). Students cannot create different e-profiles (3.03) and select material to set according to their needs or goals. This finding is a problem because these skills are essential for using the platform (3.07) (Fleaca & Stanciu, 2019).

Studies have been conducted on the digital skills of university students. Within this framework, the purpose of this study was to investigate students' skills. The research questions are as follows.

1. What are the digital skills of the participants?
2. To what extent do the study data prove whether the level of digital skills differs according to gender?
3. To what extent do the study data confirm whether participants' digital skills differ according to their field of study?

METHODOLOGY

The study aimed to determine the extent to which university students possess digital abilities. The purpose of the study will be achieved through the use of a quantitative methodology. In addition, the study will examine the status of students' digital skills concerning their fields of study and gender.

Participants

The study's sample consists of students from a college in the Kazan region of Russia who voluntarily participated. Undergraduate students studying in the spring semester of the 2021-2022 academic year were invited to participate. The questionnaire was completed online by 318 students. At the beginning of the survey, students were told they were under no obligation and could stop taking the survey if they wished. Students were informed that the survey data would be used for academic study purposes.

Table 1. Skewness and Kurtosis values for each dimension and total scale

	Skewness	SE of Skewness	Kurtosis	SE of Kurtosis
Access to and management of digital content	-0.901	0.137	-0.075	0.273
Digital empathy	-0.931	0.137	0.227	0.273
Use of digital means	-0.68	0.137	-0.339	0.273
Digital safety	-0.843	0.137	-0.245	0.273
Communication of digital content	-1.038	0.137	0.174	0.273
Creation of digital content	-0.695	0.137	-0.441	0.273
Total	-0.904	0.137	-0.043	0.273

Instrument

Fan and Wang (2022) developed the original digital skill scale. Adaptation studies have been conducted for various countries. An adaptation of the scale to the Russian context was made by Kryukova et al. (2022). The scale consists of a total of 25 questions and six dimensions. Access to and managing digital content includes questions on the ability to access and manage digital resources. For example, access to data was measured by the question, "I am able to search for, and access information in digital environments," and management of the data obtained was measured by the question "I can use different tools to store and manage information." Reliability for this dimension was calculated using McDonald's ω (.954) and Cronbach's α (.954). In the digital empathy dimension, five items measure students' understanding of other people's situations and respect for them. An example item for this dimension is "I am able to put myself in other people's shoes in digital environments." Reliability for this dimension was calculated using McDonald's ω (.942) and Cronbach's α (.944). In the Use of Digital Means dimension, there are four items on using digital media for a specific purpose. For example, "I am able to use digital means to solve problems encountered in my study", digital resources are used to solve problems. Reliability for this dimension was calculated as McDonald's ω (.934) and Cronbach's α (.934). Five items in the digital safety dimension measure whether they pay attention to safety in social environments and Internet applications. The item "I avoid behaviors that are harmful in social networks" can be an example of this dimension. Reliability for this dimension was calculated using McDonald's ω (.931) and Cronbach's α (.931). In the digital content communication dimension, three items measure the use of digital tools for communication purposes. The item "I know how to communicate with others through different digital means" can be an example item for this dimension. Reliability for this dimension was calculated using McDonald's ω (.953) and Cronbach's α (.953). Two items are related to digital content creation in the digital content creation dimension. The item "I know different ways to create and edit digital content (e.g., videos, photos, texts, animations...)" can be an example of this dimension. Reliability for this dimension was calculated as Cronbach's α (.882). Since there are two items in this dimension, the McDonald's ω cannot be calculated. McDonald's ω (.982) and Cronbach's α (.982) were calculated for the total scale.

Data analysis

Before proceeding with the inferential analysis, we needed to determine whether or not the measurements followed a normal distribution. The skewness and kurtosis values were analyzed to determine whether or not the data followed a normal distribution, as Kim (2013) suggested. For sample sizes greater than 300, interpretation will be based on the histograms and the absolute values of skewness and kurtosis; the z-values will not be considered. To detect a significant deviation from normality, a reference value can be used with either an absolute skewness value greater than two or an absolute kurtosis value greater than seven (Kim, 2013). Consequently, each measurement corresponds to a normal distribution (**Table 1**).

