Tuning Journal
for Higher Education

Volume 12, Issue No. 2, November 2026
DOI: https://doi.org/10.18543/tjhe1222026

Revealing the present and past to improve the future
in a different era and context

ARTICLES

Prospective elementary teachers' perceptions of digital literacy as a 21st-century skill

Sekar Purbarini Kawuryan, Anwar Senen, Sholahudin, and
Urmila Umardianti

doi: https://doi.org/10.18543/tjhe.3012

Received: 6 April 2024
Accepted: 20 October 2025
E-published: November 2026

Copyright

Copyright for this article is retained by the Publisher. It is an Open Access material that is free for full online access, download, storage, distribution, and or reuse in any medium only for non-commercial purposes and in compliance with any applicable copyright legislation, without prior permission from the Publisher or the author(s). In any case, proper acknowledgement of the original publication source must be made and any changes to the original work must be indicated clearly and in a manner that does not suggest the author's and or Publisher's endorsement whatsoever. Any other use of its content in any medium or format, now known or developed in the future, requires prior written permission of the copyright holder.

Prospective elementary teachers' perceptions of digital literacy as a 21st-century skill

Sekar Purbarini Kawuryan,[1] Anwar Senen,[2] Sholahudin,[3] and Urmila Umardianti[4]

doi: https://doi.org/10.18543/tjhe.3012

Received: 6 April 2024
Accepted: 20 October 2025
E-published: November 2026

Abstract: Elementary school teachers are the primary key to the successful use of learning technology, boiling down to digital literacy skills as 21st-century skills. It is anticipated that students' digital literacy will align with the requirements of an evolving educational framework and effectively address the impending difficulties of the future workforce. This study elucidates the conceptualizations of digital literacy among students pursuing the Bachelor of Elementary School Teacher Education Study Program at Universitas Negeri Yogyakarta (UNY). The study employed a quantitative survey methodology, with questionnaires as the primary data-gathering instruments. The sample of this study was 563 prospective elementary school teachers who were undergraduate students in semesters 2 and 4. The data analysis focuses on descriptive statistics, strengthened by qualitative exposure, and testing content validity, construct validity, and instrument reliability. The findings indicate that students hold favorable

[1] **Sekar Purbarini Kawuryan** (corresponding author, sekarpurbarini@uny.ac.id) is Associate Professor at Faculty of Education and Psychology, Universitas Negeri Yogyakarta (Jl. Colombo 1, Yogyakarta 55281), Indonesia. ORCID iD: https://orcid.org/0000-0002-5711-3888; Scopus ID: 57222658084.

[2] **Anwar Senen** (senen@uny.ac.id) is Associate Professor at Faculty of Education and Psychology, Universitas Negeri Yogyakarta (Jl. Colombo 1, Yogyakarta 55281), Indonesia. ORCID iD: https://orcid.org/0000-0003-3590-0132; Scopus ID: 57215097727.

[3] **Sholahudin** (sholahudin_wise@aoni.waseda.jp) is Assistant Professor at Graduate School of Fundamental Science and Engineering, Waseda University, Japan. ORCID iD: https://orchid.org/0000-0001-8529-3292; Scopus ID: 57202068616.

[4] **Urmila Umardianti** (urmilaumar@ulm.ac.id) is a lecturer in the Primary School Teacher Education undergraduate program at Universitas Lambung Mangkurat (Jl. Brigjen H. Hasan Basri, Banjarmasin, Kalimantan Selatan 70123), Indonesia. ORCID iD: https://orcid.org/0009-0007-3995-4492.

Acknowledgements: None.

Funding: None-

Conflict of inter.ests: None.

opinions regarding digital literacy from the perspectives of information and data literacy, communication and collaboration, and safety. Furthermore, notable variations exist in students' perspectives on gender-related digital literacy, school level, geographical location, and prior pertinent education. The validity of this research lies in the diversity of students' perceptions of digital literacy. Promoting the cultivation of essential competency areas pertaining to digital competencies, such as digital content production, is crucial, alongside facilitating students' acquisition of knowledge in addressing common technology challenges encountered in their daily lives. It is important to provide training for elementary school teachers in the utilization of information and communication technology (ICT), also in promoting digital competence among female first-year students in certain locations and from rural areas.

Keywords: perception; prospective elementary teachers; digital literacy; 21st-century skills; digital competence.

I. Introduction

Education experiences significant changes, so the challenges that appear must be faced using digital technology.[5, 6] It happens because the education system in the new century positions digital competence as an essential role. This condition has implications for changing learning methods and providing a comfortable, safe, and flexible learning environment for students, making it an urgent effort that educational institutions must carry out.[7] The 21st-century students grow up surrounded by the rapid development of computer networks, which simultaneously increases the popularity of digital competencies in higher education.[8, 9] Another important supporting factor for change is the COVID-19 pandemic, so public attention regarding digital competence has increased.[10]

---

[5] Abid Haleem et al., "Understanding the Role of Digital Technologies in Education: A Review," *Sustainable Operations and Computers* 3 (2022): 275–85, https://doi.org/10.1016/j.susoc.2022.05.004.

[6] Santiago Iglesias-Pradas et al., "Emergency Remote Teaching and Students' Academic Performance in Higher Education during the COVID-19 Pandemic: A Case Study," *Computers in Human Behavior* 119 (2021), https://doi.org/10.1016/j.chb.2021.106713.

[7] Andreas Schleicher, "The Impact of COVID-19 On Education: Insights from "Education at a Glance 2020," *OECD Publishing* (2020), https://eric.ed.gov/?id=ED616315.

[8] Chrysi Rapanta et al., "Balancing Technology, Pedagogy and the New Normal: Post-Pandemic Challenges for Higher Education," *Postdigital Science and Education* 3, no. 3 (2021): 715–42, https://doi.org/10.1007/s42438-021-00249-1.

[9] Y Zhao et al., "Digital Competence in Higher Education: Students' Perception and Personal Factors," *Sustainability* 13, no. 21 (2021): 12184, https://doi.org/https://doi.org/10.3390/su132112184.

[10] M Iansiti and G. Richards, "Coronavirus Is Widening the Corporate Digital Divide," *Harvard Business Review* (2020), https://hbr.org/2020/03/coronavirus-is-widening-the-

The profile of future teachers is described as digital natives who utilize technology in various daily activities and gain many great benefits in the learning process.[11] In this context, teachers with good digital competence are increasingly needed to play an essential role in improving student competence and effectively utilizing technology in the teaching and learning process.[12, 13] Therefore, Prospective educators are required to possess not only pedagogical competencies, but also digital competencies and a comprehensive understanding of their impact on students' learning practices and interaction with digital culture, or what is often known as TPACK (Technological Pedagogical and Content Knowledge).[14, 15, 16]

Students in Indonesia are expected to master digital literacy today, one of the six essential literacies. The government has implemented the School Literacy Movement at the basic education level. The implementation of this program is a serious and concrete effort as a follow-up based on the results of the reflection evaluation of the average literacy achievement of the Indonesian population compared to the population of other countries in ASEAN, especially the PISA test results regarding students' reading abilities which have not met expectations.[17] The importance of this effort is based on the consideration that elementary schools are the foundation of the literacy movement at the next level of education.

---

corporate-digital-divide.

[11] F.D. Guillén-Gámez et al., "A Study on the Actual Use of Digital Competence in the Practicum of Education Degree," *Technology Knowledge, and Learning,* 25 (2020): 667–84, https://doi.org/https://doi.org/10.1007/s10758-018-9390-z.

[12] M.S. Ramírez-Montoya et al., "In-Service Teachers' Self-Perceptions of Digital Competence and OER Use as Determined by a Xmooc Training Course," *Computers in Human Behavior,* 77 (2017): 356–64, https://doi.org/https://doi.org/10.1016/j.chb.2017.09.010.

[13] C Redecker, *European Framework for the Digital Competence of Educators: DigCompEdu,* ed. Y. Punie, EUR 28775 EN (Luxembourg: Publications Office of the European Union, 2017), https://doi.org/https://doi.org/10.2760/159770.

[14] Verónica Basilotta-Gómez-Pablos et al., "Teachers' Digital Competencies in Higher Education: A Systematic Literature Review," *International Journal of Educational Technology in Higher Education* 19, no. 8 (2022), https://doi.org/10.1186/s41239-021-00312-8

[15] R. J. Krumsvik, "Teacher Educators' Digital Competence," *Scandinavian Journal of Educational Research* 58, no. 3 (2014): 269–80, https://doi.org/https://doi.org/10.1080/00313831.2012.726273.

[16] Eufrasio Pérez-Navío et al., "University Graduate Students and Digital Competence: Are Future Secondary School Teachers Digitally Competent?," *Sustainability* 13, no. 15 (2021): 1–14, https://doi.org/10.3390/su13158519

[17] Ekene Francis Okagbue et al., "The Effects of Covid-19 Pandemic on the Education System in Nigeria: The Role of Competency-Based Education," *International Journal of Educational Research Open* 4 (2023), https://doi.org/10.1016/j.ijedro.2022.100219.

