

Digital competence for students in the networking Society 5.0: A systematic review

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Article History

Submitted : 05-07-2022
Revised : 26-10-2023
Accepted : 27-10-2023
Published : 31-10-2023

Article Link

<https://journal.uny.ac.id/index.php/civics/article/view/51673>

Abstract

The systematic review provides research trends about the importance of digital competence among students in Indonesia. However, there are limited literature reviews regarding digital competencies for students. This research used the PRISMA protocol using Scopus, ERIC, and Google Scholar databases. Researchers set inclusion and exclusion criteria in the literature search. One hundred twenty-two articles were produced, which were then filtered to 20. This research used content analysis to code, classify, and develop themes. Based on the analysis results, three major themes were obtained: student digital competence, digital native students, and digital learning engagement. This review promotes the importance of digital competencies for students and recommends strategies for developing them through learning integration.

Keywords: digital competence; digital learning; digital natives; ICT skills

Introduction

Along with the globalization marked by the Industrial Revolution 4.0, all activities are transformed digitally in terms of interaction and connectivity. Information and Communication Technology (ICT) has become critical in all countries (Valverde-Crespo et al., 2020) when internet users worldwide are increasing rapidly. According to the Global Digital Report 2020, over 60% of the population has been identified as active internet users (Çimen & Hangül, 2021). World education policy has focused on developing competencies related to the use of ICT, so that users can advance actively in global social and work contexts (Cabezas-gonz & Casillas-mart, 2021). In addition, internet users are expected to be equipped with ICT knowledge, attitudes, and skills, so it is important to implement them (Galindo-Domínguez & Bezanilla, 2021).

Over the last decade, discussions about digital competence have been paid attention to, especially regarding everyone's skills and understanding. The concept of digital competence



was first discussed in the European Parliament and the Council, which recognized there are eight main competencies in lifelong learning, namely mother tongue communication; foreign language communication; mathematics competence and basic science and technology competence; digital competence; learn to how to learn; social and civic competence; entrepreneurship; and cultural awareness and expression (European Parliament and the Council, 2006). Digital competence has been confirmed to be seen as a relevant priority for the European Commission in creating the latest policy, action, and communication innovations (European Commission, 2010; European Commission, 2010; Ferrari, 2013). The digital competency was developed by the Joint Research Center (JRC) in 2013, which was then revised in 2016, and the term changed to "Digcomp 2.0" in 2017, published as "DigComp 2.1" (Iglesias-Rodríguez et al., 2021).

Digital competency has been considered a primary competency because it is interpreted as the use and interaction of digital technology for various activities, such as workplace learning and participation in society, which is carried out confidently, critically, and responsibly. These competencies include information, data and media literacy, communications, digital content creation, cybersecurity, intellectual property issues, problem-solving, and critical thinking (Consejo de la Unión Europea, 2018). The digital competency is classified as a lifelong learning competency (Ala-mutka, 2011) and is considered one of eight lifelong competencies (European Parliament and the Council, 2006).

Experts have predicted that global society will experience a rapid increase in the use of technology (M. Graham & Dutton, 2019; Miladi, 2016; Natarajan, 2017). Through related agencies, the government should provide support and guidance to teachers, students, and parents on how to respond to and resolve problems using technological devices (Ribble, 2015). Due to the rapid adoption of digital devices to meet needs, especially in the educational setting, there is a need for a review to ensure that they, including students, can use them intelligently and responsibly (Prasetyo et al., 2021). However, literature studies regarding the application of digital competencies for students are still limited. This study offers a detailed analysis of the research conducted, thus providing an overview of replication in supporting and improving digital competence among students in the context of developing countries. The study aims to identify gaps to provide understanding and contribution regarding the digital competencies that students must have. The study is hoped that the results of this systematic review will be helpful for students, teachers, schools, researchers, and affiliates, as well as policymakers, so that they can create discourse and strategies that have been carefully prepared to integrate the use of technology with learning through the curriculum to improve students' digital competence.

