



DIGITAL LITERACY PRACTICES IN ELEMENTARY EDUCATION: CHALLENGES AND OPPORTUNITIES FOR POST-PANDEMIC CLASSROOM LEARNING TRANSFORMATION

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Abstract

Digital literacy has become a core competence in elementary education as schools move from emergency remote instruction to more stable post-pandemic learning. Although children are increasingly familiar with digital devices, their everyday use of technology does not automatically develop critical, creative, safe, and academically meaningful literacy. This article aims to synthesize how digital literacy is practiced in elementary classrooms, identify recurring challenges, and formulate opportunities for strengthening post-pandemic classroom learning. The study used a narrative literature review of international peer-reviewed studies on digital literacy, digital competence, technology integration, primary education, and digital pedagogy. The literature was analyzed thematically by focusing on the forms of practice, implementation barriers, and pedagogical possibilities relevant to young learners. The synthesis shows that digital literacy practices in elementary education are reflected in five interrelated areas: digital information searching and evaluation, multimodal content creation, digital communication, technology-supported collaboration, and responsible online behavior. The main challenges include unequal access to devices and connectivity, uneven teacher digital competence, students' limited critical evaluation skills, entertainment-oriented technology habits, and insufficient family mediation. However, post-pandemic classrooms also offer opportunities to integrate digital literacy across subjects, design blended and inquiry-based activities, strengthen teacher professional development, and build school-family partnerships for safe and productive technology use. The article concludes

that digital literacy should be positioned not as a technical supplement but as a pedagogical framework for inclusive, ethical, and future-oriented elementary education.

Keywords: *digital literacy; elementary education; post-pandemic learning; digital competence; classroom pedagogy*

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A. Introduction

The COVID-19 pandemic changed elementary education in ways that continue to shape classroom practice. During periods of school closure, teachers, students, and families depended on digital platforms, mobile devices, online worksheets, learning management systems, video conferences, and messaging applications to maintain instructional continuity. When schools returned to face-to-face instruction, many of these digital habits did not disappear. Instead, they became part of the ordinary infrastructure of teaching, homework, communication, and assessment. This condition creates a new demand for elementary education: digital literacy must be treated as an educational competence rather than as an emergency response to remote learning.

Digital literacy in elementary education refers to the ability of young learners to access, evaluate, create, communicate, and participate through digital technologies in critical, ethical, and meaningful ways. The concept is broader than operational ability. A child who can open a video platform, type a keyword, or complete an online quiz is not automatically digitally literate. Digital literacy also involves evaluating the quality of information, understanding multimodal messages, communicating respectfully, protecting personal data, producing digital artifacts, and using technology for learning purposes (Ilomaki, Paavola, Lakkala, & Kantosalo, 2016; Ng, 2012; Spante, Hashemi, Lundin, & Algers, 2018; Van Laar, van Deursen, van Dijk, & de Haan, 2017; Zhao, Pinto Llorente, & Sanchez Gomez, 2021). This broader definition is essential because

elementary students are still developing cognitive control, reading comprehension, social judgment, and self-regulated learning.

Several studies show that digital competence among school-age learners is uneven and shaped by social background, access, teacher support, and learning opportunities. Aesaert, van Nijlen, Vanderlinde, and van Braak (2014) demonstrated the need to measure digital information processing and communication skills directly in primary education, while Aesaert and van Braak (2015) showed that gender and socioeconomic differences can be reflected in performance-based ICT competences. These findings challenge the popular assumption that children are naturally competent because they grow up with digital devices. Familiarity with entertainment-oriented media is not the same as the ability to use digital resources for inquiry, literacy, collaboration, and knowledge construction.

The post-pandemic context also exposes a pedagogical problem. During emergency remote learning, technology was often used to deliver assignments, transmit teacher explanation, or substitute printed worksheets. Such uses were necessary in crisis conditions, but they do not automatically develop higher levels of digital literacy. In a more stable classroom environment, teachers need to redesign technology use so that it supports critical reading, multimodal expression, discussion, collaboration, and ethical participation. Teacher digital competence is therefore a decisive factor. Falloon (2020) argues that teacher digital competence should connect technological knowledge with pedagogy, curriculum, learner needs, and ethical considerations. Similarly, Tondeur, van Braak, Ertmer, and Ottenbreit-Leftwich (2017) emphasize that teachers' pedagogical beliefs shape how technology is integrated into classroom practice.