Tuning Journal for Higher Education
© University of Deusto • p-ISSN: 2340-8170 • e-ISSN: 2386-3137 • Volume 12, Issue No. 2, November 2026, 205-230 •
doi: https://doi.org/10.18543/tjhe.3012 • http://www.tuningjournal.org/

Various activities in elementary schools as a natural form of strengthening digital literacy include using digital sources to search for information during intracurricular activities, which can also be linked to extracurricular activities. Elementary school students must have ethics and collective awareness in utilizing their digital literacy skills to avoid bullying and addictive games.

Related to the description above, prospective elementary school teachers, as the primary key to the successful use of technology in schools, must be able to facilitate the strengthening of digital literacy. Therefore, students are responsible for improving their critical thinking skills, including their ability in digital literacy. This article aims to present information regarding the perceptions of Elementary School Teacher Education Study Program (PGSD) at UNY students regarding digital literacy as a 21st-century skill.

II. Literature review

Digital literacy, as defined by Gilster.[18], refers to the capacity to comprehend and leverage information in diverse formats originating from different sources when delivered through a computer Meanwhile, UNESCO defines digital literacy as the ability to use digital technology to process information thoroughly-from accessing to creating-in a safe and appropriate manner.[19] Digital literacy objects are constantly moving, so they are difficult to define. It has implications for the level of ambiguity in using the term digital literacy, so it becomes an inherent weakness.[20] This article pertains to the definition of digital literacy suggested by Martin[21] in the context of specific life events, the awareness, attitudes, and capacity of individuals to utilize digital tools and facilities responsibly in order to construct new knowledge and interact with others, and to reflect on the process.

Students in teacher education programs must have digital literacy skills[22] because many changes in skills and experience are required to accommodate

---

[18] Paul Gilster, *Digital Literacy* (New York: Wiley., 1997).

[19] UNESCO, "*What you need to know about literacy*," (2025), https://www.unesco.org/en/literacy/need-know.

[20] Z Chase and D Laufenberg, "Embracing the Squishiness of Digital Literacy," *Journal of Adolescent and Adult Literacy* 54, no. 7 (2011): 535–37.

[21] A. Martin, "A European Framework for Digital Literacy," *Nordic Journal of Digital Literacy* 1, no. 2 (2006): 151–61, https://doi.org/https://doi.org/10.18261/ISSN1891-943X-2006-02-06.

[22] J Gillen and D Barton, "Digital Literacies. Research Briefing for the TLRP-TEL (Teaching and Learning Research Programme – Technology Enhanced Learning)," (London: London Knowledge Lab, Institute of Education, University of London, 2010), https://www.

Tuning Journal for Higher Education
© University of Deusto • p-ISSN: 2340-8170 • e-ISSN: 2386-3137 • Volume 12, Issue No. 2, November 2026, 205-230 •
doi: https://doi.org/10.18543/tjhe.3012 • http://www.tuningjournal.org/

the needs of their students.[23] In addition, technological development requires heterogeneous skills and operations and the abilities of each individual who operates it. On the other hand, there is a gap in providing facilities to support the digital literacy practices that students need.[24] Students as "digital natives"[25] have striking differences in digital competence with their teachers. Nevertheless, this rationale has faced extensive criticism due to the fact that the extent of information availability and digital proficiency is influenced by variables such as social position, race, and gender, rather than age and educational attainment.[26, 27]

Spires & Bartlett[28] have classified the extent of digital literacy into three distinct dimensions, which emphasize the intricate competencies and proficiencies that students need to develop. These include the ability to locate and use digital material, as well as the capacity to create and distribute digital information. It is essential to master critical and evaluative thinking skills to find and utilize digital content. Creativity, innovation, and understanding the sociological context in producing and disseminating digital content are also important. Price-Dennis[29] and Price-Dennis et al.[30] investigated several initiatives aimed at equipping future teachers to incorporate technology and

---

researchgate.net/publication/273313102_Gillen_J_Barton_D_2010_Digital_Literacies_Research_briefing_for_the_TLRP-TEL_Teaching_and_Learning_Research_Programme_-_Technology_Enhanced_Learning_London_London_Knowledge_Lab_Institute_of_Education.

[23] Katarzyna Potyrała and Łukasz Tomczyk, "Teachers in the Lifelong Learning Process: Examples of Digital Literacy," *Journal of Education for Teaching* 47, no. 2 (2021): 255–73, https://doi.org/10.1080/02607476.2021.1876499.

[24] C. Burnett, "Pre-Service Teachers' Digital Literacy Practices: Exploring Contingency in Identity and Digital Literacy in and out of Educational Contexts," *Language and Education* 25, no. 5 (2011): 433–59, https://doi.org/10.1080/09500782.2011.584347.

[25] C. Prensky, "Digital Natives, Digital Immigrants," On the Horizon, (2001), https://www.marcprensky.com/writing/Prensky - Digital Natives, Digital Immigrants - Part1.pdf.

[26] N. Hargittai, "Digital Na(t)Ives? Variation in Internet Skills and Uses among Members of the 'Net Generation,'" *Sociological Inquiry* 80, no. 1 (2010): 92–113, https://doi.org/https://doi.org/10.1111/j.1475-682X.2009.00317.x

[27] N. Selwyn, "Reconsidering Political and Popular Understandings of the Digital Divide," *New Media Society* 6, no. 3 (2004): 341–62, https://doi.org/https://doi.org/10.1177/1461444804042519

[28] H. A Spires and M.E Bartlett, *Digital Literacies and Learning: Designing a Path Forward* (Raleigh, NC: The William & Ida Friday Institute, North Carolina State University, 2012), https://www.fi.ncsu.edu/wp-content/uploads/2013/05/digital-literacies

[29] D. Price-Dennis, "Developing Curriculum to Support Black Girls' Literacies in Digital Spaces," *English Education* 48, no. 4 (2016), https://www.jstor.org/stable/26492573

[30] D. Price-Dennis et al., "Learning to Develop A Culturally Relevant Approach To 21st Century Writing Instruction," *Teaching/Writing: The Journal of Writing Teacher Education* 3, no. 2 (2014): 46–77, http://scholarworks.wmich.edu/wte/vol3/iss2/5

revealed a disparity between the accessibility and utilization of digital technology in educational settings.

This difference in ability to use technology is concerning if it is related to its availability and essential role in students' daily lives.[31] In addition, the use of digital technology that is less accommodated in teacher education programs increasingly makes them unable to predict how to apply it in the learning environments (classrooms). Furthermore, empirical evidence indicates that aspiring educators exhibit a heightened level of sensitivity towards the utilization of digital technology when they are familiar with it and actively engage with it.[32, 33] Thus, instruction to learn "about, through, and with technology"[34] and becoming must be carried out continuously, including how to become an active participant in digital literacy practices.[35] The online learning environment[36] also needs to be managed well.

Today's society coexists with information that is generally easily accessible to all citizens.[37] However, "Governments around the world recognize the economic consequences of digitally literate citizens and implement systemic strategies to advance digital literacy"[38] It means that

---

[31] Michail Kalogiannakis et al., "Gamification in Science Education. A Systematic Review of the Literature," *Education Sciences* 11, no. 1 (2021): 1–36, https://doi.org/10.3390/educsci11010022.

[32] S Collier et al., "Write for Your Life: Developing Digital Literacies and Writing Pedagogy in Teacher Education," *Contemporary Issues in Technology and Teacher Education* 13, no. 3 (2013): 262-284, https://citejournal.org/wp-content/uploads/2016/04/v13i3currentpractice1.pdf

[33] M Hundley and T Holbrook, "Set in Stone or Set in Motion?: Multimodal and Digital Writing with Pre-Service English Teachers," *Journal of Adolescent & Adult Literacy* 56, no. 6 (2013): 500–9, https://doi.org/https://doi.org/10.1002/JAAL.171

[34] G Cervetti et al., "Multiple Literacies, New Literacies, and Teacher Education," *Theory into Practice* 45, no. 4 (2006): 378–86, https://doi.org/https//doi.org/10.1207/s15430421tip4504_12

[35] M Hundley and T Holbrook. "Set in Stone or Set in Motion?: Multimodal and Digital Writing with Pre-Service English Teachers," 500–9.