The Bayesian method was preferred to estimate the support status of the Ho and H1 hypotheses based on students' gender and fields of study. We used Bayesian t-test because our independent variables had binary values. Bayesian factor scores (BF10) and total scale were determined for each dimension. The criteria listed in **Table 2** were considered when interpreting Bayesian factor scores (Dienes, 2014).

Table 2. BF10 criteria

Criteria (BF10)	Interpretation
> 100	Extreme evidence for H1
30 – 100	Very strong evidence for H1
10 – 30	Strong evidence for H1
3 – 10	Moderate evidence for H1
1 – 3	Anecdotal evidence for H0
1	No evidence
1/3 – 1	Anecdotal evidence for H0
1/3 – 1/10	Moderate evidence for H0
1/10 – 1/30	Strong evidence for H0
1/30 – 1/100	Very strong evidence for H0
< 1/100	Extreme evidence for H0

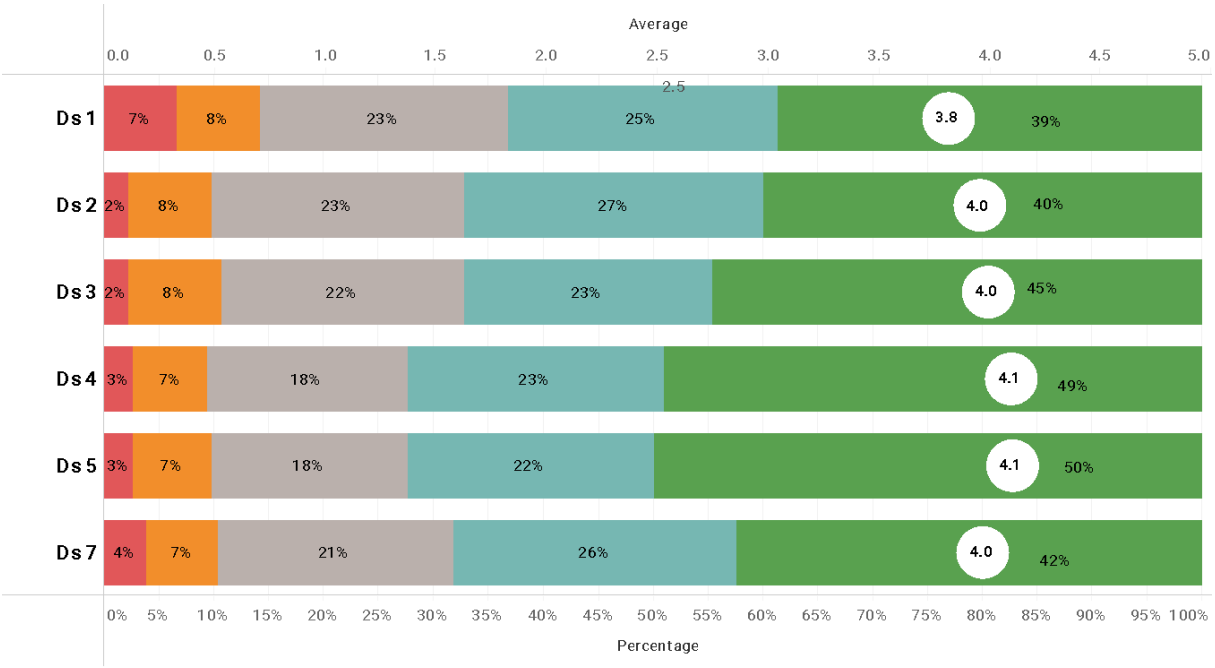

Figure 1. Distribution of support levels in the items in access to and management of digital content (Created by authors based on the research data)

FINDINGS

Descriptive Statistics

Access to and management of digital content

Some items in this factor measure students' ability to access and manage Internet information. On the Likert scale, item 5 (I can understand the information I get from the Internet) was the most preferred option. Then item 4, "I am able to search for information I need." It received positive feedback. Then, with 45%, "I can use different tools to store and manage information (Ds 3)." Students also feel competent in the item "I can use digital software skillfully to complete learning tasks (DS 7)". This result is followed by the item "I am able to search for and access information in digital environments (Ds 2)," with 42% support. The lowest level of support for this factor is "I have apps that keep me up to date on the news (Ds 1)." (See **Figure 1**).