For elementary schools, the issue is not whether digital tools should be used, but how they can be used developmentally and inclusively. Some students have stable internet access, supportive parents, and personal devices. Others rely on shared phones, unstable connectivity, and limited guidance at home. Digital literacy programs that ignore such differences may reproduce educational

inequality. Van Deursen and van Dijk (2011) describe digital inequality as a matter not only of access but also of skills and meaningful use. In elementary education, this inequality appears when students are given similar digital tasks but do not have similar support systems. Alderete and Formichella (2023) further indicate that access to ICT at home can influence school achievement, which means that school-level digital literacy initiatives must consider the home environment.

Based on these issues, this article aims to synthesize digital literacy practices in elementary education in post-pandemic classrooms. The article addresses three questions: (1) What forms of digital literacy practices are commonly emphasized in elementary education? (2) What challenges affect the implementation of digital literacy after the pandemic? (3) What opportunities can be developed to strengthen digital literacy as an integrated pedagogical practice? By answering these questions, the article contributes a conceptual and practical framework for schools, teachers, and curriculum developers who seek to move beyond technical technology use toward meaningful digital literacy development.

B. Method

This study employed a narrative literature review. This design was selected because the purpose of the article was to synthesize conceptual and empirical insights from previous studies rather than to calculate statistical effect sizes. A narrative review is appropriate for clarifying a broad educational issue, identifying patterns across studies, and formulating practical implications for classroom practice. The review focused on literature related to digital literacy, digital competence, ICT literacy, teacher digital competence, educational technology integration, primary or elementary education, and post-pandemic learning transformation.

The literature was selected purposively from international peer-reviewed journals in education, educational technology, literacy studies, and learning sciences. The search and screening process used several conceptual keywords, including digital literacy, digital competence, ICT competence, primary school, elementary

education, teacher digital competence, online learning, digital pedagogy, digital divide, and post-pandemic classroom. Priority was given to studies that offered strong theoretical framing, empirical evidence, systematic synthesis, or direct relevance to school-level education. Although some foundational articles published before the pandemic were included, they were used to establish the conceptual basis for digital literacy and digital competence.

The inclusion criteria were as follows. First, the article had to discuss digital literacy, digital competence, ICT literacy, or technology-supported learning in an educational context. Second, the article had to provide conceptual, empirical, or review-based evidence relevant to school-level learning, teacher practice, or children's digital participation. Third, the article had to be published in a reputable international peer-reviewed outlet. Fourth, the article had to contribute to at least one analytical category: forms of digital literacy practice, implementation challenges, or pedagogical opportunities. Studies that focused only on technical software performance without educational interpretation were excluded.

The selected literature was analyzed thematically. The analysis began by reading each source to identify recurring concepts related to digital literacy practices. These concepts were coded into initial categories, such as information searching, critical evaluation, content creation, communication, collaboration, safety, teacher competence, access, and parental mediation. The categories were then reorganized into three broader themes: forms of digital literacy practice, challenges in implementation, and opportunities for post-pandemic classroom transformation. The synthesis was written by connecting evidence from previous studies with the developmental characteristics and institutional realities of elementary education.

C. Finding and Discussion

1. Finding

The literature synthesis indicates that digital literacy in elementary education is multidimensional. It cannot be reduced to the use of devices, the completion of online assignments, or the frequency of classroom technology use. Five forms of practice are

particularly relevant for post-pandemic elementary classrooms: information searching and evaluation, multimodal content creation, digital communication, technology-supported collaboration, and responsible digital behavior. These practices are interrelated because children need to search, interpret, create, share, and evaluate digital information within socially guided learning environments.