[36] M.M. Juzwik et al., "Supporting Dialogically Organized Instruction in an English Teacher Preparation Program: A Video-Based, Web 2.0-Mediated Response and Revision Pedagogy," *Teachers College Record* 114, no. 3 (2012): 1–42, https://doi.org/https://doi.org/10.1177/016146811211400307

[37] J. R. Sparks et al., *Assessing Digital Information Literacy in Higher Education: A Review of Existing Frameworks and Assessments with Recommendations for Next-Generation Assessment,* Research Report RR-16-32 (Princeton, NJ: Educational Testing Service, 2016), https://files.eric.ed.gov/fulltext/EJ1124778.pdf

[38] M.C. Murray and J Pérez, "Unravelling the Digital Literacy Paradox: How Higher Education Fails at the Fourth Literacy," *Issues in Informing Science and Information Technology* 11 (2014): 85–100, https://doi.org/https://doi.org/10.28945/1982

access to information differs from access to knowledge. Universities need to pay attention to this situation, in which prospective teachers must consciously place themselves, especially in carefully selecting and making decisions regarding scientific information that can be accessed openly.

Information sources from the Internet can provide benefits and risks if it is not used wisely and consciously. Therefore, prospective teachers must be critical and careful in using virtual libraries or indexed journal databases. Many journals of varying quality are available on the Internet, but optimal use requires individuals with digital literacy, despite often being expert users of Facebook or computers.[39, 40]

Proficiency in digital skills is crucial for achieving success in social, academic, and professional domains.[41] Therefore, digital literacy is intricately linked to scientific culture, encompassing both official and informal settings, as well as face-to-face or online learning methods.[42, 43, 44] Various studies that have been studied above convince prospective teachers to become active users of digital technology, use it in the learning environment, and increase self-confidence so they are ready to compete positively in the 21st century.

III. Materials and methods

This survey collects data using a questionnaire adapted from.[45] The grid is then used to develop instruments that students fill out online through Google Forms. The research instrument in showing the role of prospective elementary school teachers in digital literacy practices in social studies learning is formed

---

[39] L.M. Jeffrey et al., "Developing Digital Information Literacy in Higher Education: Obstacles and Supports," *Journal of Information Technology Education* 10 (2011): 383–413, https://doi.org/https://doi.org/10.28945/1532

[40] Murray and Pérez, "Unravelling the Digital Literacy Paradox: How Higher Education Fails at the Fourth Literacy." 85–100.

[41] Murray and Pérez, "Unravelling the Digital Literacy Paradox: How Higher Education Fails at the Fourth Literacy." 85–100.

[42] C. Kivunja, "Unpacking the Information, Media, and Technology Skills Domain of the New Learning Paradigm," *International Journal of Sustainability in Higher Education* 4, no. 1 (2015): 166–81, https://doi.org/https://doi.org/10.5430/ijhe.v4n1p166

[43] E.M. Meyers et al., "Digital Literacy And Informal Learning Environments: An Introduction," *Learning, Media and Technology* 38, no. 4 (2013): 355–67, https://doi.org/https://doi.org/10.1080/17439884.2013.783597

[44] D.D. Prior et al., "Attitude, Digital Literacy and Self Efficacy: Flow-on Effects for Online Learning Behavior," *Internet and Higher Education* 29 (2016): 91–97, https://doi.org/https://doi.org/10.1016/j.iheduc.2016.01.001

[45] Zhao et al., "Digital Competence in Higher Education: Students' Perception and Personal Factors," 12184.

from 5 main components, in which 38 statements are contained. Respondents can access the research questionnaire using Google Forms. A Likert scale is used in this questionnaire with four choices: very good, good, bad, and very bad. The aspects of digital literacy measured can be observed in Table 1.

Table 1.

Instrument Grille

Digital Literacy Aspects	Indicator	Statement Number
Information and data literacy (X1)	Browse, search, filter data, information, and digital content	1, 2
	Evaluate data, information, and digital content	4
	Manage data, information, and digital content	3, 5, 6
Communication and collaboration (X2)	Interacting through digital technology	7
	Sharing through digital technology	8, 9
	Collaborate through digital technology	10, 11, 12
	Etiquette	13, 14
	Manage digital identities	15, 16, 17, 18
Digital content creation (X3)	Developing digital content	19, 20
	Integrate and re-elaborate digital content	21
	Copyright and license	22
	Programming	23, 24
Security (X4)	Protect the device	25, 26
	Protect personal data and privacy	27
	Protecting health and well-being	28, 29
	Protecting the environment	30, 31
Troubleshooting (X5)	Troubleshoot technical issues	32, 33
	Identify technology needs and responses	34, 35
	Using digital technology creatively	36, 37
	Identifying digital competency gaps	38

Tuning Journal for Higher Education
© University of Deusto • p-ISSN: 2340-8170 • e-ISSN: 2386-3137 • Volume 12, Issue No. 2, November 2026, 205-230 •
doi: https://doi.org/10.18543/tjhe.3012 • http://www.tuningjournal.org/

The alignment of research objectives with research design is very important. Quantitative research design with discriminant analysis is able to direct researchers in choosing the right type of sampling technique. In this case, the sampling technique used is adjusted to the needs of the study, namely purposive sampling, so researchers provide limits on grouping samples based on criteria. The criteria consider prospective teachers who have taken social studies education courses whose lecture process has facilitated several digital literacy skills that are measured. Thus, a sample of 563 future elementary school teachers was obtained, in this case, students in the second and fourth semesters of PGSD UNY. Data collection in the form of questionnaires was carried out online due to the limitations of researchers in reaching various campus units organized by PGSD UNY. Information about the identity and credibility of respondents is confidential.

The data obtained was analyzed using SPSS for Windows, version 26. The analysis only focused on descriptive statistics, strengthened by qualitative exposure, such as doing an interview with a fourth-semester student who scored high. However, validating and ensuring the reliability of the instruments used in the study is crucial to get evidence that the device developed aligns with the goals of measuring and extracting information. The content's validity was established through targeted group conversations with experts in social studies, technology and information, and literacy. Construct validity was conducted through CFA-assisted SPSS for Windows series 26 and LISREL 8.80. Instrument reliability testing was carried out using SPSS for Windows version 26.

IV. Results

Construct validity

Table 2.

KMO and Bartlett's Test scores

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.963
Bartlett's Test of Sphericity	Approx. Chi-Square	13273.501
	Df	666
	Sig.	.000

Table 2 shows a KMO value of 0.963 (>0.5) and a significance level of 0.00 (α<0.05) in Bartlett's Test of Sphericity. This indicates that the chosen sample is appropriate for analysis using factor analysis. Analyzed using confirmatory factor analysis, the factor loadings of each item are shown in Table 3.

Tuning Journal for Higher Education
© University of Deusto • p-ISSN: 2340-8170 • e-ISSN: 2386-3137 • Volume 12, Issue No. 2, November 2026, 205-230 •
doi: https://doi.org/10.18543/tjhe.3012 • http://www.tuningjournal.org/

Table 3.
Factor Analysis Results

Item	Loading Factor	Criteria	Item	Loading Factor	Criteria	Item	Loading Factor	Criteria
B_1	.537	Valid	B_14	.610	Valid	B_26	.647	Valid
B_2	.570	Valid	B_15	.623	Valid	B_27	.726	Valid
B_3	.533	Valid	B_16	.734	Valid	B_28	.691	Valid
B_4	.600	Valid	B_17	.549	Valid	B_29	.528	Valid
B_5	.645	Valid	B_18	.587	Valid	B_30	.641	Valid
B_6	.550	Valid	B_19	.588	Valid	B_31	.769	Valid
B_7	.564	Valid	B_20	.426	Valid	B_32	.764	Valid
B_8	.670	Valid	B_21	.499	Valid	B_33	.463	Valid
B_9	.634	Valid	B_22	.505	Valid	B_34	.394	Valid
B_10	.566	Valid	B_23	.827	Valid	B_35	.374	Valid
B_11	.605	Valid	B_24	.818	Valid	B_36	.407	Valid
B_12	.483	Valid	B_25	.660	Valid	B_37	.500	Valid
B_13	.589	Valid						

All valid items are presented in Table 3 because no items are discarded. CFA results show that only 37 items can be used with factor loadings of more than 0.40.

IV.1. Reliability

The Cronbach's Alpha coefficient was used to assess dependability, taking into account the coefficient threshold of 0.70 or above. The following reliability results are divided based on the components that form the role of prospective elementary school teachers.

Table 4.
Instrument Reliability Statistics

Component	N of Items	Cronbach's Alpha
Information and data literacy	11	0.901
Communication and Collaboration	8	0.894
Digital content creation	5	0.841

Tuning Journal for Higher Education
© University of Deusto • p-ISSN: 2340-8170 • e-ISSN: 2386-3137 • Volume 12, Issue No. 2, November 2026, 205-230 •
doi: https://doi.org/10.18543/tjhe.3012 • http://www.tuningjournal.org/

Component	N of Items	Cronbach's Alpha
Security	6	0.888
Troubleshooting	7	0.877
The entire instrument	37	0.963

Table 4 displays data that the reliability requirements for the instrument being developed have been successfully fulfilled, both for each component and overall, based on Cronbach's Alpha coefficient results. Therefore, the device can be used to measure perceptions regarding the digital literacy of prospective elementary school teachers.

