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Developing Students' Digital Skills: A Case Study at Hanoi University of Science and Technology

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Abstract: The research was undertaken to evaluate the level of digital skills of 196 students from Hanoi University of Science and Technology. Findings show that students demonstrate a good understanding and grasp of necessary digital skills, especially locating information and communication skills. However, digital content creation skills and digital empathy skills need improvement. Results indicate no significant difference in digital skills between genders, fields of study, and internet usage per day. However, the level of digital skills tends to decrease slightly from the first to the fourth year, indicating that students are becoming more aware of the need to continuously learn and develop digital skills. Some solutions proposed to enhance students' digital skills over the course of their degree include: integrating specialized courses and workshops into the already existing training program; continuously offering courses on new technologies; enhancing university facilities and technology; integrating real-world projects and internship opportunities to boost digital skills; and developing tools and courses that allow students to self-assess their digital skills and receive feedback from teachers who can support them in improving their capabilities.

Keywords: Digital Skills; Tertiary Students.

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1. Introduction

In the past decade, the rapid development of digital technology has created new challenges and opportunities for global industry. To meet the increasing demands of the market, both large and small businesses are undergoing digital transformation to enhance their operational flexibility and improve work efficiency. Henriette and colleagues (2015: 13) emphasize that we are living in the era of advanced digital technology. Currently, the application of technology in every aspect of social life has become more important than ever. In this context, digital skills are not only an indispensable part of lifelong learning but also a key factor in maintaining competitiveness in the evolving labor market.

Frey and colleagues (2013: 280) have identified digital skills as one of the most important skills for life, work, and modern global economies. Possessing digital skills enables not only proficiency in using information technologies but also

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knowledge about how to participate effectively and safely within digital environments. This has significant implications for maximizing one's potential in every aspect of life including learning, work, and entertainment.

Previous studies have emphasized the importance of developing students' digital skills. Ba et al (2002: 48) defined digital skills as "a set of habits that young people use information technology for learning, working, and playing." Shopova (2014: 32) highlighted the role of students' digital skills in the learning process, especially important, she argues, in the context of the integration of higher education in Europe. Specifically, digital skills help university students improve the efficiency and performance of the learning process, as well as adapt to the changing labor market. To this end, Ferrari (2013: 95) developed a framework of digital competence that includes five areas and 21 competencies. Studies conducted in China, Russia, and Vietnam to measure and evaluate digital skills show that students have high digital skills in various contexts, from online education to the ability to create and use digital content (Yustika et al 2020:76; Tran and Hung 2021: 51; Fan and Wang 2022: 22; and Urakova et al 2023: 13).

Hanoi University of Science and Technology (HUST) is one of Vietnam's largest universities. In its development strategy for the period 2017-2025, HUST aims to become a multi-disciplinary training and research center focusing on engineering and technology, and moving towards an advanced, autonomous, and internationally integrated management model. The University has committed to enhancing the quality of education, focusing on applied and fundamental research and developing digital and creative skills in students to promote socio-economic development to meet the demands of the Industrial Revolution 4.0 (HUST 2017).

Despite this increasing interest in digital skills in education in Vietnam, there still exist many research gaps, especially regarding the assessment of students' digital skills, and in particular, students at HUST. This situation prompts the need for research and evaluation of the current status of university students' digital skills. Depending on the results such research can propose solutions to enhance digital skills for students, thus contributing to the development of technical education in Vietnam in the digital age.

This article primarily aims to assess the current level of digital skills among students at HUST, including skills such as information, communication, content creation, safety, and empathy. By comparing the digital skills levels among student groups based on gender, academic year, field of study, and internet usage per day, the study subsequently proposes ways to improve the quality of digital skills training of HUST students.

2. Methodology

2.1 Development of the survey instrument

Based on the digital skills scale developed by Cunying Fan and Juan Wang (2022) a questionnaire including both closed and open-ended questions was designed. To ensure legality and ethics in the research process, we contacted Fan and Wang and gained their consent to use their scale in this study.