The first form is digital information searching and evaluation. Elementary students often begin digital activity by using search engines, educational websites, videos, or teacher-provided links. However, searching is only the first step. A digitally literate student should gradually learn to identify relevant keywords, distinguish educational content from entertainment or advertising, compare information from more than one source, and explain why a source is reliable. Research on digital information processing in primary education shows that such skills need explicit instruction rather than incidental exposure (Aesaert et al., 2014; Godaert, Aesaert, Voogt, & van Braak, 2022). Kong (2014) also demonstrates that information literacy and critical thinking can be strengthened when digital classroom activities are connected with domain knowledge rather than isolated technical tasks. In this sense, digital literacy supports reading comprehension because students must interpret texts, images, hyperlinks, and audiovisual messages critically.

The second form is multimodal content creation. Post-pandemic classrooms offer opportunities for students to produce digital posters, short videos, audio recordings, slides, digital stories, diagrams, and simple e-portfolios. Content creation is important because digital literacy involves production, not only consumption. When students create a digital story, for example, they combine written language, images, narration, sequencing, and audience awareness. List (2019) notes that digital literacy development involves beliefs about what it means to read and compose in digital environments. Van Laar, van Deursen, van Dijk, and de Haan (2020) also show that digital skills are connected with broader twenty-first-century competencies, including creativity and problem solving. For elementary students, content creation should be structured,

scaffolded, and connected to curricular goals so that digital products become evidence of learning rather than decorative tasks.

The third form is digital communication. During pandemic learning, many teachers used messaging applications, video meetings, and online forms to communicate with students and parents. In the post-pandemic classroom, digital communication can be retained for feedback, assignment submission, parent communication, and student reflection. However, communication must be accompanied by digital etiquette. Students need to learn how to write polite messages, respond respectfully, avoid sharing private information, and recognize that digital communication has social consequences. Hatlevik, Guðmundsdóttir, and Loi (2015) argue that digital competence includes strategic and self-efficacious use of information and communication resources. This implies that digital communication in elementary education should be taught as social literacy, not merely as message delivery.

The fourth form is technology-supported collaboration. Digital tools can facilitate collaborative writing, group presentations, shared concept maps, online quizzes, and project-based inquiry. Collaboration is central because digital literacy is increasingly participatory. Students do not only retrieve information individually; they negotiate meaning, share resources, and solve problems with peers. Voogt, Erstad, Dede, and Mishra (2013) describe learning in the digital networked world as requiring new relationships between knowledge, schooling, and participation. Siddiq, Scherer, and Tondeur (2016) also emphasize teachers' role in developing students' digital information and communication skills. In elementary classrooms, collaborative digital practice should begin with small and clearly guided tasks, such as jointly organizing information, commenting on a peer's digital story, or preparing a simple presentation.

The fifth form is responsible digital behavior. Students need to understand basic principles of safety, privacy, copyright, cyberbullying prevention, and screen-time balance. This theme is crucial for young learners because they may be active digital users while still lacking mature judgment about risk. Mascheroni and

Ólafsson (2016) show that children's access to the mobile internet creates both opportunities and divides. Digital opportunity must therefore be accompanied by digital protection and guidance. Responsible digital behavior can be taught through classroom agreements, teacher modeling, discussion of cases, and simple routines such as asking permission before using images, not sharing personal data, and using respectful language in online interaction.

The synthesis also reveals five recurring challenges. The first challenge is unequal access. Schools may encourage online assignments or digital projects, but not all students have personal devices, stable internet, or a quiet learning space. Digital inequality includes access, skills, and outcomes (Van Deursen & van Dijk, 2011). In elementary education, this means that technology-based tasks must be designed with attention to students' real conditions. Schools need alternatives such as shared devices, offline resources, classroom-based digital activities, and flexible submission formats.

The second challenge is uneven teacher digital competence. Many teachers became more familiar with digital tools during the pandemic, but familiarity does not always lead to pedagogically meaningful integration. Teachers may use technology to display materials, distribute quizzes, or collect assignments without developing students' critical and creative literacy. Tondeur, Aesaert, Prestridge, and Consuegra (2018) show that teacher preparation matters for ICT competence, while Falloon (2020) stresses the need for a framework that integrates pedagogy, technology, and ethics. Therefore, professional development should move beyond technical training toward lesson design, digital assessment, differentiation, and classroom management.