IV.2. Descriptive analysis

Primary school teacher candidates' perceptions of digital competence were measured using 37 statement items, which were divided into several aspects. Specifically, the competencies assessed include information and data literacy (11 items), communication and cooperation (8 items), digital content production (6 items), security (6 items), and problem-solving (7 items). Respondents were provided with options on a Likert scale of 1 to 4. The scores for SBU, BU, BA, and SBA are 1 (poor), 2 (terrible), 3 (good), and 4 (very good), respectively. To prevent biased responses, this study was undertaken.

Table 5.

Perceptions of Prospective Elementary School Teachers on Digital Competencies

Competencies	Statement Item	SBU	BU	BA	SBA	Mean	SD
Information and Data Literacy	Item 1	0.53	0.36	68.92	30.2	3.29	0.49
	Item 2	0.18	2.31	72.11	25.4	3.23	0.48
	Item 3	0.00	1.60	74.42	23.98	3.22	0.45
	Item 4	0.18	3.73	80.46	15.63	3.12	0.43
	Item 5	0.00	1.78	67.85	30.37	3.29	0.49
	Item 6	0.18	1.95	76.38	21.49	3.19	0.45
	Item 7	0.18	2.13	63.77	33.93	3.31	0.52
	Item 8	0.36	7.28	72.47	19.89	3.12	0.52
	Item 9	0.00	6.04	74.6	19.36	3.13	0.49
	Item 10	0.00	2.31	71.4	26.29	3.24	0.48
	Item 11	0.00	2.49	69.8	27.71	3.25	0.49

Tuning Journal for Higher Education
© University of Deusto • p-ISSN: 2340-8170 • e-ISSN: 2386-3137 • Volume 12, Issue No. 2, November 2026, 205-230 •
doi: https://doi.org/10.18543/tjhe.3012 • http://www.tuningjournal.org/

Competencies	Statement Item	SBU	BU	BA	SBA	Mean	SD
Communication and Cooperation	Item 12	0.36	3.20	77.44	19.01	3.15	0.46
	Item 13	0.18	0.36	58.97	40.50	3.40	0.51
	Item 14	0.18	0.53	63.94	35.35	3.34	0.50
	Item 15	0.18	1.95	69.80	28.06	3.26	0.49
	Item 16	0.18	2.84	70.16	26.82	3.24	0.50
	Item 17	0.00	2.13	77.09	20.78	3.19	0.44
	Item 18	0.00	0.53	64.65	34.81	3.34	0.49
	Item 19	0.36	4.09	74.07	21.49	3.17	0.49
Digital Content Production	Item 20	0.53	4.97	74.42	20.07	3.14	0.50
	Item 21	0.18	4.09	77.80	17.94	3.13	0.46
	Item 22	0.18	6.57	77.09	16.16	3.09	0.48
	Item 23	1.42	21.31	66.61	10.66	2.87	0.60
	Item 24	2.31	27.18	61.10	9.41	2.78	0.64
Security	Item 25	0.71	0.36	72.82	26.11	3.24	0.48
	Item 26	0.00	1.07	74.60	24.33	3.23	0.45
	Item 27	0.00	0.18	60.92	38.90	3.39	0.49
	Item 28	0.18	1.42	70.34	28.06	3.26	0.48
	Item 29	0.18	3.73	71.94	24.16	3.20	0.50
	Item 30	0.00	0.53	67.67	31.79	3.31	0.48
Problem-Solving	Item 31	0.53	7.46	74.78	17.23	3.09	0.51
	Item 32	0.53	7.82	74.42	17.23	3.08	0.52
	Item 33	0.18	1.95	75.13	22.74	3.20	0.46
	Item 34	0.00	2.31	73.89	23.80	3.21	0.46
	Item 35	0.00	2.49	69.45	28.06	3.26	0.49
	Item 36	1.78	28.42	59.33	10.48	2.79	0.64
	Item 37	0.00	7.10	76.55	16.34	3.09	0.48

Most students consider themselves good at learning digital competencies, which consists of information and data literacy, communication and cooperation, digital content production, security, and problem-solving. All items formed in this aspect are dominated by more than 65%, responding well to all statements.

Tuning Journal for Higher Education
© University of Deusto • p-ISSN: 2340-8170 • e-ISSN: 2386-3137 • Volume 12, Issue No. 2, November 2026, 205-230 •
doi: https://doi.org/10.18543/tjhe.3012 • http://www.tuningjournal.org/

IV.3. Inferential analysis

The subsequent information examines the conditions that impact students' views of digital proficiency, including gender, class, place of residence, formal education, and possession of lecture support equipment.

Gender Factor

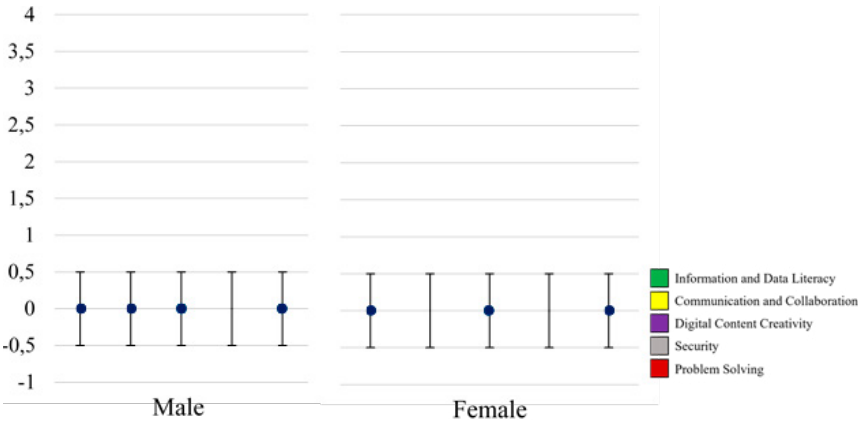


Figure 1.
Student perceptions of digital literacy based on gender

The purpose of testing utilizing the Mann-Whitney U formula is to ascertain if there exist disparities in the perspectives of female and male pupils on the elements of information and data literacy. Gender analysis reveals statistically significant differences (p-value = 0.000). Figure 1 presents a comparison of students' opinions of digital ability based on gender. The average total score of men is 34.87, while women's is 35.51. The gain for each component based on gender has a significance of 0.114 on the information and data literacy component, 0.025 on the communication and collaboration component, 0.152 on the digital content creativity component, 0.995 on the security component, and 0.103 on the problem-solving component. Based on this data, only the security component is able to differentiate student perceptions based on gender. It shows that the difference in students' perceptions of digital competence is apparent from their carefulness in using information and sharing data in the information communication process. On the other hand, the other four components are

Tuning Journal for Higher Education
© University of Deusto • p-ISSN: 2340-8170 • e-ISSN: 2386-3137 • Volume 12, Issue No. 2, November 2026, 205-230 •
doi: https://doi.org/10.18543/tjhe.3012 • http://www.tuningjournal.org/

classified as having low competence with far significance when compared to the competence of security components (>0.05). Thus, there is hope for educators to improve students' competence through components that still need to be improved.

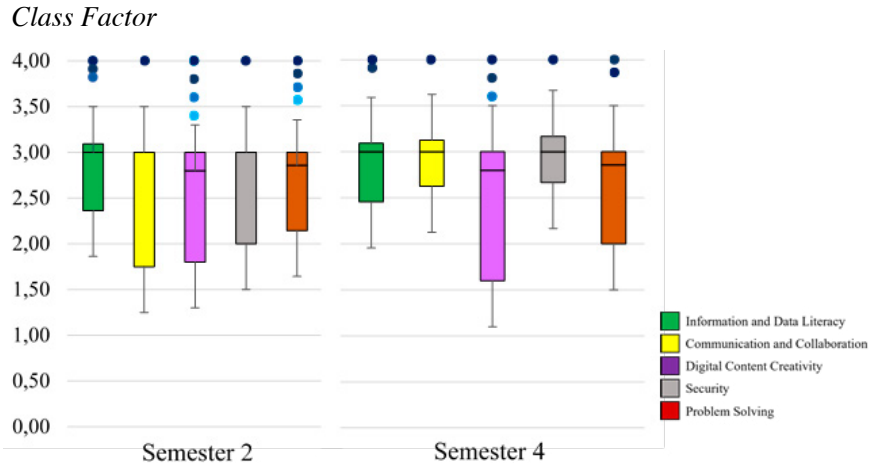


Figure 2.