The scale includes a total of 27 items, categorized into five different aspects of

digital skills: information skills, communication skills, creative skills, safety skills and empathy skills. However, in the process of adjusting the scale to fit the context of Vietnam, we found that 10 items related to information skills included five items culturally appropriate to measure the digital skills specifically of Chinese students. To ensure objectivity and relevance to the research subjects, we removed these items from the scale, reducing the total number of items to 22. The responses in the questionnaire were rated on a scale from 1 to 7, with 1 corresponding to "Strongly Disagree" and 7 to "Strongly Agree".

Before conducting the official large-scale survey, the research team carried out a pilot survey on a small group of ten students. In addition to the survey results, we collected feedback from the students and adjusted and improved the questionnaire to ensure that it was scientifically designed to accurately reflect the research objectives.

Additionally, after the large-scale survey was completed the research team conducted in-depth interviews with five third- and fourth-year students from HUST. Interviews explored their digital skills further to better understand the reasons behind the survey findings as well as provide solutions for skills enhancement.

2.2 Sample and data collection

To assess the digital skills of HUST students, the study surveyed 196 students, with a gender ratio of 61.2% male (120 students) and 38.8% female (76 students). The representative sample included 24.5% first-year students, 27.6% second-year, 20.4% third-year, and 27.6% fourth-year students. The sample comprised students from Engineering and Applied Technology (91) Natural Sciences (47) and Economics, Management, and Social Sciences (58). Sample selection was based on the willingness to participate and the ability to provide accurate information. This approach ensured the study offered a comprehensive and accurate view of students' digital skills, to subsequently propose effective measures for improvement and development of these skills.

Table 1: *Sample classification*

Classification criteria		Number of participants	Percentage (%)
Gender	Male	120	61.2
	Female	76	38.8
Academic year	First year	48	24.5
	Second year	54	27.6
	Third year	40	20.4
	Fourth year	54	27.6
Field of study	Applied Engineering and Technology	91	46.4

	Natural Sciences	47	26.0
	Economics, Management, and Social Sciences	58	29.6
Internet usage per day	Under 2 hours	17	8.7
	From 2 to 4 hours	47	24.0
	From 4 to 6 hours	69	35.2
	Over 6 hours	63	32.1

2.3 Data analysis method

The research team used SPSS 26 software to analyze data collected from 196 questionnaires and 5 in-depth interviews with students from HUST. Initially, the team tested the reliability of the adjusted digital skills scale with Cronbach's alpha coefficient and conducted factor analysis to determine the structure for the five different factors of digital skills. Subsequently, the team performed descriptive statistical analysis to assess the level of students' digital skills by each aspect. The team continued with t-tests and ANOVA to compare digital skills levels among groups based on gender, academic year, field of study and internet usage per day. Finally, the team analyzed the content of the interviews to provide deeper insights into the obtained findings, particularly the causes and feasible solutions for enhancing students' digital skills.

3. Findings

3.1 Reliability of the scale

The reliability of the scale was assessed through Cronbach's Alpha coefficient, the corrected-item total correlation, the KMO (Kaiser-Meyer-Olkin Measure of Sampling Adequacy) coefficients, the p-value of the Bartlett's test factor loading coefficients, and the total variance explained (TVE) coefficients of each factor.

Initially, the Cronbach's Alpha coefficient for the digital skills scale was .914, indicating that the scale had high reliability, and the items, good internal consistency. For the factors, the Cronbach's Alpha ranged from .701 (digital empathy skills) to .796 (information skills) demonstrating additionally, significant consistency within each subscale.

The corrected-item total correlation minimum coefficients ranged from .412 to .572, hence all greater than 0.3. The KMO coefficients were greater than 0.6 for both the scale and all factors within the scale. Thus, the scale was valid and had good discriminant ability. The p-value = 0.000 demonstrated statistical distinction between factors. The factor loading minimum coefficients ranged from .670 to .841, with TVE coefficients ranging from 45.826% to 69.099%, showing a good level of contribution and explanation of the items to the corresponding factor (Table 2).

Findings of the study indicated that the Scale and its factors used in this study had high reliability and validity, providing a solid foundation for measuring and analyzing the digital skills of students.