The third challenge is students' limited ability to evaluate digital information. Porat, Blau, and Barak (2018) found that students' perceived digital competence may differ from their actual performance. This problem is relevant in elementary education because children can appear confident when using devices but may be unable to judge credibility, bias, or relevance. Teachers should not assume that students who can search quickly can evaluate

accurately. Critical evaluation must be modeled through simple questions: Who created this content? What is the purpose? Is the information supported by evidence? Does another source say the same thing? Such questions transform digital searching into critical literacy practice.

The fourth challenge is the dominance of entertainment-oriented digital habits. Many students associate digital devices with games, videos, short-form content, or social interaction. When devices are introduced into class, students may be easily distracted if learning tasks are not structured. Ng (2012) argues that digital natives still need to be taught digital literacy. This point is especially important for elementary classrooms because students' attention and self-regulation are still developing. Teachers need to design tasks with clear objectives, time limits, visible products, and reflection activities so that technology supports learning rather than competes with it.

The fifth challenge is limited family mediation. Digital literacy develops across school and home. Parents may provide access but may not always provide guidance. Some parents have limited digital knowledge, while others are constrained by work demands. As a result, children's digital practices may differ sharply between classroom expectations and home routines. Buchanan, Southgate, Scevak, and Smith (2021) argue that critical digital literacy requires sustainable and equitable educational futures. Such sustainability cannot depend on teachers alone. Schools need to communicate with families about safe use, homework expectations, digital reading habits, and responsible device routines.

Table 1 summarizes the major themes identified in the literature synthesis and their implications for elementary classroom practice. The table shows that the post-pandemic digital literacy agenda involves both pedagogical redesign and institutional support. The central issue is not the availability of technology itself, but the extent to which technology use is connected to literacy, learning objectives, social guidance, and equity.

Table 1 Literature synthesis on digital literacy practices in elementary education

Theme	Core Indicators	Representative Literature	Implication for Elementary Classrooms
Information searching and evaluation	Keyword use, source comparison, credibility judgment, relevance checking	Aesaert et al. (2014); Godaert et al. (2022); Kong (2014)	Teachers should model searching, questioning, and comparing information before assigning independent online inquiry.
Multimodal content creation	Digital storytelling, posters, slides, audio, video, and e-portfolios	List (2019); Van Laar et al. (2020); Zhao et al. (2021)	Digital products should be connected to curriculum goals and assessed through simple rubrics.
Digital communication	Polite messaging, feedback, online reflection, parent-teacher communication	Hatlevik, Gudmundsdottir, & Loi (2015); Siddiq, Scherer, & Tondeur (2016)	Communication tools should be used with explicit norms for language, privacy, and respect.
Technology-supported collaboration	Shared documents, group inquiry, peer comments, collaborative presentations	Voogt et al. (2013); Claro et al. (2012)	Collaboration should start from small guided tasks and gradually move toward inquiry-based projects.
Responsible digital behavior	Privacy, copyright, cyberbullying prevention, safety, screen-time balance	Mascheroni & Olafsson (2016); Buchanan et al. (2021)	Digital safety should be embedded in classroom culture and supported by family guidance.

Source: Author synthesis based on selected literature.

2. Discussion

The findings suggest that digital literacy in elementary education should be positioned as a pedagogical framework. In the early stage of pandemic learning, technology was often used to maintain access to instruction. In the post-pandemic phase, the question shifts from continuity to quality. Classrooms need to move from emergency digital use to intentional digital literacy development. This means that teachers should decide what literacy competence is being developed when students search online, create a digital product, communicate through a platform, or collaborate using shared resources.

A central implication is that digital literacy must be integrated across subjects. Treating digital literacy as a separate computer lesson is inadequate because students encounter digital texts, images, data, and media across the curriculum. In language learning, students can evaluate online texts, create digital stories, record oral reading, and respond to multimodal prompts. In science, students can use simulations, collect visual evidence, and create simple explanatory videos. In social studies, students can interpret digital maps, compare sources, and discuss citizenship in online spaces. Claro et al. (2012) show that ICT skills are related to broader twenty-first-century assessment concerns, while Van Laar et al. (2017) connect digital skills with problem solving, communication, collaboration, and information management. These connections support cross-curricular integration.