Students' perceptions of digital literacy based on class distribution

Almost the same as student perceptions in terms of gender, student perceptions based on class distribution, in this case, are based on semester two and semester 4. Both have differences, even though the data processing results show significant differences in the four components, and only one component does not show significance. The next Mann-Whitney U test aims to find out whether there are differences between semester two and semester four students regarding perceptions of each component. The test results are presented in Figure 2. There is a significance level of 0.242 for the information and data literacy component and 0.565 for the communication and cooperation component, the digital content creativity component 0.504, the security component 0.363, and the problem-solving component 0.850. The obtained data show that digital content's problem-solving and creativity components can differentiate student perceptions based on class. The total average score obtained in semester two is 35.27, while in semester four, it is 35.38. Thus, students' perceived digital competence can differentiate the extent of their information and data

Tuning Journal for Higher Education
© University of Deusto • p-ISSN: 2340-8170 • e-ISSN: 2386-3137 • Volume 12, Issue No. 2, November 2026, 205-230 •
doi: https://doi.org/10.18543/tjhe.3012 • http://www.tuningjournal.org/

literacy abilities.[46] It is also a foothold for educators, who in this case are lecturers, to explore further the extent of the perspective of female students towards a problem and creativity, so there is no gap with male students.

Factors of Residential Area

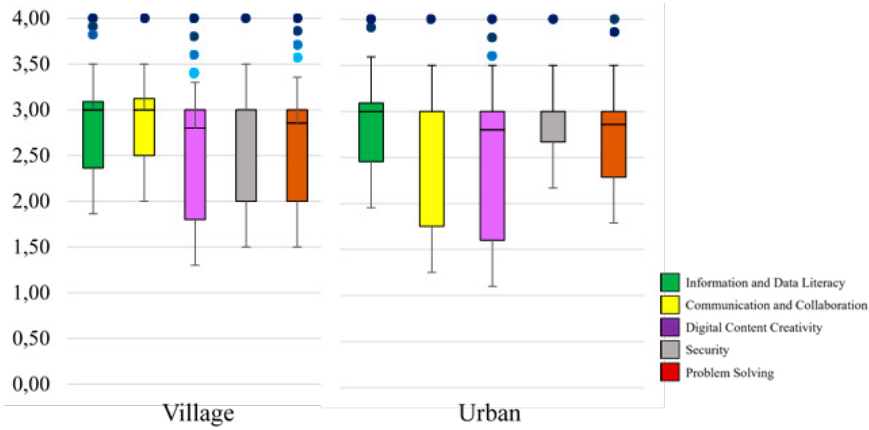


Figure 3.
Students' perceptions of digital literacy based on region of origin

The area of origin is divided into urban and rural. To distinguish students' perceptions, the Mann-Whitney U test aims to determine whether there are differences between students from villages and cities related to each perception in the components. A comparison of students' perceptions of digital competence between regions of origin is presented in Figure 3. There is a significance level of 0.292 for each element in the information and data literacy component, 0.534 in the communication and collaboration component, 0.609 in the digital content creative component, 0.643 in the security component, and 0.688 in the problem-solving component. More clearly, the problem-solving and creativity components of digital content can distinguish student perceptions based on the region of origin. It shows that the perception of digital literacy owned by students is not too strong; it can be distinguished based on students' information and data literacy skills.

[46] S.M. Avdeeva et al., "Digital Transformation of Schools and Student's Information and Communication Literacy," *Voprosy Obrazovaniya / Educational Studies Moscow* 2022, no. 1 (2022): 218–43, https://doi.org/10.17323/1814-9545-2022-1-218-243.

Tuning Journal for Higher Education
© University of Deusto • p-ISSN: 2340-8170 • e-ISSN: 2386-3137 • Volume 12, Issue No. 2, November 2026, 205-230 •
doi: https://doi.org/10.18543/tjhe.3012 • http://www.tuningjournal.org/

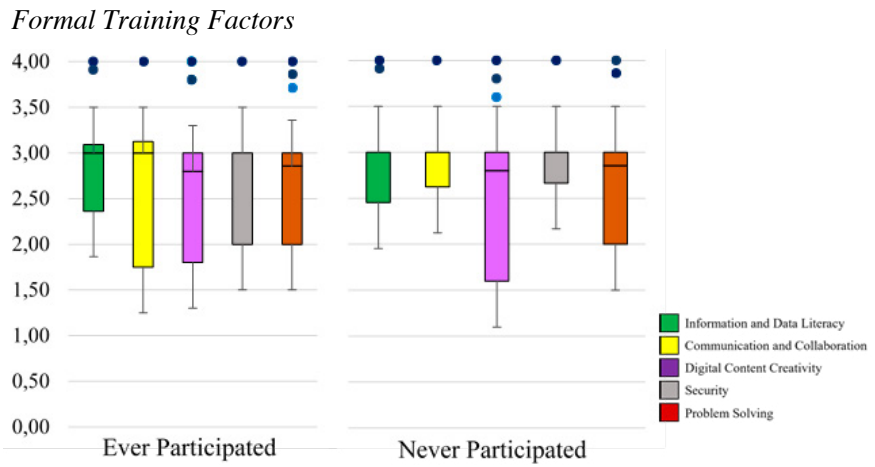


Figure 4.

Students' Perceptions of Digital Literacy Based on Participation in Digital Training

Not all students have attended training related to improving digital competence, so students' perceptions will tend to lead to unbalanced perceptions. However, the analysis results show that the purpose of the Mann-Whitney U test is to ascertain if there are disparities between pupils who have received instruction and those who have not, with regard to each perception of the components. In Figure 4, a comparison of students' opinions of digital proficiency between genders is presented. A significant level of 0.033 is seen in the information and data literacy component, 0.068 in the communication and collaboration component, and 0.552 in the digital content creative component, based on students' involvement in training, 0.064 is seen in the security component, and 0.746 in the problem-solving component. More clearly, the problem-solving component is able to distinguish student perceptions based on student participation in training based on increasing digital competence. Although other components are classified as influential and able to distinguish student groups, only the information and data literacy component is still relatively low and unable to distinguish between the two groups. Becomes a basis for evaluation to explore weaknesses in students' literacy culture.

Tuning Journal for Higher Education
© University of Deusto • p-ISSN: 2340-8170 • e-ISSN: 2386-3137 • Volume 12, Issue No. 2, November 2026, 205-230 •
doi: https://doi.org/10.18543/tjhe.3012 • http://www.tuningjournal.org/

Supporting Device Ownership Factors

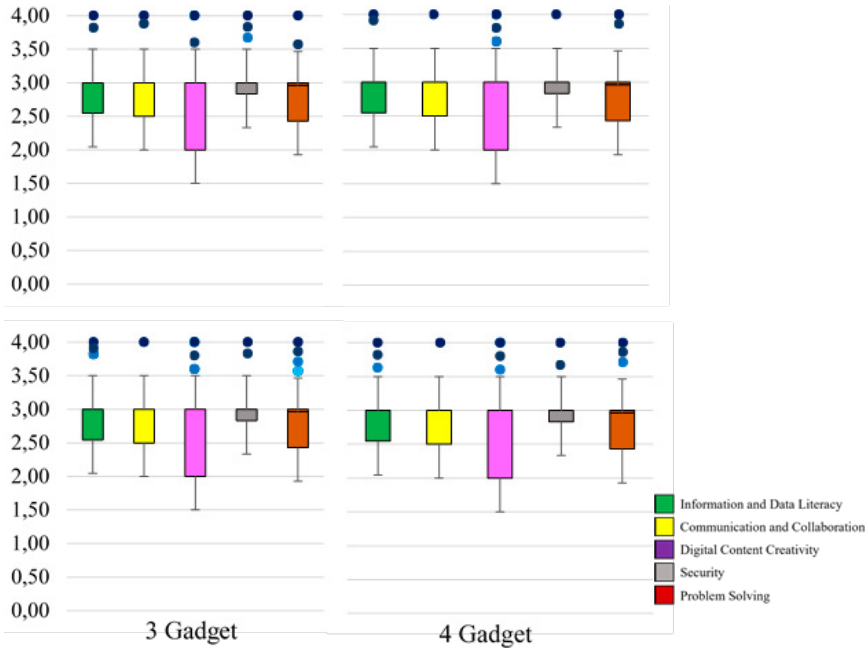


Figure 5.

Students' Perceptions of Digital Literacy Based on Ownership of Learning Support Device

Like the extent of students' abilities in digital-based literacy, not all students have the same learning support devices, so it is possible that the habit of obtaining and processing information digitally may differ. More clearly, the application of Mann-Whitney analysis U testing seeks to ascertain if there are disparities among students with varying quantities of gadgets when it comes to each impression of the component. The comparison of students' opinions of digital competence across different devices is shown in Figure 5. A significant level of 0.895 is seen in the information and data literacy component and 0.830 in the communication and collaboration component when acquiring each component based on the number of devices possessed, 0.441 in the digital content creativity component, 0.969 in the security component, and 0.838 in the problem-solving component. The acquisition of significance in each component that is differentiated based on

Tuning Journal for Higher Education
© University of Deusto • p-ISSN: 2340-8170 • e-ISSN: 2386-3137 • Volume 12, Issue No. 2, November 2026, 205-230 •
doi: https://doi.org/10.18543/tjhe.3012 • http://www.tuningjournal.org/

the number of devices owned by students is able to show the extent of the influence of the number of devices on student competence in digital literacy. Perceptions of students in information and data literacy, communication and teamwork, security, and problem-solving are predominantly positive. These four components reflect the purpose of using devices that a student has used. In addition, the component of digital content creativity has a low differentiation test; it is an opportunity for educators to direct learning that is more innovative and creative, produces digital-based works, and is able to explore weaknesses in students' creativity.