Digital empathy

The digital empathy dimension includes a total of 5 different components. The highest mean score and the highest agreement of the participants with "strongly agree" was the item "I respect other people in digital environments (Ds 32)". The following statement, "I respect other people in digital environments (Ds 34)"

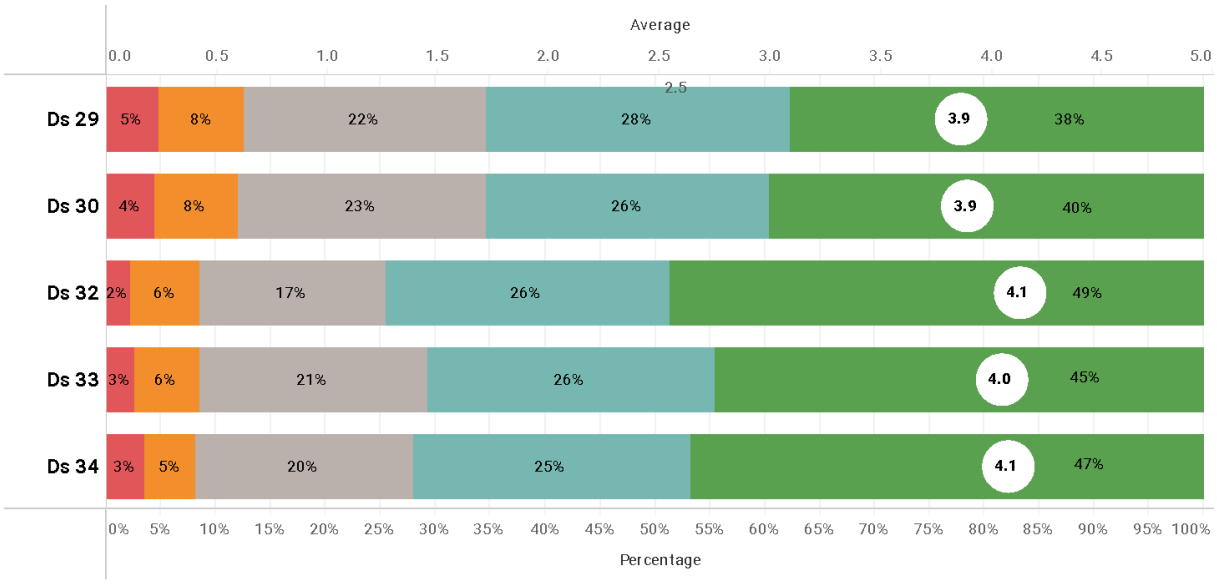

Figure 2. Distribution of support levels in the items in digital empathy (Created by authors based on the research data)