The post-pandemic classroom also provides an opportunity to design blended digital literacy. Face-to-face instruction is valuable for modeling, discussion, feedback, and social regulation. Digital tools can extend learning through exploration, production, storage, and communication. Blended practice is particularly suitable for elementary education because young learners still need direct guidance. A teacher may introduce a topic through classroom discussion, guide students to evaluate a digital source, ask them to create a digital response in pairs, and then conduct reflection in class. This sequence combines direct pedagogy with digital participation.

Teacher professional development should be redesigned accordingly. Short training sessions on how to use applications are useful but insufficient. Teachers need to understand how digital tasks align with learning outcomes, how to scaffold students' cognitive processes, how to assess digital products, and how to protect students' safety and privacy. Tondeur et al. (2017) show that teachers' pedagogical beliefs influence technology use. Eickelmann and Vennemann (2017) similarly indicate that teachers' attitudes and beliefs are important for ICT integration. Professional development should therefore include reflective discussions about why technology is used, not only demonstrations of how it is operated.

Assessment is another important issue. Digital literacy assessment should not focus only on whether students complete online tasks. It should evaluate the quality of information selection, accuracy of interpretation, creativity of digital production, clarity of communication, ethical use of sources, and collaboration. Siddiq, Hatlevik, Olsen, Throndsen, and Scherer (2016) review instruments for measuring ICT literacy and show that assessment must capture complex skill dimensions. In elementary classrooms, assessment can use simple rubrics with observable indicators, such as identifying a source, explaining an idea in one's own words, using images appropriately, responding politely, and contributing to group work.

The synthesis also challenges the notion of the digital native. Children may be confident technology users, but confidence may hide shallow literacy. Porat et al. (2018) demonstrate the gap between perceived competence and actual performance. Therefore, elementary teachers need to provide structured scaffolding. For lower grades, scaffolding may involve using teacher-curated resources, discussing pictures and videos, and practicing safe communication. For upper grades, scaffolding can involve comparing sources, citing digital materials, creating multimodal projects, and reflecting on online behavior. The progression should move from access and operation to critical and responsible participation.

Equity must remain central in digital literacy policy. If schools assume that all students have similar access, the use of digital assignments may disadvantage learners from low-resource families. Alderete and Formichella (2023) highlight the role of home ICT access in school achievement. Aesaert and van Braak (2015) also show that socioeconomic differences are related to ICT competence. For this reason, schools should provide inclusive alternatives, such as classroom-based digital work, lending programs, offline materials, peer support, and flexible assessment modes. Digital literacy should reduce educational gaps, not intensify them.

Responsible digital behavior should be treated as part of character and civic education. Elementary students require explicit instruction about privacy, respectful communication, authorship, and digital footprints. In post-pandemic learning, students are likely to continue using digital communication for homework, peer interaction, and information access. Without guidance, these practices can produce problems such as copying, inappropriate sharing, and cyberbullying. Digital citizenship routines should therefore be embedded in classroom culture. Teachers can develop simple rules, discuss concrete cases, involve parents, and model ethical use of digital resources.

Finally, school-family collaboration is necessary because children's digital lives are not confined to school. Parents and guardians influence device access, screen time, application choice, and online routines. Schools should not assume that families already know how to mediate children's technology use. Instead, schools can provide practical guidance through parent meetings, short handouts, digital literacy campaigns, and consistent communication. Such collaboration helps align classroom expectations with home practices and supports safer learning environments.

Based on the synthesis, a staged framework for elementary digital literacy can be proposed. The first stage is access and operation, where students learn basic and safe use of devices and platforms. The second stage is guided exploration, where students search and interpret digital information with teacher support. The

third stage is critical and creative production, where students evaluate sources and create multimodal artifacts. The fourth stage is responsible participation, where students communicate, collaborate, and make ethical decisions in digital spaces. This framework is not linear in a strict sense; rather, it provides a developmental orientation for teachers designing post-pandemic digital literacy learning.