V. Discussion

Digital literacy is a critical competency that needs to be developed in students, especially if it is linked to preparing professional resources with academic abilities according to the needs of future society.[47, 48] This started with the situation and conditions of education and learning, which experienced many changes as one of the impacts of the COVID-19 epidemic.[49, 50]

Research that focuses on digital literacy, literacy outcomes, perceptions of it, and the relationship between its dimensions has been carried out by researchers in various countries.[51, 52, 53] The present study enhances the existing research findings, particularly on the digital literacy level of

---

[47] F.D. Guillén-Gámez et al., "A Study on the Actual Use of Digital Competence in the Practicum of Education Degree," *Technology Knowledge, and Learning,* 25 (2020): 667–84, https://doi.org/https://doi.org/10.1007/s10758-018-9390-z

[48] E. López-Meneses et al., "University Students' Digital Competence in Three Areas of The Digcom 2.1 Model: A Comparative Study at Three European Universities," *Australasian Journal of Educational Technology* 36 (2020): 69–88, https://doi.org/https://doi.org/10.14742/ajet.5583

[49] Elias G Carayannis and Joanna Morawska-Jancelewicz, "The Futures of Europe: Society 5.0 and Industry 5.0 as Driving Forces of Future Universities," *Journal of the Knowledge Economy* 13, no. 4 (2022): 3445–71, https://doi.org/10.1007/s13132-021-00854-2

[50] Richard Watermeyer et al., "'Education without Limits': The Digital Resettlement of Post-Secondary Education and Training in Singapore in the COVID-19 Era," *Journal of Education Policy* 37, no. 6 (2022): 861–82, https://doi.org/10.1080/02680939.2021.1933198

[51] R. Ata and K Yildirim, "Exploring Turkish Pre-Service Teachers' Perceptions and Views of Digital Literacy," *Education Sciences* 9 (2019): 40, https://doi.org/http://doi.org/10.3390/educsci9010040

[52] K. Martzoukou et al., "A Study of Higher Education Students' Self-Perceived Digital Competences for Learning and Everyday Life Online Participation," *Journal of Documentation* 76, no. 6 (2020): 1413–58, https://doi.org/https://doi.org/10.1108/JD-03-2020-0041

[53] C. Sánchez-Cruzado et al., "Teacher Digital Literacy: The Indisputable Challenge after COVID-19," *Sustainability* 13 (2021): 1858, https://doi.org/https://doi.org/10.3390/su13041858

Tuning Journal for Higher Education
© University of Deusto • p-ISSN: 2340-8170 • e-ISSN: 2386-3137 • Volume 12, Issue No. 2, November 2026, 205-230 •
doi: https://doi.org/10.18543/tjhe.3012 • http://www.tuningjournal.org/

Bachelor of PGSD at UNY students as perceived within the higher education setting. The digital literacy of students in the areas of information and data literacy, communication, and cooperation demonstrates robust outcomes, as the majority of students perceive these aspects as beneficial. Students' perceptions of digital literacy are inversely proportional to task complexity. Tasks that increase complexity cause students' literacy levels to decrease.[54,55] Therefore, digital content creation and programming skills that are dynamic, following technological development trends, and other problem-solving skills, especially when encountering technical problems, need to be improved. This study's findings align with Gallego-Arrufat et al.[56] and Martzoukou et al.,[57] the positive perception of the security aspect of digital competence contradicts the results explored by Porlan and Sanchez.[58] However, overall, students' digital literacy level still has the potential to be developed further.

Gender is a research theme widely conducted today.[59] Significant differences regarding digital literacy when examined from a gender perspective have been found by several researchers.[60,61] However, simultaneously, different findings are shown by Galindo-Domínguez and Bezanilla, Gil-Juarez et al, and Prieto et al in which no statistically significant differences exist based on

---

[54] M. Cabezas González et al., "Do Gender and Age Affect the Level of Digital Competence? A Study with University Students," *Fonseca Journal of Communication* 15 (2017): 115–32, https://doi.org/https://doi.org/10.14201/fjc201715109125

[55] A. Pérez-Escoda et al., "Digital Skills in the Z Generation: Key Questions for a Curricular Introduction in Primary School," *Comunicar* 49 (2016): 71–79, https://doi.org/https://doi.org/10.3916/C49-2016-07

[56] M. Gallego-Arrufat et al., "Competence of Future Teachers in the Digital Security Area," *Comunicar* 61 (2019): 57–67, https://doi.org/https://doi.org/10.3916/C61-2019-05

[57] Martzoukou et al., "A Study of Higher Education Students' Self-Perceived Digital Competences for Learning and Everyday Life Online Participation," 1413–58.

[58] I.G. Porlan and J.S. Sanchez, "Evaluation and Development of Digital Competence in Future Primary School Teachers at the University of Murcia. J.," *New Approaches in Educational Research* 5, no. 1 (2016): 51–56, https://doi.org/https://doi.org/10.7821/naer.2016.1.152

[59] N.C. Dedebali, "Analysis of Digital Literacy and Metaphoric Perceptions of Teacher Candidate," *International Journal of Educational Methodology* 6, no. 1 (2020): 135–45, https://doi.org/https://doi.org/10.12973/ijem.6.1.135

[60] A. Basantes-Andrade et al., "Digital Competences Relationship between Gender and Generation of University Professors," *International Journal on Advanced Science Engineering Information Technology*. 1 (2020): 205–11, https://doi.org/https://doi.org/10.18517/ijaseit.10.1.10806

[61] L.J. Rodríguez-Muñiz et al., "Secondary Mathematics Teachers' Perception of Their Readiness for Emergency Remote Teaching during the COVID-19 Pandemic: A Case Study," *Education Sciences* 11, no. 5 (2021): 228, https://doi.org/https://doi.org/10.3390/educsci11050228

gender.[62, 63, 64] Meanwhile, this study verifies that male students rate themselves higher than female students on one aspect of security.[65]

Many researchers have discovered that digital competencies have been explored based on age gaps. However, research that looked at the issue of digital competency from the different classes' students had taken only found small gaps.[66] Therefore, researchers should take into account the lack of significant age disparity among students when examining variations in views of digital competence between first and second-year students. Research findings provide evidence that second-year (fourth- semester) students show better self-perception in two aspects of digital literacy, including problem-solving and digital content creativity.

Research findings show that where students live influences the digital divide. The causes of the gap from demographic factors arise due to several aspects, such as age, education level, and Internet connections.[67] The digital literacy of students who live in urban areas shows better results in the aspects of problem-solving and digital content creativity. Therefore, these findings are in line with Sánchez-Caballé, Gisbert et al.[68] All students have previous relevant experience through formal training related to the use of ICT and digital competencies. Thus, supporting the findings of Sánchez-Caballé, Gisbert, et al.,[69] the knowledge gained through formal training can influence

---

[62] H Galindo-Domínguez and M J Bezanilla. "Digital Competence in the Training of Pre-Service Teachers: Perceptions of Students in the Degrees of Early Childhood Education and Primary Education," *Journal of Digital Learning in Teacher Education* 37, no. 4 (2021): 262–78, https://doi.org/https://doi.org/10.1080/21532974.2021.1934757

[63] A. Gil-Juarez et al., "Digital Gender Gap: A Review and a Proposal," *Education in the Knowledge Society* 12 (2011): 25–53, https://doi.org/https://doi.org/10.14201/eks.8272

[64] J.S. Prieto et al., "Gender and Digital Teaching Competence in Dual Vocational Education and Training," *Education Sciences* 10, no. 3 (2020): 84, https://doi.org/https://doi.org/10.3390/educsci10030084

[65] Ismael Hernández Sempere and Cinta Espuny Vidal, "STEM Studies and Digital Gender Gap in Baccalaureate: The Influence of Digital Competence in the Academic Future," *Edutec*, no. 81 (2022): 55–71, https://doi.org/10.21556/edutec.2022.81.2601

[66] G. Blank et al., "Local Geographies of Digital Inequality," *Social Science Computer Review* 36, no. 1 (2018): 82–102, https://doi.org/https://doi.org/10.1177/0894439317693332

[67] C. Rundel and K Salemink, "Bridging Digital Inequalities in Rural Schools in Germany: A Geographical Lottery?," *Education Sciences* 11, no. 4 (2021): 181, https://doi.org/https://doi.org/10.3390/educsci11040181

[68] A Sánchez-Caballé , M. Gisbert, and F. Esteve, "The Digital Competence of University Students: A Systematic Literature Review," *Aloma Revista de Psicologia Ciències de l Educació i de l Esport* 38, no. 1 (2020): 63–74, https://doi.org/https://doi.org/10.51698/aloma.2020.38.1.