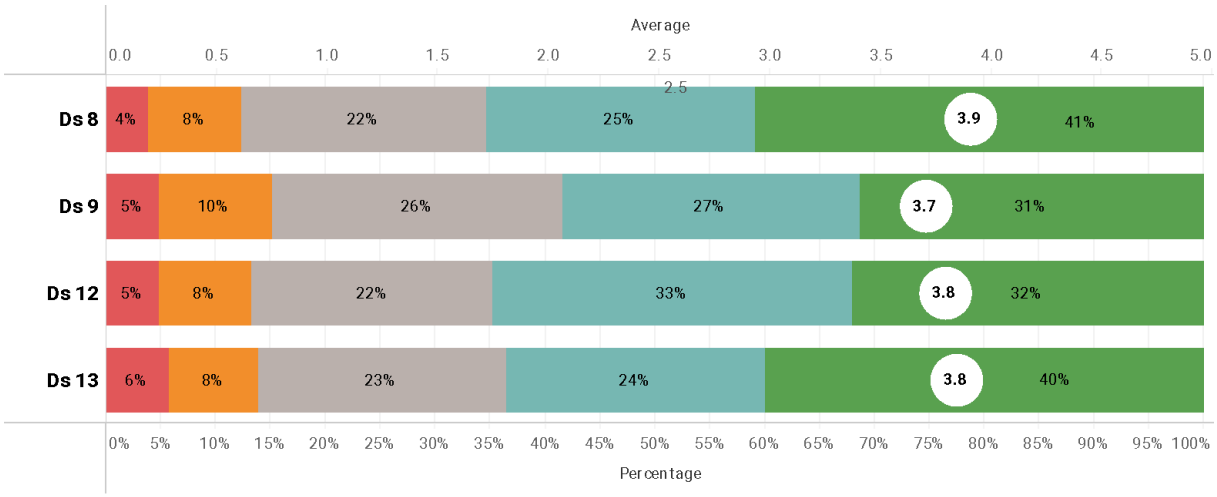

Figure 3. Distribution of support levels in the items in digital means (Created by authors based on the research data)

received 45% of the votes and was immediately followed by the statement, "I take into account the opinion of others in digital environments (Ds 33)". The statement "I am able to put myself in digital environments" received 38% of the total votes, while the statement "I am willing to help other people in digital environments (Ds 30)" received 40% of the total votes (See **Figure 2**).

Use of digital means

There are four items related to the digital environment. The highest average score and "strongly agree" option was given to the item "I can complete digital content that meets the minimum requirements of the learning tasks (Ds8)" at 41%, followed by "I am able to use digital means to detect plagiarism of content I have created (Ds 13)." While the item "I am able to use digital means to solve problems I encountered in my study" received the least support, the item "I can create and edit digital content with higher standards according to the requirements of work or study" received the least support (See **Figure 3**).

Digital safety

There are five items related to digital security. The item "I avoid behaviors on social networks" received the highest agreement with 50%, followed by the item "I am careful with my personal information". Later, "I

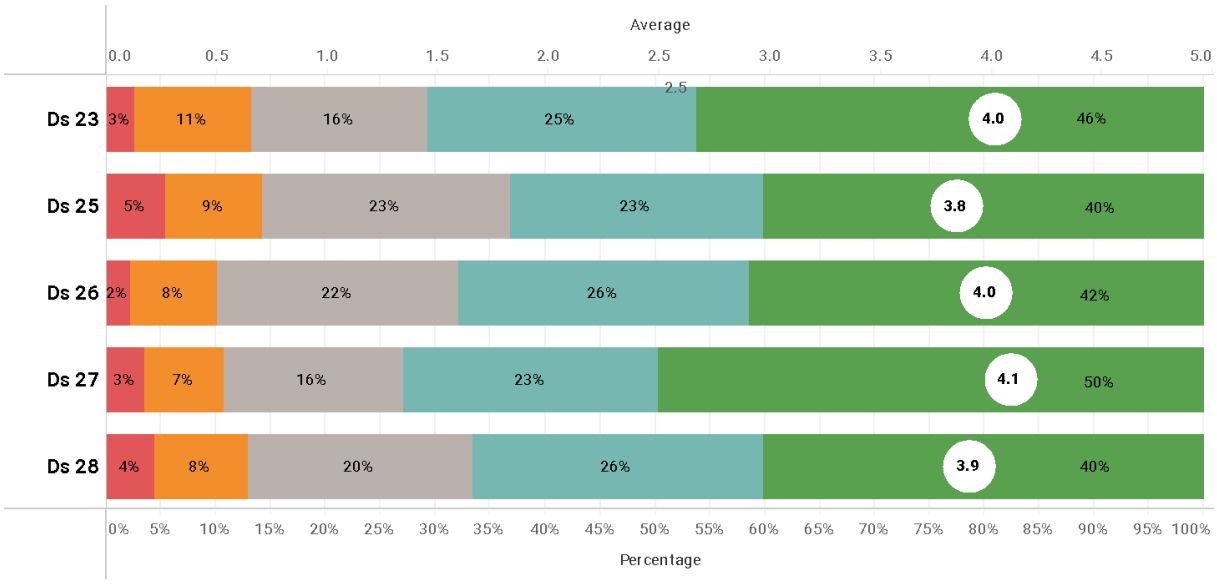

Figure 4. Distribution of support levels in the items in digital safety (Created by authors based on the research data)

