Teachers' digital literacy overview in secondary school

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Article Info	ABSTRACT
	This study explored the teachers' digital literacy in secondary school and deciphered the most suggested way of enhancing secondary teachers' digital literacy, overview levels, and the trends factors in the last five years of research. The methodologies in this study employed the traditional systematic literature review (SLR), which compiled some previous studies to be examined. The initial studies were only selected from an article published in a reputable journal indexed by Scopus. Of the 118 articles reviewed, 46 were selected to be included in the analysis. Significant findings summarize the fact that most of the last five-year research about teachers in secondary schools was impacted by the rapid development of technology and the demand for 21st-century skills. To summarize, as it is at the intermediate level, most secondary school teachers are digitally literate. However, future research may evaluate digital literacy training programs for teachers to assess what improvements should be made to delivery as well as existing frameworks used to test teachers' digital literacy.
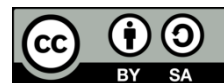
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1. INTRODUCTION

The essential phase of the world's rapid development is digitalization in every aspect of life. Digital literacy is viewed as a catalyst for educational innovation because it results in the development of new digital media teaching resources. While discussing society's skill development, one of the most critical factors that point out digital transformation is people's digital literacy, especially in educational development [1]. Many terms mention digital literacy, such as "digital competence," "digital literacy," "digital ability," and "digital skills." The differences among those terms are still fuzzy. However, digital literacy and digital competence are the most commonly used terms in many articles.

Digital literacy was commonly used decades ago and alluded to for the first time in 1997 by Paul Gilster in his book titled "Digital literacy." According to the definition, digital literacy is the ability to employ and consider digital tools, resources, or services in daily activities as one of the life skills. The term "digital literacy" was then expressed as the sets of individuals' acknowledgment, attitude, and skills in working with digital tools, starting from accessing, managing, integrating, analyzing, and evaluating the digital assets in their personal or professional activities [2], [3]. Derived from the digital literacy framework named DigEuLit in 2006, it was portrayed that digital literacy has three main components, such as digital competence at level 1, digital usage at level 2, and digital transformation at level 3.

Furthermore, the term "digital literacy" was replaced by the term "digital competence" in 2012. Digital competence was defined as one of the proficiency areas among all proficiencies that should be

mastered in a digital society, with five areas of focus: information, communication, content creation, safety, and problem-solving [4]. Afterward, digital literacy is now commonly referred to as "digital competence," while the components inside those two terms are nearly the same. A recent study has summarized that the most used framework for measuring and assessing an individual's digital competence is Digital Competence (DigComp) by the European Commission, which was then updated to the current version as DigComp 2.1 [5]. The other framework is Digital Competence of Educators (DigCompEdu), exclusively customized for teachers and developed by the European Commission [6]. Nevertheless, many previous studies still use the general framework of digital competence in measuring teachers' digital literacy.

The use of digital technology is increasing across all dimensions of society, including individual activities, the economy, health, education, and governance [7], [8]. Since COVID-19 spread throughout the universe, the demand for cultivating distance learning has increased significantly. People are forced to stay at home and do everything digitally, starting from shopping, working, studying, or even commuting [9]. This situation has precisely changed the phase of teaching and learning in schools to be fully based on distance learning. The teacher should be ready to go through this sudden transformation, and at the very least, they should have a fundamental understanding of using digital tools. It means that teachers should have advanced digital literacy. Meanwhile, a recent study found that primary school teachers' digital literacy is still lacking [10]. Quite the reverse, teachers' digital literacy readiness in vocational secondary schools has been in an advanced category, which means that secondary schools might have the same level as [11].

Since the rapid changes in technology, several studies on digital competence and digital literacy have been conducted. The studies were conducted by discussing the differences between the concepts of digital literacy and digital competence [12]. Another research wrote about digital literacy development in society [13]–[17]. Likewise, many articles were written about digital competence or digital literacy in education, especially at the higher education level, and even a systematic literature review about digital literacy [5], [18]–[20]. Lastly, there were dozens of researches on the students' digital competence or literacy [21]–[24]. The studies about teachers' and students' digital literacy are various, especially for teachers in a secondary school, and have been researched in many different countries such as Indonesia, Portugal, Spain, and Russia [25], [26]. Nonetheless, it remains difficult to portray broad information about teachers' digital literacy in secondary schools, which could be useful for furthering teachers' digital literacy development.

Digital literacy is a fundamental skill for teachers to integrate into the teaching-learning process. The demands of education 4.0 and the future concept of society 5.0 in the industry necessitate teachers renewing the teaching process through digital integration [27]. Teachers must know how to deliver the materials using digital tools. Not only are we talking about the teachers' skill in using digital tools, but teachers also must know how to filter the appropriate source of material, digital learning media, digital safety, and communication literacy when delivering all the materials through the teaching process. Teachers are the fundamental actors in introducing digital development to students—teachers who are mastering digital literacy, can assist and support students in using technology appropriately for learning or implementation [28]–[31].