[69] Sánchez-Caballé, Gisbert, and Esteve, "The Digital Competence of University Students," 63–74

the development of students' subsequent digital competencies. Formal training has a beneficial effect on pupils, leading to an increased degree of self-perception as regards their digital literacy.

VI. Conclusion

Multimedia technology is experiencing more rapid and extensive changes, especially in education. Therefore, accurate assessment of students' digital literacy competence is crucial. Results of research can enhance the present state of digital literacy among students. The research results can be followed up to determine the digital literacy perceptions of students in different education systems. Therefore, they might be compared to pupils from various nations or educational settings. Furthermore, study findings can serve as a reference for lecturers and educational institutions, particularly when establishing suitable training and education programs.

Bibliography

Ata, R., and K Yildirim. "Exploring Turkish Pre-Service Teachers' Perceptions and Views of Digital Literacy." *Education Sciences* 9 (2019): 40. https://doi.org/http://doi.org/10.3390/educsci9010040.

Avdeeva, S. M., A. Yu Uvarov, and K. V. Tarasova. "Digital Transformation of Schools and Student's Information and Communication Literacy." *Voprosy Obrazovaniya / Educational Studies Moscow* 2022, no. 1 (2022): 218–43. https://doi.org/10.17323/1814-9545-2022-1-218-243.

Basantes-Andrade, A., M. Cabezas-González, and S Casillas-Martín. "Digital Competences Relationship between Gender and Generation of University Professors." *International Journal on Advanced Science Engineering Information Technology* 1 (2020): 205–11. https://doi.org/https://doi.org/10.18517/ijaseit.10.1.10806.

Basilotta-Gómez-Pablos, Verónica, María Matarranz, Luis Alberto Casado-Aranda, and Ana Otto. "Teachers' Digital Competencies in Higher Education: A Systematic Literature Review." *International Journal of Educational Technology in Higher Education* 19, no. 8 (2022). https://doi.org/10.1186/s41239-021-00312-8.

Blank, G., M. Graham, and C Calvino. "Local Geographies of Digital Inequality." *Social Science Computer Review* 36, no. 1 (2018): 82–102. https://doi.org/https://doi.org/10.1177/0894439317693332.

Burnett, C. "Pre-Service Teachers' Digital Literacy Practices: Exploring Contingency in Identity and Digital Literacy in and out of Educational Contexts." *Language and Education* 25, no. 5 (2011): 433–459. https://doi.org/10.1080/09500782.2011.584347.

Cabezas González, M., S. Casillas Martín, M. Sanches-Ferreira, and F.L Teixeira Diogo. "Do Gender and Age Affect the Level of Digital Competence? A Study with University Students." *Fonseca Journal of Communication* 15 (2017): 115–32. https://doi.org/https://doi.org/10.14201/fjc201715109125.

Carayannis, Elias G., and Joanna Morawska-Jancelewicz. "The Futures of Europe: Society 5.0 and Industry 5.0 as Driving Forces of Future Universities." *Journal of the Knowledge Economy* 13, no. 4 (2022): 3445–71. https://doi.org/10.1007/s13132-021-00854-2.

Cervetti, G, J Damico, and P.D Pearson. "Multiple Literacies, New Literacies, and Teacher Education." *Theory into Practice* 45, no. 4 (2006): 378–86. https://doi.org/https//doi.org/10.1207/s15430421tip4504_12.

Chase, Z, and D Laufenberg. "Embracing the Squishiness of Digital Literacy." *Journal of Adolescent and Adult Literacy* 54, no. 7 (2011): 535–537.

Collier, S, B Foley, D Moguel, and I Barnard. "Write for Your Life: Developing Digital Literacies and Writing Pedagogy in Teacher Education." Contemporary Issues in Technology and Teacher Education, 2013. https://citejournal.org/wp-content/uploads/2016/04/v13i3currentpractice1.pdf.

Dedebali, N.C. "Analysis of Digital Literacy and Metaphoric Perceptions of Teacher Candidate." *International Journal of Educational Methodology* 6, no. 1 (2020): 135–45. https://doi.org/https://doi.org/10.12973/ijem.6.1.135.

Galindo-Domínguez, H, and M.J Bezanilla. "Digital Competence in the Training of Pre-Service Teachers: Perceptions of Students in the Degrees of Early Childhood Education and Primary Education." *Journal of Digital Learning in Teacher Education*, 2021, 262–78. https://doi.org/https://doi.org/10.1080/21532974.2021.1934757.

Gallego-Arrufat, M, N Torres-Hernández, and T Pessoa. "Competence of Future Teachers in the Digital Security Area." *Comunicar* 61 (2019): 57–67. https://doi.org/https://doi.org/10.3916/C61-2019-05.

Gil-Juarez, A., A. Vitores, J. Feliu, and M Vall-Llovera. "Digital Gender Gap: A Review and a Proposal. ." *Education in the Knowledge Society* 12 (2011): 25–53. https://doi.org/https://doi.org/10.14201/eks.8272.

Gillen, J, and D Barton. "Digital Literacies. Research Briefing for the TLRP-TEL (Teaching and Learning Research Programme – Technology Enhanced Learning)." London: London Knowledge Lab, Institute of Education, University of London, 2010. https://www.researchgate.net/publication/273313102_Gillen_J_Barton_D_2010_Digital_Literacies_Research_briefing_for_the_TLRP-TEL_Teaching_and_Learning_Research_Programme_-_Technology_Enhanced_Learning_London_London_Knowledge_Lab_Institute_of_Education.

Gilster, P. *Digital Literacy*. New York: Wiley., 1997.

Guillén-Gámez, F.D., M.J Mayorga-Fernández, and F.J Álvarez-García. "A Study on the Actual Use of Digital Competence in the Practicum of Education Degree." *Technology Knowledge, and Learning*. 25 (2020): 667–84. https://doi.org/https://doi.org/10.1007/s10758-018-9390-z.

Haleem, Abid, Mohd Javaid, Mohd Asim Qadri, and Rajiv Suman. "Understanding the Role of Digital Technologies in Education: A Review." *Sustainable Operations and Computers* 3, no. February (2022): 275–85. https://doi.org/10.1016/j.susoc.2022.05.004.

Hargittai, N. "Digital Na(t)Ives? Variation in Internet Skills and Uses among Members of the 'Net Generation.'" *Sociological Inquiry* 80, no. 1 (2010): 92–113. https://doi.org/https://doi.org/10.1111/j.1475-682X.2009.00317.x.

Hundley, M, and T Holbrook. "Set in Stone or Set in Motion?: Multimodal and Digital Writing with Pre-Service English Teachers." *Journal of Adolescent & Adult Literacy* 56, no. 6 (2013): 500–509. https://doi.org/https://doi.org/10.1002/JAAL.171.

Iansiti, M., and G. Richards. "Coronavirus Is Widening the Corporate Digital Divide." Harvard Business Review, 2020. https://hbr.org/2020/03/coronavirus-is-widening-the-corporate-digital-divide.

Iglesias-Pradas, Santiago, Ángel Hernández-García, Julián Chaparro-Peláez, and José Luis Prieto. "Emergency Remote Teaching and Students' Academic Performance in Higher Education during the COVID-19 Pandemic: A Case Study." *Computers in Human Behavior* 119, no. October 2020 (2021). https://doi.org/10.1016/j.chb.2021.106713.

Jeffrey, L.M., B. Hegarty, O. Kelly, M. Penman, D. Coburn, and J. McDonald. "Developing Digital Information Literacy in Higher Education: Obstacles and Supports." *Journal of Information Technology Education* 10 (2011): 383–413. https://doi.org/https://doi.org/10.28945/1532.

Juzwik, M.M., M.B. Sherry, S. Caughlan, A. Heintz, C. Borsheim-Black, S. Auerbach, and P Herbst. "Supporting Dialogically Organized Instruction in an English Teacher Preparation Program: A Video-Based, Web 2.0-Mediated Response and Revision Pedagogy." *Teachers College Record* 114, no. 3 (2012): 1–42. https://doi.org/https://doi.org/10.1177/016146811211400307.

Kalogiannakis, Michail, Stamatios Papadakis, and Alkinoos Ioannis Zourmpakis. "Gamification in Science Education. A Systematic Review of the Literature." *Education Sciences* 11, no. 1 (2021): 1–36. https://doi.org/10.3390/educsci11010022.

Kivunja, C. "Unpacking the Information, Media, and Technology Skills Domain of the New Learning Paradigm." *International Journal of Sustainability in Higher Education* 4, no. 1 (2015): 166–81. https://doi.org/https://doi.org/10.5430/ijhe.v4n1p166.