Table 2: *Reliability analysis results*

Constructs	Cronbach's Alpha	Corrected-item-total correlation minimum	KMO	p-value	Factor loading minimum	TVE (%)
Digital skills	.859	.639	.841	0.000	.767	64.752
Information skills	.796	.503	.823	0.000	.674	55.228
Communication skills	.775	.522	.670	0.000	.765	69.099
Digital content creation skills	.765	.572	.689	0.000	.808	68.135
Digital safety skills	.761	.460	.756	0.000	.649	51.229
Digital empathy skills	.701	.412	.729	0.000	.623	45.826

3.2 Digital skills of students

Data analysis from Table 3 provides a comprehensive view of the levels of specific skills within the digital skills of students. Specifically:

Information and communication skills received the highest mean among the skills surveyed, at 5.89 and 5.88 respectively, reflecting students' high level of ability in searching for, processing information, and communicating through digital means. However, the standard deviation (SD) for communication skills (.998) was higher than that for information skills (.881), indicating greater variability in communication abilities among individuals. Meanwhile, digital content creation skills and digital empathy skills scored the lowest mean (5.58 and 5.55) with standard deviations of .971 and .846, respectively. Despite this, the average scores of these skills were also relatively high. However, the scores indicated that the development and uniformity of these skills among students were more limited compared to the other skills. The digital safety skills had a mean of 5.73 with a standard deviation of .785, showing that students had a fairly good awareness of digital safety.

The total mean of digital skills was 5.73 with a standard deviation of .722, indicating a good level of digital skills among students but a certain variability between individuals. These findings emphasized the importance of designing specific training programs to enhance digital skills, especially in areas that require improvement such as content creation and empathy skills, to meet the demands of an increasingly complex digital environment (Table 3).

Table 3: *Level of students' digital skills*

Factors	**Mean**	**SD**
Information skills	5.89	.881
Communication skills	5.88	.998
Digital content creation skills	5.58	.971
Digital safety skills	5.73	.785
Digital empathy skills	5.55	.864
Total	5.73	.722

3.3 Digital skills level by gender

Data analysis from Table 4 showed no significant differences in the level of digital skills between males and females across all considered aspects. Rather, the mean of information skills, communication skills, digital content creation skills, digital safety skills, and digital empathy skills showed equivalent levels between genders, with high p-values from the t-test. This indicated that there were no statistically significant differences between males and females. Additionally, high p-values from Levene's test in all factors also indicated homogeneity of variance between groups. This also suggested that there was no difference in variability in digital skills between males and females. Hence, there is uniformity in the development of digital skills among genders at HUST, indicating no significant gender-based differences in digital skill levels.

Table 4: *Comparison of digital skill levels by gender*

Factors	Gender	Mean	SD	p-value (Levene's test)	p-value (t – test)
Information skills	Male	5.90	.841	.887	.918
	Female	5.88	.947		
Communication skills	Male	5.89	.965	.606	.827
	Female	5.86	1.054		
Digital content creation skills	Male	5.55	.985	.407	.602
	Female	5.63	.952		
Digital safety skills	Male	5.79	.699	.386	.202

	Female	5.64	.902		
Digital empathy skills	Male	5.54	.854	.532	.849
	Female	5.57	.884		
Total	Male	5.73	.656	.758	.860
	Female	5.72	.819		

3.4 Digital skills level by academic year

Data in Table 5 shows a slight decreasing trend in the mean of digital skills from the first to the fourth year. Specifically, information and communication skills decrease in mean over the academic years. Information skills decreased from 6.05 in the first year to 5.82 in the fourth year, while communication skills decrease from 6.31 to 5.71. Creative skills, digital safety skills, and digital empathy skills also show a slight decreasing trend from the first to the third year, with a slight increase in the fourth year. Among these skills, communication and digital content creation skills have a significantly higher mean for first-year students compared to other academic year groups at the 5% significance level. The data also indicate that overall, students' digital skills gradually decrease from the first to the third year, before slightly increasing in the fourth year. First-year students have significantly higher levels than other academic year groups at the 5% significance level.

The communication skills among students vary significantly in their final year, with a high standard deviation reflecting individual differences. In contrast, digital safety skills show the highest uniformity with a low standard deviation over the years. Other skills fluctuate but are less pronounced than communication skills.

In conclusion, the data indicates a slight decline in the level of digital skills of students from the first to the fourth year, with significant variations among specific skills.