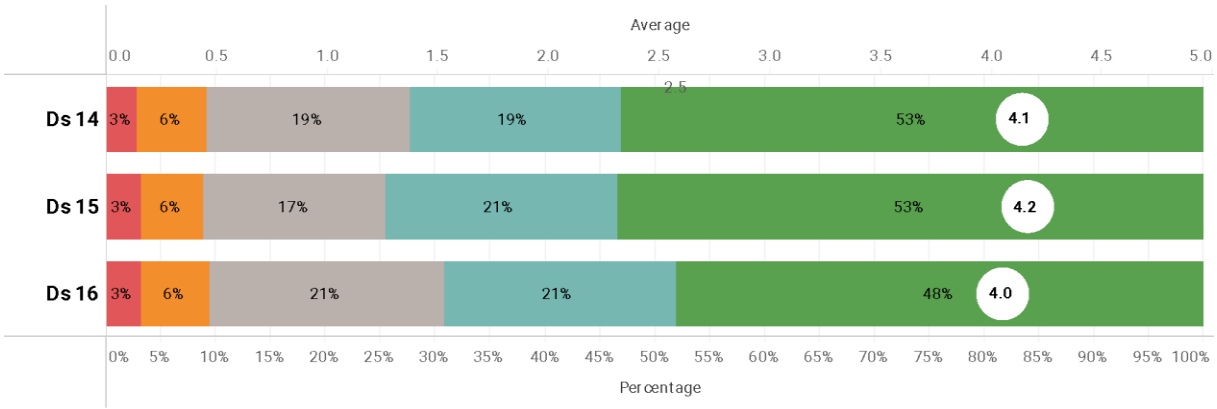

Figure 5. Distribution of support levels in the items in combination with digital content (Created by authors based on the research data)

am able to identify harmful behaviors that can affect me on social networks" with 42%. "Before performing a digital activity (e.g., uploading a photo, making a comment...), I think about the possible consequences" and "I avoid having arguments with others in digital environments" were supported by 40% of the participants at the "Totally agree" level (See **Figure 4**)..

Communication of digital content

In the Communication dimension, the items "I know how to communicate with others through different digital means" and "I can communicate with others in digital environments" were supported by 53% of participants at the "totally agree" level. The item "I know how to communicate with others in different ways (e.g., images, texts, videos...)" received full support from 48% of the participants (See **Figure 5**).

Creation of digital content

In the content creation dimension, "I can transform information and organize it in different formats" was fully supported by 38% of participants. In contrast, "I am able to present what I want to convey in digital environments" was fully supported by 36% of participants (See **Figure 6**).

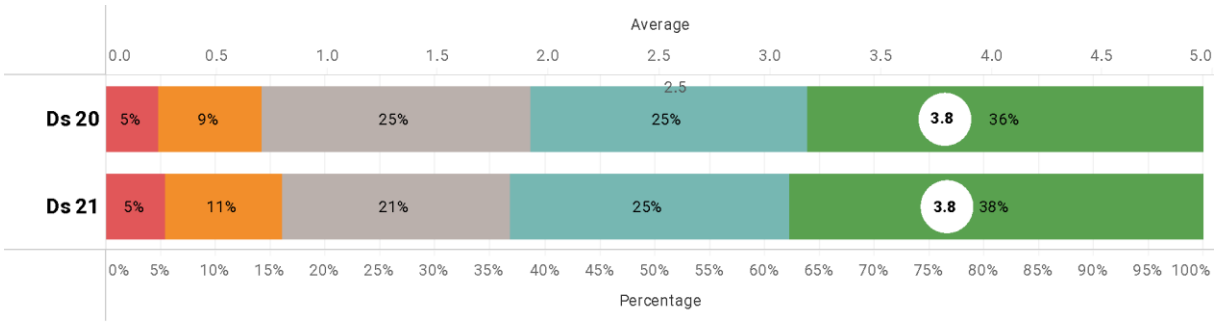

Figure 6. Distribution of support levels in the items in the creation of digital content (Created by authors based on the research data)