In general, this research aims to examine students' digital competence. The results are expected to provide a theoretical perspective to help teachers or education personnel, school leaders, parents, policymakers, and other stakeholders in classroom management. Thus, the specific questions in this research study are: i) what are the main dimensions of digital competence that are most mentioned? and ii) what are the strategies for developing students' digital competencies?

Method

The study used the PRISMA approach based on a systematic review of literature reporting items with a meta-analysis approach (Moher et al., 2015a). The review was conducted based on recommendations from the selection results of several established databases, defining inclusion and exclusion criteria to be published based on the outcomes of transparently completed evaluations conducted during the selection process (Bendermacher et al., 2017; Connolly et al., 2012). Systematic reviews and meta-analyses both have different characteristics. Systematic review originates from questions that have been clearly formulated. Structured and explicit to identify, select, assess, critically summarize relevant studies, and collect and analyze data relevant to the review (Moher et al., 2009a). The study is based on a

review focusing on students' digital competencies, particularly understanding the use of technology wisely and responsibly.

Data Source

The systematic literature review used three databases, namely Scopus, Eric, and Google Scholar. Scopus was chosen as the main database because it contains academic literature that is multidisciplinary and internationally based. Eric was included in this study because it contains published literature focusing on education. Google Scholar was chosen because most scholars were used as reference sources. Digital competency was closely related to digital literacy and the use of digital technology because digital competence and digital literacy are terms often used by the public to describe individual skills in digital devices (Prasetyo et al., 2021; Spante et al., 2018). This study has determined specific search terms, including student digital competency, digital literacy, and technology use. Consequently, this study employed these terms in each database search using the format outlined below.

(TITLE-ABS-KEY ("Digital Competence Student") OR TITLE-ABS-KEY ("Digital Literacy*") OR TITLE-ABS-KEY ("Using Technology*") AND DOCTYPE (ar) AND PUBYEAR > 2017)

Each database produced has abundant scientific studies. Researchers selected various scientific studies relevant to the keywords. Limiting searches to titles, abstracts, and keywords in databases was also a strategy and consideration for researchers to minimize the number of published studies to make them easier to read and increase the accuracy of information searches (Malinen & Savolainen, 2016; Wang et al., 2011). Each database has different features to simplify searching and selecting data. Therefore, using "advanced search" helped researchers filter findings based on predetermined inclusion and exclusion criteria.

Screening and Eligibility Assessment for Data Analysis

In this study, researchers limited the search criteria for all scientific studies in the database to align them to answer the research question, "What is the definition of digital competence?". The inclusion criteria guide that publications are articles or papers, while books, statements, or reports are supporting documents that define digital competency. Thus, this research uses explicit limitations as described below.

Table 1.
Inclusion and Exclusion Criteria

Inclusion criteria:
Publication articles were published between January 1, 2017, and December 30, 2021
Focus on discussing digital competence.
Articles are published in the form of research journals.
The research journal is written in English.
The scope of education and technology.
<i>Peer-Reviewed.</i>
Exclusion criteria:
Publication articles were not published between January 1, 2017, and December 30, 2021
It does not focus on discussing digital competence.
Articles are not published in the form of research journals.
The research journal is not written in English.
The scope is not education and technology.
<i>Not Peer-Reviewed.</i>

This research performed several stages based on the specified inclusion and exclusion criteria. First, all published articles that met the criteria were filtered. Second, part of the article abstract was screened to ensure it was relevant to the research objectives. Third, the researcher read intensively and in-depth on each publication reading text obtained. All articles that met

the criteria were classified according to several codes: database, publication type, scope, language, methods, and year of publication.

Furthermore, all articles were developed through thematic coding. The review process was done through content analysis consisting of various main findings. This stage would provide an overview regarding understanding digital competence for secondary students. Thus, the classification of articles is explained in detail in the following table.