Table 5: *Comparison of digital skill levels by academic year*

Factors	Academic year	Mean	SD
Information skills	First year	6.05	0.920
	Second year	5.91	0.781
	Third year	5.75	0.796
	Fourth year	5.82	0.993
Communication skills	First year	6.31a	.888
	Second year	5.79	.974
	Third year	5.72	.941
	Fourth year	5.71	1.068

Digital content creation skills	First year	5.95a	1.054
	Second year	5.46	0.991
	Third year	5.41	0.808
	Fourth year	5.50	0.922
Digital safety skills	First year	5.93	0.625
	Second year	5.66	0.773
	Third year	5.61	0.812
	Fourth year	5.73	0.884
Digital empathy skills	First year	5.75	0.877
	Second year	5.50	0.798
	Third year	5.45	0.772
	Fourth year	5.50	0.967
Total	First year	6.00a	0.724
	Second year	5.66	0.696
	Third year	5.59	0.642
	Fourth year	5.65	0.757

Note: "a" indicates a difference from other groups at the 5% significance level.

3.5 Digital skills level by field of study

Hanoi University of Science and Technology currently comprises 13 universities, departments, and institutes, offering 34 standard training programs, 24 ELITECH training programs, and 6 international training programs (HUST 2022). As mentioned above we categorized the student sample, based on the training programs of the university, into three groups: engineering and applied technology, the group of natural sciences, economics, management and social sciences. The research team analyzed the level of digital skills among students in these fields of study focusing on information skills, communication skills, digital content creation skills, digital safety skills, digital empathy skills, as well as total skills. The data shows that the level of digital skills varies among the fields, with different mean and standard deviations. However, post hoc analysis findings do not indicate significant differences between the groups at the 5% statistical significance level. This suggests that, although there is variability in scores among the fields, this variability is not large enough to be considered as having a real difference in the level of digital skills among the fields of study.

Table 6: *Comparison of digital skill levels by field of study*

Factors	Field of study	Mean	SD
Information skills	Applied Engineering and Technology	5.95	.813
	Natural Sciences	6.01	.693
	Economics, Management, and Social Sciences	5.70	1.081
Communication skills	Applied Engineering and Technology	5.84	1.034
	Natural Sciences	6.05	.764
	Economics, Management, and Social Sciences	5.80	1.101
Digital content creation skills	Applied Engineering and Technology	5.52	.980
	Natural Sciences	5.78	.852
	Economics, Management, and Social Sciences	5.52	1.038
Digital safety skills	Applied Engineering and Technology	5.80	.719
	Natural Sciences	5.83	.676
	Economics, Management, and Social Sciences	5.55	.935
Digital empathy skills	Applied Engineering and Technology	5.55	.853
	Natural Sciences	5.63	.775
	Economics, Management, and Social Sciences	5.49	.955
Total	Applied Engineering and Technology	5.73	.663
	Natural Sciences	5.86	.596
	Economics, Management, and Social Sciences	5.61	.880

Note: "a" indicates a difference from other groups at the 5% significance level.

3.6 Digital skills level by Internet usage per day

Examining the relationship between internet usage per day and the development level of digital skills reveals a certain variability in the mean and standard deviations of digital skills across different internet usage per day groups. However, post hoc test findings did not find significant differences between the internet usage per day groups at the 5% significance level. This indicates that, although there is variability in scores between the groups, these variations do not reflect a real difference in the level of digital skills related to internet usage per day. Specifically, there is no statistical evidence to suggest that the duration of internet use is a significant factor affecting the development level of the digital skills studied.

Table 7: *Comparison of digital skill levels by Internet usage per day*

Factors	Internet usage time	Mean	SD
Information skills	Under 2 hours	5.98	0.632
	From 2 to 4 hours	5.86	0.906
	From 4 to 6 hours	5.88	0.830
	Over 6 hours	5.90	0.986
Communication skills	Under 2 hours	5.84	0.843
	From 2 to 4 hours	6.11	0.719
	From 4 to 6 hours	5.91	0.961
	Over 6 hours	5.69	1.214
Digital content creation skills	Under 2 hours	5.65	0.893
	From 2 to 4 hours	5.71	0.984
	From 4 to 6 hours	5.61	0.879
	Over 6 hours	5.43	1.074
Digital safety skills	Under 2 hours	5.61	0.685
	From 2 to 4 hours	5.84	0.686
	From 4 to 6 hours	5.72	0.738
	Over 6 hours	5.70	0.925
Digital empathy skills	Under 2 hours	5.48	0.596
	From 2 to 4 hours	5.77	0.803
	From 4 to 6 hours	5.49	0.837
	Over 6 hours	5.48	0.981
Total	Under 2 hours	5.70	0.496
	From 2 to 4 hours	5.85	0.629
	From 4 to 6 hours	5.72	0.676
	Over 6 hours	5.66	0.852