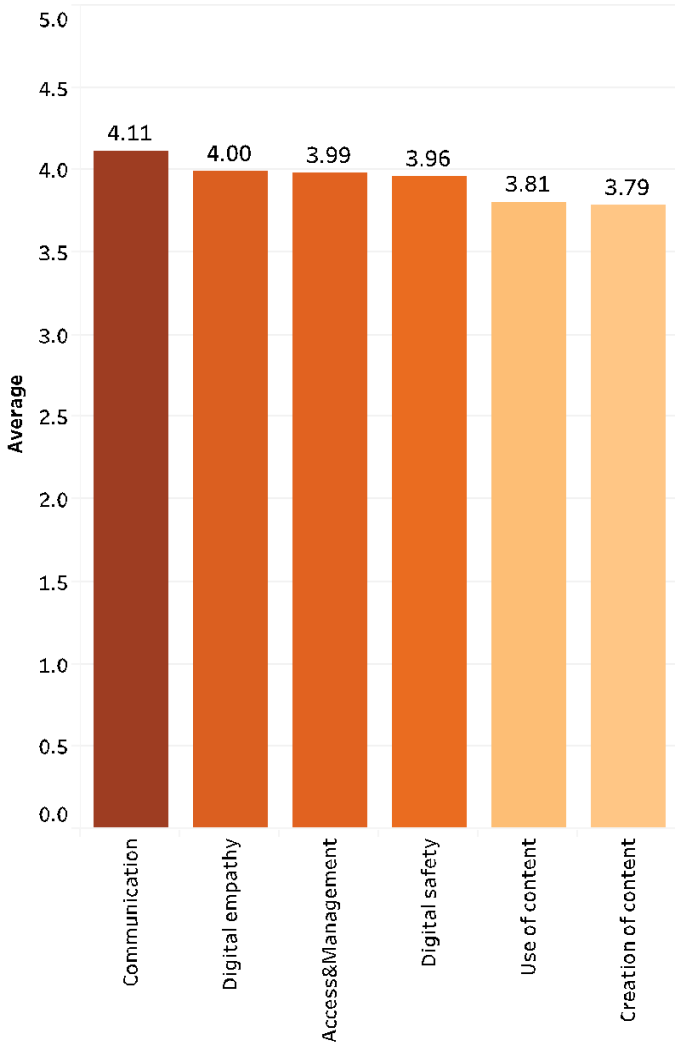

Figure 7. Average for each dimension (Created by authors based on the research data)

Compare Factors

When analyzing the average scores in relation to the dimensions, it can be seen that the communication dimension has the highest average score of 4.11 points. In contrast to the Access and management dimension, which has an average score of 3.99, the digital empathy component has an average score of 4.00. The overall score for digital security came in at 3.96. Both the use of content and the production of content aspects received a 3.81 out of a possible 3.79. The importance attached to content creation is lower than that of the other aspects (See **Figure 7**).