Table 2.
Characteristics of Included Studies

Characteristics	N
Database	
Scopus	13
Eric	4
Google Scholars	3
Type of Publication	
Research article	20
Scope	
ICT	4
Education	16
Language	
English	20
Method	
Survey	14
Document analysis	4
Interview	2
Years	
2017	0
2018	2
2019	5
2020	9
2021	4

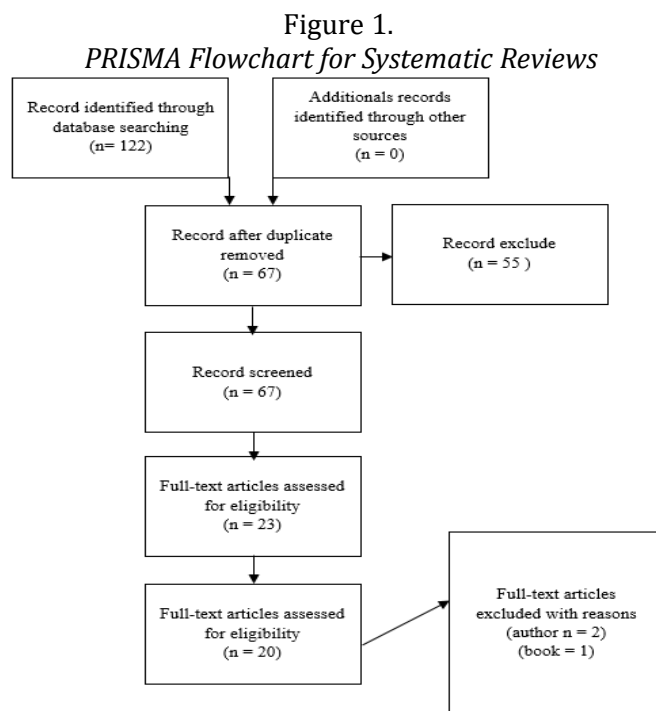
Flow Diagram

This systematic review was prepared with careful and precise protocols to maintain accountability, integrity, and transparency regarding the report to be completed (Moher et al., 2009b, 2015b). The PRISMA flowchart contained a checklist to assess the completeness of protocol reporting and help researchers comply with guidelines. The PRISMA flow diagram was able to help reduce deviations in the selection and conclusion process (Prasetyo et al., 2021). The information management process includes selecting and including various documents that have been obtained.

Table 1 shows the research obtained from screening and includes various found documents. Figure 1 shows that this research obtained 122 articles consisting of journals and papers in fields such as education and ICT. Fifty-five articles were published in multiple databases, so 67 were screened. The researcher read the title and abstract and found 44 articles that did not meet the inclusion criteria.

Therefore, only 23 articles were eligible for the full-text screening process. As a result, this research examined 20 articles using content analysis for several reasons: i) Context of discussion related to digital competence; ii) Contains the use of technology; iii) The latest publications from each author; and iv) confirmed through the peer-review stage. After the articles were finally screened, an assessment was conducted to measure the quality of the articles, as suggested by Petticrew and Roberts (Petticrew & Roberts, 2008). Two experts

assessed all articles to categorize them into high, medium, and low. The last process has categorized eight articles as high and 12 as medium. Thus, 20 articles had to be reviewed.



Result and Discussion

The research used qualitative methods to provide an understanding of digital competence in students, especially at the secondary-high level. Diverse articles are mostly focused on revealing an understanding of digital competency. It is possible for an article to have various main topics and be unlimited regarding each concept that appears. Each main concept reveals the dimensions that are the focus of digital competency development. Table 2 shows seven dimensions of digital competence: digital competence, digital learning, digital communication, digital literacy, digital skills, digital environment, and attitudes towards using technology. From these results, digital competence was most discussed (fourteen articles), followed by digital learning (four articles) and communication (three articles). Digital competence is a fundamental ability that every human being must have as one of the main competencies in lifelong learning (Ala-mutka, 2011). Digital competency involves three main aspects, namely knowledge, attitudes, and skills (Calvani et al., 2009, 2012). Digital competency was initiated for the first time by the European Parliament and the Council (European Parliament and the Council, 2006) and developed until 2017 with the concept of "DigCom 2.1". Digital competency is promoted as a guide in technology, leading to collaboration, creative communication, problem-solving, and critical thinking, supporting 21st-century skills (Fadel, 2010).