Note: "a" indicates a difference from other groups at the 5% significance level

4. Discussion

The findings of this study indicate that the level of digital skills among students at HUST is good, with a mean of 5.73 on a scale from 1 to 7. This demonstrates that students have a good understanding and grasp of the necessary digital skills in today's digital environment. Information and communication skills scored the highest, indicating that students are capable of searching, processing information, and communicating effectively through digital means. However, creativity and digital empathy skills scored lower on average, which suggests that more attention needs to

be given to the development of these skills during the training process. The finding above is similar to the one of a study conducted by López – Meneses et al (2020: 88). This study states that the capability of students in the aspects of "information and data literacy" and "communication and collaboration" was high. Lopez-Meneses et al. also point out that the competency level of university students in "digital content creation" is below average, especially in their ability to create multimedia documents using various technologies. However, Csobanka (2016: 76) argues that university students have a relatively high level of digital content creation skills, as most students today are members of Generation Z. The reason for these creativity differences may be the differences in cultural and educational research contexts.

The analysis of digital skill levels by gender shows that there is no significant difference between males and females, indicating uniformity in the development of digital skills across genders. All five students interviewed believed that it was not surprising that the digital skills of male and female students were the same, as they all underwent the same training program, with no different requirements for males and females while participating in technology-related activities. Specifically, when interviewing P – a third-year female student at HUST, P shared, "I find that male and female students have equal opportunities in participating in courses and technology-related activities. Therefore, in my opinion, the development of digital skills among both male and female students at Hanoi University of Science and Technology is similar." This is a positive sign, indicating an absence of gender discrimination in accessing and developing digital skills at HUST. This finding is reinforced by previous research by Gibbs and colleagues (2020: 127), which suggests that gender is not a major factor in the level of digital skills.

The study also discovered a trend of a slight decrease in the digital skills mean from the first to the fourth year. In the interviews, N, a fourth-year student explained their self-assessment of digital skills has changed over the years. They stated, "When I first entered university, I was very confident in my digital skills because I frequently used computers and the internet. After progressing to the second, third, and finally the fourth year, and taking part in specialized courses, I realized there was so much more to learn. Technology has developed very rapidly. Therefore, I think my digital skills were not as good as I thought they were. I need to equip myself with better digital skills to meet the demands of the job market after I graduate." Three-quarters of the other interviewed students agreed. It can be seen through their learning experiences and exposure to new technology, students are increasingly aware of the need to continuously learn and develop digital skills to meet job requirements, leading them to evaluate their capabilities more carefully and accurately. This not only reflects cognitive development but also emphasizes the importance of educating students on accurate self-assessment and receiving objective feedback for their complete development.

The study on the relationship between digital skills and the field of study shows that there is no statistically significant correlation. This finding indicates that despite the diversity in professional fields, the level of digital skills among students can be considered relatively uniform, reflecting a positive trend in integrating

digital skills into university curricula, regardless of the field of study. When asked about how students in their major develop digital skills during their study at HUST, student M shared, "I am a Computer Science major, exposed to many technology applications. We, the students, learn subjects like Programming, Data Structures and Algorithms, Databases, Computer Networks, and Artificial Intelligence. And I think this is how students in our major can further develop their digital skills." Meanwhile, student Q believes that the professional diversity of the classroom and the practice of online group work at the University are factors that foster the development of communication skills and the search for accurate information. This helps students from different majors learn from each other and develop the necessary digital skills in a modern work environment. This may also indicate that the educators responsible for developing the university's curriculum at HUST have recognized the importance of equipping students with digital skills, enabling them to meet the demands of today's digital society.

The overall findings of this study are consistent with the findings of Urakova et al (2023:13). Specifically, in their article, "Investigating digital skills among Russian higher education students" the researchers found that university students in Russia also possess relatively high levels of digital skills. However, as in our study, their creative skills and the use of digital content are lower compared to other skills. Regarding their hypothesis that there is no difference between genders among students, the study shows support for this hypothesis, although not at a high level. As for the hypothesis that there is no difference between the fields of study of students, the research also shows stronger support, yet still at a moderate level.