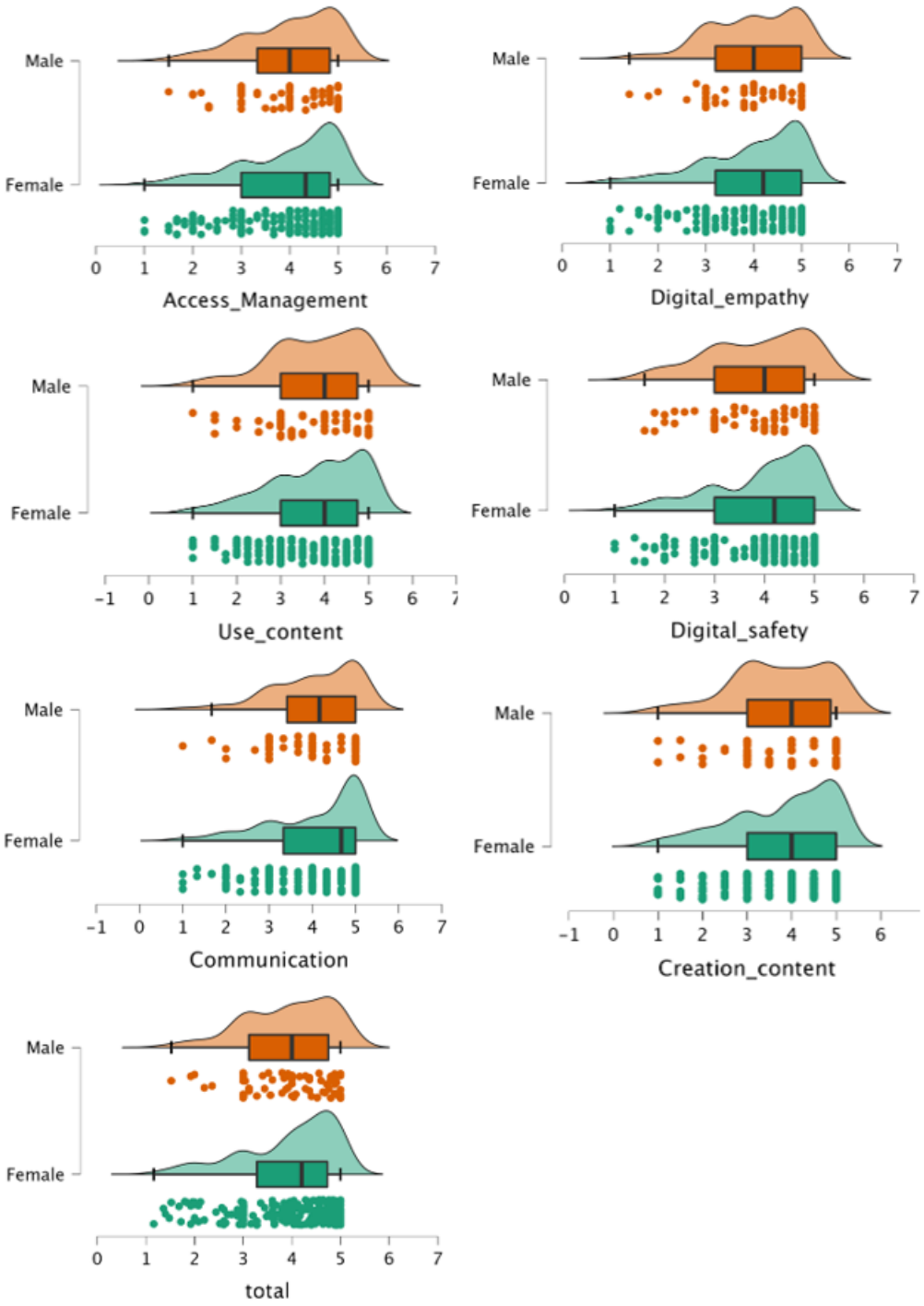

Figure 8. Distribution based on gender in each dimension (Created by authors based on the research data)

Compare gender

Analyzing the distribution of scores in each dimension by gender, we find that the female group has a clear advantage over the male group in several aspects, including the communication dimension. To evaluate the significance of this difference, a Bayesian t-test was performed (See **Figure 8**).

As a result, the hypothesis "no differentiation by gender in science motivation", sometimes referred to as the "null hypothesis", was found to be true. In addition, hypothesis H1 "There is differentiation by gender in science motivation" was tested and found to be true. A Bayesian t-test was performed to assess the degree to which the data supported each of the hypotheses.

The likely value of BF10 was calculated considering the differential and non-differential status. The data provide evidence for the Ho hypothesis, falling within the range of 1/10 to BF10 to 1/3 for the individual dimensions and the total score. There was a more significant amount of support because there is no distinction based on gender.