Krumsvik, R. J. "Teacher Educators' Digital Competence." *Scandinavian Journal of Educational Research* 58, no. 3 (2014): 269–280. https://doi.org/https://doi.org/10.1080/00313831.2012.726273.

López-Meneses, E., F.M. Sirignano, E. Vázquez-Cano, and J.M Ramírez-Hurtado. "University Students' Digital Competence in Three Areas of The Digcom 2.1 Model: A Comparative Study at Three European Universities. ." *Australasian Journal of Educational Technology* 36 (2020): 69–88. https://doi.org/https://doi.org/10.14742/ajet.5583.

Martin, A. "A European Framework for Digital Literacy." *Nordic Journal of Digital Literacy* 1, no. 2 (2006): 151–61. https://doi.org/https://doi.org/10.18261/ISSN1891-943X-2006-02-06.

Martzoukou, K, C Fulton, P Kostagiolas, and C Lavranos. "A Study of Higher Education Students' Self-Perceived Digital Competences for Learning and Everyday Life Online Participation." *Journal of Documentation* 76, no. 6 (2020): 1413–58. https://doi.org/https://doi.org/10.1108/JD-03-2020-0041.

Meyers, E.M., I. Erickson, and R.V Small. "Digital Literacy And Informal Learning Environments: An Introduction." *Learning, Media and Technology* 38, no. 4 (2013): 355–67. https://doi.org/https://doi.org/10.1080/17439884.2013.783597.

Murray, M.C., and J Pérez. "Unravelling the Digital Literacy Paradox: How Higher Education Fails at the Fourth Literacy." *Issues in Informing Science and Information Technology* 11 (2014): 85–100. https://doi.org/https://doi.org/10.28945/1982.

Okagbue, Ekene Francis, Ujunwa Perpetua Ezeachikulo, Ilokanulo Samuel Nchekwubemchukwu, Ilodibe Emeka Chidiebere, Obisoanya Kosiso, Cheick Amadou Tidiane Ouattaraa, and Esther Onyinye Nwigwe. "The Effects of Covid-19 Pandemic on the Education System in Nigeria: The Role of Competency-Based Education." *International Journal of Educational Research Open* 4, no. December 2022 (2023). https://doi.org/10.1016/j.ijedro.2022.100219.

Pérez-Escoda, A., A. Castro-Zubizarreta, and M Fandos-Igado. "Digital Skills in the Z Generation: Key Questions for a Curricular Introduction in Primary School." *Comunicar* 49 (2016): 71–79. https://doi.org/https://doi.org/10.3916/C49-2016-07.

Pérez-Navío, Eufrasio, María Teresa Ocaña-Moral, and María Del Carmen Martínez-Serrano. "University Graduate Students and Digital Competence: Are Future Secondary School Teachers Digitally Competent?" *Sustainability (Switzerland)* 13, no. 15 (2021): 1–14. https://doi.org/10.3390/su13158519.

Porlan, I.G., and J.S. Sanchez. "Evaluation and Development of Digital Competence in Future Primary School Teachers at the University of Murcia. J." *New Approaches in Educational Research* 5, no. 1 (2016): 51–56. https://doi.org/https://doi.org/10.7821/naer.2016.1.152.

Potyrała, Katarzyna, and Łukasz Tomczyk. "Teachers in the Lifelong Learning Process: Examples of Digital Literacy." *Journal of Education for Teaching* 47, no. 2 (2021): 255–73. https://doi.org/10.1080/02607476.2021.1876499.

Prensky, Marc. "Digital Natives, Digital Immigrants Part 1." *On the Horizon* 9, no. 5 (2001): 1–6. https://doi.org/10.1108/10748120110424816.

Price-Dennis, D. "Developing Curriculum to Support Black Girls' Literacies in Digital Spaces." English Education, 2016. https://www.jstor.org/stable/26492573.

Price-Dennis, D, M.T. Wiebe, and M Fowler-Amato. "Learning to Develop A Culturally Relevant Approach To 21st Century Writing Instruction." *Teaching/Writing: The Journal of Writing Teacher Education* 3, no. 2 (2014): 46–77. http://scholarworks.wmich.edu/wte/vol3/iss2/5.

Prieto, J.S., J.M.T Torres, M.G. Garcia, and G.G Garcia. "Gender and Digital Teaching Competence in Dual Vocational Education and Training." *Education Sciences* 10, no. 3 (2020): 84. https://doi.org/https://doi.org/10.3390/educsci10030084.

Prior, D.D., J. Mazanov, D. Meacheam, G. Heaslip, and J.M. Hanson. "Attitude, Digital Literacy and Self Efficacy: Flow-on Effects for Online Learning Behavior." *Internet and Higher Education* 29 (2016): 91–97. https://doi.org/https://doi.org/10.1016/j.iheduc.2016.01.001.

Ramírez-Montoya, M.S., J. Mena, and J.A. Rodríguez-Arroyo. "In-Service Teachers' Self-Perceptions of Digital Competence and OER Use as Determined by a Xmooc Training Course." *Computers in Human Behavior*. 77 (2017): 356–364. https://doi.org/https://doi.org/10.1016/j.chb.2017.09.010.

Rapanta, Chrysi, Luca Botturi, Peter Goodyear, Lourdes Guàrdia, and Marguerite Koole. "Balancing Technology, Pedagogy and the New Normal: Post-Pandemic Challenges for Higher Education." *Postdigital Science and Education* 3, no. 3 (2021): 715–42. https://doi.org/10.1007/s42438-021-00249-1.

Redecker, C. *European Framework for the Digital Competence of Educators: DigCompEdu. In Y. Punie (Ed.), EUR 28775 EN*. Luxembourg: Publications Office of the European Union, 2017. https://doi.org/https://doi.org/10.2760/159770.

Rodríguez-Muñiz, L.J., D. Burón, Á. Aguilar-González, and L Muñiz-Rodríguez. "Secondary Mathematics Teachers' Perception of Their Readiness for Emergency Remote Teaching during the COVID-19 Pandemic: A Case Study." *Education Sciences* 11, no. 5 (2021): 228. https://doi.org/https://doi.org/10.3390/educsci11050228.

Rundel, C., and K Salemink. "Bridging Digital Inequalities in Rural Schools in Germany: A Geographical Lottery?" *Education Sciences* 11, no. 4 (2021): 181. https://doi.org/https://doi.org/10.3390/educsci11040181.

Sánchez-Caballé, A., M. Gisbert, and F Esteve. "The Digital Competence of University Students: A Systematic Literature Review." *Aloma Revista de Psicologia Ciències de l Educació i de l Esport* 38, no. 1 (2020): 63–74. https://doi.org/https://doi.org/10.51698/aloma.2020.38.1.63-74.

Sánchez-Cruzado, C, R Santiago Campión, and M.T Sánchez-Compaña. "Teacher Digital Literacy: The Indisputable Challenge after COVID-19." *Sustainability* 13 (2021): 1858. https://doi.org/https://doi.org/10.3390/su13041858.

Schleicher, Andreas. "The Impact of COVID-19 OnEducation Institutions From Education at a Glance 2020." OECD Publishing, 2020. https://eric.ed.gov/?id=ED616315.

Selwyn, N. "Reconsidering Political and Popular Understandings of the Digital Divide." *New Media Society* 6, no. 3 (2004): 341–362. https://doi.org/https://doi.org/10.1177/1461444804042519.

Sempere, Ismael Hernández, and Cinta Espuny Vidal. "STEM Studies and Digital Gender Gap in Baccalaureate: The Influence of Digital Competence in the Academic Future." *Edutec*, no. 81 (2022): 55–71. https://doi.org/10.21556/edutec.2022.81.2601.

Sparks, J.R., I.R. Katz, and P.M Beile. "Assessing Digital Information Literacy in Higher Education: A Review of Existing Frameworks and Assessments with Recommendations for Next-Generation Assessment (Research Report No. RR-16-32)." Princeton, NJ: Educational Testing Service, 2016. https://files.eric.ed.gov/fulltext/EJ1124778.pdf.

Spires, H. A, and M.E Bartlett. *Digital Literacies and Learning: Designing a Path Forward*. The William & Ida Friday Institute, North Carolina State University, 2012. https://www.fi.ncsu.edu/wp-content/uploads/2013/05/digital-literacies.

UNESCO. (2025). *What you need to know about literacy*. https://www.unesco.org/en/literacy/need-know

Watermeyer, Richard, Zan Chen, and Bryan John Ang. "'Education without Limits': The Digital Resettlement of Post-Secondary Education and Training in Singapore in the COVID-19 Era." *Journal of Education Policy* 37, no. 6 (2022): 861–82. https://doi.org/10.1080/02680939.2021.1933198.

Zhao, Y, M.C.S Gómez, A.M.P. Llorente, and L Zhao. "Digital Competence in Higher Education: Students' Perception and Personal Factors." *Sustainability* 13, no. 21 (2021): 12184. https://doi.org/https://doi.org/10.3390/su132112184.