Finally, the research findings indicate that despite variations in the average digital skills score based on internet usage per day, statistical tests did not find a significant difference between groups. Explaining this, student L believes, "Aside from personal entertainment, students inevitably (sic) use technology and the internet to complete assignments for their courses. It is through these activities that students' digital skills are developed. Therefore, in my opinion, the amount of time spent on the internet does not significantly affect the digital skills of students at HUST. How they use the internet for what purpose has more impact on their digital skills." This explains why the amount of time spent on the internet is not a determining factor in the development of digital skills among students at HUST. Instead, other factors such as access to new technology, the learning environment, and internships may have a stronger influence on improving students' digital skills.

The limitation of the study is the use of self-assessment questionnaires to discern students' digital skills. This could lead to bias in self-evaluating one's own digital skills. Additionally, the study sample is concentrated in one university, reducing the ability to generalize the digital skills results to all university students in Vietnam.

5. Solutions

Based on the analysis and research results the research team offers several recommendations to enhance and develop the digital skills of students as follows:

The university should integrate additional courses and in-depth workshops into the educational program to develop digital skills, particularly digital content creation skills, critical thinking, and empathy in a digital environment.

It is necessary to provide ongoing and updated courses on the latest technology and digital trends so that students can continue to develop their digital skills, especially since they have realized that digital skills need to be continuously upgraded to meet the demands of the labor market.

The university should enhance its facilities and provide the latest technology to students, including software, hardware and digital platforms, to support their learning and research process.

More real-world projects and internship opportunities should be integrated into the curriculum, helping students apply digital skills in a practical work environment, thereby improving their creativity and problem-solving abilities.

Tools and courses helping students accurately self-assess their digital skills, and receive objective feedback from teachers and experts should be developed.

These recommendations if acted upon will not only help students at HUST develop a more comprehensive set of digital skills but also offer them a solid foundation to participate in the rapidly changing world of technology.

6. Conclusion

Research at Hanoi University of Science and Technology shows that students possess good digital skills, with an average score of 5.73/7. Information and communication skills are rated highly, while digital content creation and digital empathy skills need improvement. There is no significant difference in digital skills between male and female students, reflecting equality in educational access. However, there is a slight decrease in the digital skills mean by academic year, indicating that students recognize the need to continuously learn and develop digital skills to meet job requirements. The relationship between digital skills and field of study is not statistically significant, showing uniform development of digital skills regardless of the specific field of study. Finally, the time spent using the internet does not significantly affect digital skills, emphasizing the role of 'how the internet is used' in skill development. These findings highlight the importance of comprehensive training and development of digital skills in the university education environment, while also suggesting the need for adjustments in the curriculum to improve lacking skills.

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APPENDIX

Factors and items of digital skills

Dimensions	Items
Information skills	1. I have apps that keep me up to date with news.
	2. I can search for and access information in digital environments.
	3. I can use different tools to store and manage information.
	4. I can search for information that I need on the Internet.
	5. I can understand the information that I get from the Internet.
Communication skills	6. I can communicate with others in digital environments.
	7. I know how to communicate with others through different digital means.
	8. I know how to communicate with others in different ways (e.g., images, texts, videos ...).
Digital content creation skills	9. I know different ways to create and edit digital content (e.g., videos, photographs, texts, animations...).
	10. I can accurately present what I want to deliver in digital environments.
	11. I can transform information and organize it in different formats.
Digital safety skills	12. I am careful with my personal information.
	13. I avoid having arguments with others in digital environments.
	14. I can identify harmful behaviors that can affect me on social networks.
	15. I avoid behaviors that are harmful on social networks.
	16. Before doing a digital activity (e.g., upload a photo, or comment ...), I think about the possible consequences.
	17. When sharing digital information, I can protect my privacy and security.
Digital empathy skills	18. I can put myself in other people's shoes in digital environments.
	19. I am willing to help other people in digital environments.
	20. I respect other people in digital environments.
	21. I take into account the opinions of others in digital environments.
	22. I get informed before commenting on a topic.