In some dimensions, students with a social science major have high mean scores, while in some dimensions, students without a social science major have a higher concentration in the high mean. Hypotheses Ho (No differences in students' level of digital skills according to major) and H1 (Students' level of digital skills differs according to major) were written. A Bayesian t-test was performed to determine if the data supported these hypotheses, and BF10 was calculated.

Since the score ranges between 1/10 < BF10 < 1/3 in all dimensions and the total score, the data support the Ho hypothesis at a moderate level, i.e., there is no difference in the level of students' digital skills according to their field of study.

DISCUSSION

The development of digital skills is essential for university students to perform at a sufficient level professionally and academically and to advance their educational and professional use of digital technologies. For students' learning experiences to become richer and more meaningful online and through digital devices, they must acquire, organize, evaluate, and produce their forms of knowledge independently (DeSchryver, 2009; Youssef et al., 2022).

According to the results, students' digital skills are high. The current studies show that students' digital skills, Internet skills, and 21st-century digital literacy are high. From this perspective, the results of this study have parallels with the results of other recent studies. Students' self-perceived digital skills for completing their academic work were rated as "intermediate" overall, and they also rated themselves as "intermediate" in most specific categories (Martzoukou et al., 2021). According to the results, the amount of 'high agreement" on their education in digital citizenship skills (Ruenphongphun et al., 2021). According to the results of a study conducted by López-Meneses et al. (2020) with three university students, the students' competencies in the dimensions of "information and data literacy" and "communication and collaboration" are sufficient.

Content creation and usage are lower than in other dimensions. This result is a crucial result. People can produce and redistribute material more efficiently using technologies that are part of the Web 2.0 movement (Caliskan et al., 2019; Wang et al., 2012). We assume that students have a high level of content production abilities, as most of today's students are members of Generation Z (Csobanka, 2016; Pérez-Escoda et al., 2016) and digital immigrants (Prensky, 2001; Šorgo et al., 2017). However, similar results were found in the studies. Students' competency level in "digital content creation" was below the intermediate level, especially in their ability to create multimedia materials using different technologies (López-Meneses et al., 2020). The results show a low level of competence (referred to as "basic") in the categories of "designing new digital content," "promoting new online tools and opportunities to others," and "using online tools to record learning events/outcomes and using them for self-analysis, reflection, and performance presentation"The further grouping of variables confirmed some of the results from the previous section, with the lowest mean values being obtained in the categories of "Digital creation" and "Digital innovation."

In contrast, the Digital Research Skills and Digital Learning and Development categories had the lowest scores for "intermediate" (Martzoukou et al., 2021). According to the ideas of Gil-Flores et al. (2017) and those Tondeur et al. (2017), the capacity to produce digital information and media is one of the key components of digital literacy. The American Library Association (2013) and the European Commission (2018) agree that creating something is one of the fundamental building blocks in any setting, whether in America, Europe, or Asia.

The research data suggest that there is no difference between the gender of the students, but not at a very high level. According to the study conducted by van Deursen et al. (2015), males outperform females in all four internet skills. According to Alan (Gibbs & Sagrista, 2020), gender was not a significant factor in digital skills.

Certain digital tools, such as Instagram, are used differently by men and women, but both genders use most digital tools similarly (Perifanou et al., 2021). According to Jones et al. (2010), men rated their Internet skills and confidence as greater only in certain online activities, such as dealing with computer security. However, the researchers observed no gender differences in other areas, such as using online library resources. The study data also supported the hypothesis that there were no differences between students' majors, but this remained at a moderate level.

CONCLUSION

In general, students' digital skills are high. However, digital content creation and use skills were lower than others. The hypothesis that there is no difference between the students' genders was supported, but not at a very high level. The hypothesis that there is no difference between students' majors was more strongly supported but remained at a moderate level. Future researchers can determine the salient characteristics of each cluster using cluster analysis by identifying the high and low-level students in the data. Further studies can be conducted by collecting more data on the independent variables of the participants. Students with partially high digital literacy may have been more likely to participate in the online data collection. The study data does not cover all students at the university.

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Declaration of interest: Authors declare no competing interest.

Data availability: Data generated or analysed during this study are available from the authors on request.

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