Thematic analysis was designed to evaluate various articles and classify them for further development according to themes. These various themes will help design a general picture of digital competence, especially for students. Based on the analysis results, three major themes were obtained: student digital competence, digital native students, and digital learning engagement. Table 3 depicts the distribution of articles included in each theme.

Table 3.
Main Concepts of Digital Competence for Students

Main Concept	N
Digital Competence	14
Digital Learning	4
Digital Communication	3
Digital Literacy	2
Digital Skills	2

Attitudes to the Use of Digital Technology	2
Digital Environment	1

* some studies have more than one concept

Table 4.

Main Distribution of Included Articles in Each Data Source

Theme	N
Student Digital Competence	12
Digital Native Learner	6
Digital Learning Engagement	6

Student Digital Competence

The rapid progress of technological development has created a digital divide experienced by individuals, groups, and even institutions (Çimen & Hangül, 2021). Even though they are called "digital natives" in the 21st century, they use technology based on their intuition (Iglesias-Rodríguez et al., 2021). For example, the findings explain that students experience obstacles based on critical engagement and evaluating the quality of information they take online (Catalano, 2013; Gross & Latham, 2013; Head & Eisenberg, 2009; Wineburg et al., 2016). Other research state that students are still relatively low in terms of communication and interaction on social networks (Cabezas-González et al., 2021). Students must acquire knowledge, skills, and attitudes that support activities (Cabezas-González et al., 2021). In the 21st century, society must change to new lifestyles supporting life with extensive skills (Cabezas-González et al., 2021).

Digital competency is a concept that provides an overview of technology-related skills (Juškevičienė & Dagiene, 2018). Digital competency is supported by a set of knowledge, skills, attitudes, strategies, and values in using ICT and digital media as a means for working, learning, solving problems, managing information, and communicating during daily activities with the aim that individuals can utilize free time effectively, efficiently, skillfully, innovate, and have critical thinking skills which lead to technological development (Ferrari, 2013). Digital competence covers information, communication, content creation, security, and problem-solving (Carretero Gomez & Yves, 2017; Ferrari et al., 2013). Digital competency is essential to understanding and learning to develop potential knowledge, skills, and attitudes in using technology safely, wisely, and judiciously (Galindo-Domínguez & Bezanilla, 2021). Providing digital competency for individuals as a guide for life in a world dominated by ICT is part of lifelong learning (Alkalai, 2004; Murawski & Bick, 2017).

Digital competence positively impacts users, such as increasing interest in using technology (Kim et al., 2018). For students, digital competence can improve abilities in the academic field and participation in the digital environment (van Laar et al., 2017). Through digital competency, students can transfer knowledge and produce innovation (García-Quismondo & Cruz-Palacios, 2018; Iordache et al., 2017; Krumsvik, 2011). Digital competency provides the ability for users, such as individual awareness and attitude, to use the tool appropriately and reflect on the process, which is supported by identifying, accessing, evaluating, and synthesizing. Therefore, digital competence has received attention in various circles and is considered an important skill for student involvement (Meneses et al., 2020; Padilla et al., 2019).