D. Conclusion

Digital literacy practices in elementary education have become more urgent after the pandemic because digital technology is now embedded in everyday classroom communication, learning resources, and assessment. This review shows that meaningful digital literacy includes information searching and evaluation, multimodal content creation, digital communication, technology-supported collaboration, and responsible digital behavior. The main challenges include unequal access, uneven teacher digital competence, students' weak critical evaluation skills, entertainment-oriented technology habits, and limited family mediation. Nevertheless, post-pandemic classrooms provide opportunities to transform digital literacy from a technical supplement into an integrated pedagogical framework. Schools should embed digital literacy across subjects, strengthen teacher professional development, design blended and inquiry-based activities, assess critical and creative digital performance, and build collaboration with families. Future studies should develop classroom-based empirical models of digital literacy in elementary education, particularly models that are sensitive to students' developmental stages, local contexts, and digital equity.

Bibliography

Aesaert, K., & van Braak, J. (2015). Gender and socioeconomic related differences in performance-based ICT competences. *Computers & Education*, 84, 8-25. <https://doi.org/10.1016/j.compedu.2014.12.017>

- Aesaert, K., van Nijlen, D., Vanderlinde, R., & van Braak, J. (2014). Direct measures of digital information processing and communication skills in primary education: Using item response theory for the development and validation of an ICT competence scale. *Computers & Education*, 76, 168-181. <https://doi.org/10.1016/j.compedu.2014.03.013>
- Alderete, M. V., & Formichella, M. M. (2023). Access to ICT at Argentine elementary school children's homes and its impact on school achievements. *Education and Information Technologies*, 28, 2767-2790. <https://doi.org/10.1007/s10639-022-11227-w>
- Buchanan, R., Southgate, E., Scevak, J., & Smith, S. P. (2021). Expert insights into education for critical digital literacy: Beyond the 'new normal' to a sustainable and equitable digital future. *British Journal of Educational Technology*, 52(4), 1711-1727. <https://doi.org/10.1111/bjet.13094>
- Claro, M., Preiss, D. D., San Martin, E., Jara, I., Hinostroza, J. E., Valenzuela, S., Cortes, F., & Nussbaum, M. (2012). Assessment of 21st century ICT skills in Chile: Test design and results from high school level students. *Computers & Education*, 59(3), 1042-1053. <https://doi.org/10.1016/j.compedu.2012.04.004>
- Eickelmann, B., & Vennemann, M. (2017). Teachers' attitudes and beliefs regarding ICT in teaching and learning in European countries. *European Educational Research Journal*, 16(6), 733-761. <https://doi.org/10.1177/1474904117725899>
- Falloon, G. (2020). From digital literacy to digital competence: The teacher digital competency framework. *Educational Technology Research and Development*, 68, 2449-2472. <https://doi.org/10.1007/s11423-020-09767-4>
- Godaert, E., Aesaert, K., Voogt, J., & van Braak, J. (2022). Assessment of students' digital competences in primary school: A systematic review. *Education and Information Technologies*, 27, 9953-9979. <https://doi.org/10.1007/s10639-022-11020-9>
- Hatlevik, O. E., Gudmundsdottir, G. B., & Loi, M. (2015). Digital diversity among upper secondary students: A multilevel analysis

of the relationship between cultural capital, self-efficacy, strategic use of information, and digital competence. *Computers & Education*, 81, 345-353.
<https://doi.org/10.1016/j.compedu.2014.10.019>

Hatlevik, O. E., Ottestad, G., & Throndsen, I. (2015). Predictors of digital competence in 7th grade: A multilevel analysis. *Journal of Computer Assisted Learning*, 31(3), 220-231.
<https://doi.org/10.1111/jcal.12065>

Iilomaki, L., Paavola, S., Lakkala, M., & Kantosalo, A. (2016). Digital competence: An emergent boundary concept for policy and educational research. *Education and Information Technologies*, 21, 655-679. <https://doi.org/10.1007/s10639-014-9346-4>