Digital Native Learner

In the era of Society 5.0, technology has influenced human beings, including students (Ramírez-Rueda et al., 2021). The net generation era is close to ICT, which presents a higher level of digital competence (Galindo-Domínguez & Bezanilla, 2021). Unsurprisingly, they are called "digital native students" because the concept was introduced to separate students in the 21st century from previous generations (Prensky, 2001). Digital native students are claimed to be the only generation who grew up with technology, equipped with digital devices, such as computers, cell phones, and laptops, which support their lives and differentiate them from

previous generations (Çimen & Hangül, 2021). However, several studies explain that those who live in the digital era do not fully describe the competencies they should master (Espinosa & García, 2017; Gisbert, 2011). Even though these digital native learners can use digital devices in their activities, they are not fully proficient and utilized, especially in learning (Jiménez-Hernández et al., 2020). Research results show disparities regarding digital skills among students requiring attention (Goldhammer et al., 2016; Kaarakainen et al., 2018). They are expected to have digital skills (Leahy et al., 2014).

Research results explain that, from students to the university level, many do not have the digital skills needed (Verhoeven et al., 2016). Students' digital experiences must be examined as a precedent for integrating technology to support their activities (Kim et al., 2018) because students have diverse digital experiences based on their backgrounds (Martzoukou et al., 2020). The findings explain that students' positive perceptions of technology tend to be based on previous experiences with family, personal business, and teachers (Frieze et al., 2015). In the current digital world, the essential question that must be posed is how to comprehend and correlate the various levels of experience and digital competence of students in diverse online situations to empower them to have a proactive character to support their life demands (Martzoukou et al., 2020). The findings explain that digital students tend to have a passive, antisocial, and lonely character due to unlimited use of technology (Çimen & Hangül, 2021). Digital students might experience emotional instability, such as irritability and boredom. There must be support from parents, teachers, and the surrounding community and supportive training (Çimen & Hangül, 2021).

Digital Learning Engagement

Along with technological developments, all activities have changed the learning ecology to digital-based (He & Li, 2019). The Covid-19 pandemic made students engage in digital learning (Bao, 2020; Jayanti et al., 2021; Pramita et al., 2022; Villela et al., 2020). Digital learning effectively increases students' academic engagement (Heidari et al., 2021). Academic involvement is an effort to actively participate in the learning process in class and other academic activities (Skinner & Pitzer, 2012). Scholars explain that students' academic engagement in the digital learning process can be increased through their digital competencies (Bergdahl et al., 2020; Kim et al., 2018). Even though there is limited evidence regarding the relationship between digital competence, the findings explain that students with high digital skills raise their engagement when learning through digital technology. It could be argued that students' effective use of digital technology increases learning engagement and encourages positive attitudes toward school (Goode, 2010; Guzmán-Simón et al., 2017; National Survey of Student Engagement, 2013). The main characteristics of modern learning in the 21st century are the pedagogical use of ICT (Jiménez Hernández et al., 2019; López Meneses et al., 2014). Students' use of digital technology can be a good predictor of learning and educational success (Carini et al., 2006; National Survey of Student Engagement, 2013; Redmond et al., 2018). The results explain that student involvement in digital-based learning has a different impact from those involved in traditional classes (Bergdahl et al., 2020; Halverson, 2016; Ma et al., 2018).

In addition to assessing students' digital skills, another element that might influence students' use of technology in the classroom and is deemed helpful in integrating digital casual learning is examining students' informal learning environments (Graham et al., 2017). Digital learning is a process where students use technology, access information, and communicate with other people without the limitations of space and time (Ang et al., 2018). Classes and systems do not bind this digital learning. Researchers outline that this learning can contribute to students' motivation, performance, and knowledge (Jin et al., 2019; Peters & Romero, 2019). However, learning agility needs to be supported: the ability to continue learning and the willingness to apply the knowledge gained (Kim et al., 2018). Research results show that informal digital learning relates to academic engagement (Imlawi et al., 2015; Liu et al., 2017; McGuinness & Fulton, 2019). All teachers, parents, and policymakers play a central role in supporting the implementation of digital learning.

This study aims to answer the research question, "What does the current literature inform us about the digital competence of students?" This article was analyzed based on the PRISMA systematic review, which gave rise to the following main findings: i) The development of digital competence among students who have not been able to support ICT skills appropriately; ii) Digital learning, digital communication, and digital literacy are the main concepts for students' digital competencies, and iii) Educational policies take most digital competencies to be integrated with learning activities.

All articles included in the study refer to similar problem statements: inadequate digital skills, irresponsible use of technology, and weak digital-based education. With digitalized activities, the digital gaps are still found in various circles (Bergdahl et al., 2020; Çimen & Hangül, 2021) and were exacerbated by the lack of digital skills mastered by students in using technology (Bergdahl et al., 2020; Çimen & Hangül, 2021). The findings explain that previous experience significantly influences students' digital competence and attitudes toward using technology (Kim et al., 2018). Digital competence involves a confident, critical, and responsible attitude toward digital technology for learning, workplace, and social participation (Juškevičiene & Dagiene, 2018).

Several researchers explain that students' digital competencies must be honed with various training. It is crucial to implement digital competency training effectively (Reisoğlu & Çebi, 2020). Students in the 21st century must learn to handle the technological needs needed in a society where life is entirely digital, which has changed how we communicate, learn, and so on (Meneses et al., 2020). In addition, they are considered "digital native learners" who have self-confidence and are more open because of their digital skills (Çimen & Hangül, 2021).

Digital competence is becoming a vital skill for everyone, so it is necessary to incorporate it into educational curricula and intra- and extracurricular digital literacy programs as instructional tools (Cabezas-González et al., 2021). The research results explain that it is very beneficial for educators and policymakers to develop new learning frameworks at each level of education to increase student competence (Hajduová et al., 2020). Thus, the experience realized in integrating digital technology with academic activities will impact students' future careers and quality of life (Kim et al., 2018).

Limitations

The research used the PRISMA approach in compiling this systematic review of literature reviews in the last five years, from 2017-2021. The criteria included in this research do not cover all fields because most of this literature comes from education and technology. Publications in the form of articles, the primary source of literature, can affect accountability without diminishing the richness of empirical data used to support this study. Other publications, including dissertations and books, are also excluded from the review because the peer review procedure is not as rigorous for these types of publications as it is for research journals.

Implications

Research on digital competence in students shows that the problem of the ability to use technology impacts life. The digital divide and the surrounding environment are factors discussed by several researchers. This research illustrates the push of the government and interest groups to implement policies that can improve digital skills in students. Therefore, all parties need synergy to provide outreach and special training to create students who are competent in technology.

Recommendations for Further Research

This research is not free from limitations, so future studies need to consider it in depth and comprehensively to develop digital competence and students' readiness to use technology. It is also important to look for digital competencies suitable for students. There needs to be collaboration with various related parties, such as experts in the field of ICT, psychologists, and

educational observers, to find appropriate skills for students to master in using technology. From a methodological aspect, this research utilizes various features of each database in the literature search process. For example, on Google Scholar, almost every finding can be summarized in other databases. Researchers are directed to use existing databases such as Web of Science (WoS) and Microsoft Academic. The research recommends that other researchers explore more deeply the strategies for developing digital competence for students. It appears that no other research has attempted to contribute to this gap. For example, in the education sector, through the application of learning models to improve students' digital skills.

Conclusion

Understanding digital competence in students needs to be known, especially for those who use technology. The systematic literature review provides views regarding digital competence and how this concept needs to be developed, especially for students and teenagers who need guidance. Most researchers explain that weak literacy, lack of infrastructure, and deviations in digital use are factors in digital inequality. Therefore, the role of government, educators, parents, and policymakers is important to promote digital competence for students.

Acknowledgment

The authors thank the Civic Education Department and the Faculty of Teacher Training and Education, Muhammadiyah University of Surakarta, for supporting this research.

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