Kong, S. C. (2014). Developing information literacy and critical thinking skills through domain knowledge learning in digital classrooms: An experience of practicing flipped classroom strategy. *Computers & Education*, 78, 160-173.
<https://doi.org/10.1016/j.compedu.2014.05.009>

List, A. (2019). Defining digital literacy development: An examination of pre-service teachers' beliefs. *Computers & Education*, 138, 146-158.
<https://doi.org/10.1016/j.compedu.2019.03.009>

Mascheroni, G., & Olafsson, K. (2016). The mobile Internet: Access, use, opportunities and divides among European children. *New Media & Society*, 18(8), 1657-1679.
<https://doi.org/10.1177/1461444814567986>

Ng, W. (2012). Can we teach digital natives digital literacy? *Computers & Education*, 59(3), 1065-1078.
<https://doi.org/10.1016/j.compedu.2012.04.016>

Porat, E., Blau, I., & Barak, A. (2018). Measuring digital literacies: Junior high-school students' perceived competencies versus actual performance. *Computers & Education*, 126, 23-36.
<https://doi.org/10.1016/j.compedu.2018.06.030>

- Siddiq, F., Hatlevik, O. E., Olsen, R. V., Throndsen, I., & Scherer, R. (2016). Taking a future perspective by learning from the past: A systematic review of assessment instruments that aim to measure primary and secondary school students' ICT literacy. *Educational Research Review*, 19, 58-84. <https://doi.org/10.1016/j.edurev.2016.05.002>
- Siddiq, F., Scherer, R., & Tondeur, J. (2016). Teachers' emphasis on developing students' digital information and communication skills. *Computers & Education*, 92-93, 1-14. <https://doi.org/10.1016/j.compedu.2015.10.006>
- Spante, M., Hashemi, S. S., Lundin, M., & Algers, A. (2018). Digital competence and digital literacy in higher education research: Systematic review of concept use. *Cogent Education*, 5(1), 1519143. <https://doi.org/10.1080/2331186X.2018.1519143>
- Tondeur, J., Aesaert, K., Prestridge, S., & Consuegra, E. (2018). A multilevel analysis of what matters in the training of pre-service teachers' ICT competencies. *Computers & Education*, 122, 32-42. <https://doi.org/10.1016/j.compedu.2018.03.002>
- Tondeur, J., van Braak, J., Ertmer, P. A., & Ottenbreit-Leftwich, A. (2017). Understanding the relationship between teachers' pedagogical beliefs and technology use in education: A systematic review of qualitative evidence. *Educational Technology Research and Development*, 65, 555-575. <https://doi.org/10.1007/s11423-016-9481-2>
- Van Deursen, A. J. A. M., & van Dijk, J. A. G. M. (2011). Internet skills and the digital divide. *New Media & Society*, 13(6), 893-911. <https://doi.org/10.1177/1461444810386774>
- Van Laar, E., van Deursen, A. J. A. M., van Dijk, J. A. G. M., & de Haan, J. (2017). The relation between 21st-century skills and digital skills: A systematic literature review. *Computers in Human Behavior*, 72, 577-588. <https://doi.org/10.1016/j.chb.2017.03.010>
- Van Laar, E., van Deursen, A. J. A. M., van Dijk, J. A. G. M., & de Haan, J. (2020). Determinants of 21st-century digital skills: A

large-scale survey among working professionals. *Computers in Human Behavior*, 100, 93-104.
<https://doi.org/10.1016/j.chb.2019.06.017>

Voogt, J., Erstad, O., Dede, C., & Mishra, P. (2013). Challenges to learning and schooling in the digital networked world of the 21st century. *Journal of Computer Assisted Learning*, 29(5), 403-413.
<https://doi.org/10.1111/jcal.12029>

Zhao, Y., Pinto Llorente, A. M., & Sanchez Gomez, M. C. (2021). Digital competence in higher education research: A systematic literature review. *Computers & Education*, 168, 104212.
<https://doi.org/10.1016/j.compedu.2021.104212>