In this study, using a systematic literature review, the researchers wanted to decipher the trend factors of research in secondary school teachers' digital literacy, delineate the majority level of secondary school teachers' digital literacy, and analyze the most suggested way to enhance teachers' digital literacy in secondary schools. The purposes were summed up through the following research problems: i) What is the most suggested way of enhancing Secondary School teachers' digital literacy? (RQ1); ii) What are digital literacy research trends' factors in the last five years, mainly focused on secondary school teachers? (RQ2); and iii) What is the majority level of teachers' digital literacy in secondary school? (RQ3).

2.   RESEARCH METHOD

The following exclusion and inclusion criteria were substantiated to select studies related to obtaining answers to the research questions. The results were obtained after applying the keywords. The inclusion and exclusion criteria should be applied to each study. Table 1 explains the inclusion and exclusion criteria.

Additionally, the sources of information in this study were downloaded and filtered from Scopus and searched from September 2018 to January 2022. In the end, the researchers used 46 articles in this systematic literature study. To limit the articles to be included in the study, the researchers analyzed some articles through the following questions: i) Do the articles analyze the teachers' digital literacy in secondary school?; ii) Do the articles have a clear study purpose?; iii) How were the researchers presenting the research instruments?; iv) Are the research questions wholly answered?; and v) Do the researchers give a precise research method, conclusions, and future suggestions for teachers in secondary schools?

Table 1. Internal consistency reliability of biology test

The inclusion criteria (the article will be considered and selected with these criteria):	The exclusion criteria (the article will be eliminated if it has these following criteria):
– The articles are related to the teachers' digital literacy in secondary school;	– The articles are not related to the teachers' digital literacy in secondary school;
– The research articles should be published between 2017–2022;	– The research articles are published outside of the year 2017–2022 (not in the recent five years);
– The articles use English as its language;	– The articles do not use English as its language;
– The articles are not a pre-proof type of paper; and	– The articles are a pre-proof type of paper; and
– The articles are published in a journal;	– The articles are not published in a journal;

This systematic literature review study used Scopus to find the articles to be reviewed. Scopus was chosen as it is one of the most significant and multidisciplinary scientific databases for scholars who want to find and search data such as scientific journals, conference proceedings, and book chapters [32], [33]. The selected articles were identified and searched using the title, keywords, and abstract of their paper. The search strategy of this study was portrayed as:

(TITLE-ABS-KEY (*"digital literac*"* OR *"digital competenc*"* OR *"digital abilit*"* OR *"digital skill*"*) AND TITLE-ABS-KEY (*"secondary school*"* OR *"secondary education*"* OR *"high school*"* OR *"senior high school*"*) AND TITLE-ABS-KEY (*teacher**)) AND (LIMIT-TO (PUBSTAGE , *"final"*)) AND (LIMIT-TO (PUBYEAR , *2022*) OR LIMIT-TO (PUBYEAR , *2021*) OR LIMIT-TO (PUBYEAR , *2020*) OR LIMIT-TO (PUBYEAR , *2019*) OR LIMIT-TO (PUBYEAR , *2018*) OR LIMIT-TO (PUBYEAR , *2017*)) AND (LIMIT-TO (DOCTYPE , *"ar"*)) AND (LIMIT-TO (LANGUAGE , *"English"*)) AND (LIMIT-TO (SRCTYPE , *"j"*)) = **118 articles**

In the systematic research, the study selection process took a long time because it was divided into several stages with different activities carried out. The researchers searched and downloaded through the Scopus database. The initial search resulted in 118 articles in Scopus by applying some limitations such as year (2017–2022), document type (article), publication stage (final), source type (journal), and its language (English). The data was represented using the preferred reporting items for systematic reviews and meta-analysis (PRISMA) flow, which described the process of article selection such as selecting, identifying, and synthesizing [34]. In assessing the quality of this study, the researchers compared and did some research through many pieces of literature based on the papers published in some reputable journals and many frameworks of digital literacy. Each different definition was portrayed by its quality through classification ranking, namely selected, considered, and eliminated.

From 118 Scopus articles, the researchers selected the most viewed based on their titles. The article would be selected if the title seemed relevant to the researchers' topic. From this phase, there were 93 nominated articles out of 118. The next step was to read through scanning and skimming in double measure to know the articles' content and relevance and get the final selection of articles to be included in the study. The final selected articles should meet the inclusion criteria, such as relevance, trusted source, purpose, method, result, limitation, and further suggestion. The researchers finally got 46 final articles from the journal to be included in the study process.

Meanwhile, the articles excluded from the lists did not meet the inclusion criteria since they did not discuss some aspects of teachers' digital literacy in secondary schools. Moreover, the definitions, purposes, methods, limitations, results, and discussions of the excluded criteria were sometimes unclear. Among the articles reviewed to answer the questions, the researchers must conclude their findings through a systematic description, which would be divided into sections classified by their research questions. Finally, it would also be visualized through tables, charts, and figures to make the data easier to conclude and review. Figure 1 illustrates the process of the PRISMA method from identification to the final included article.
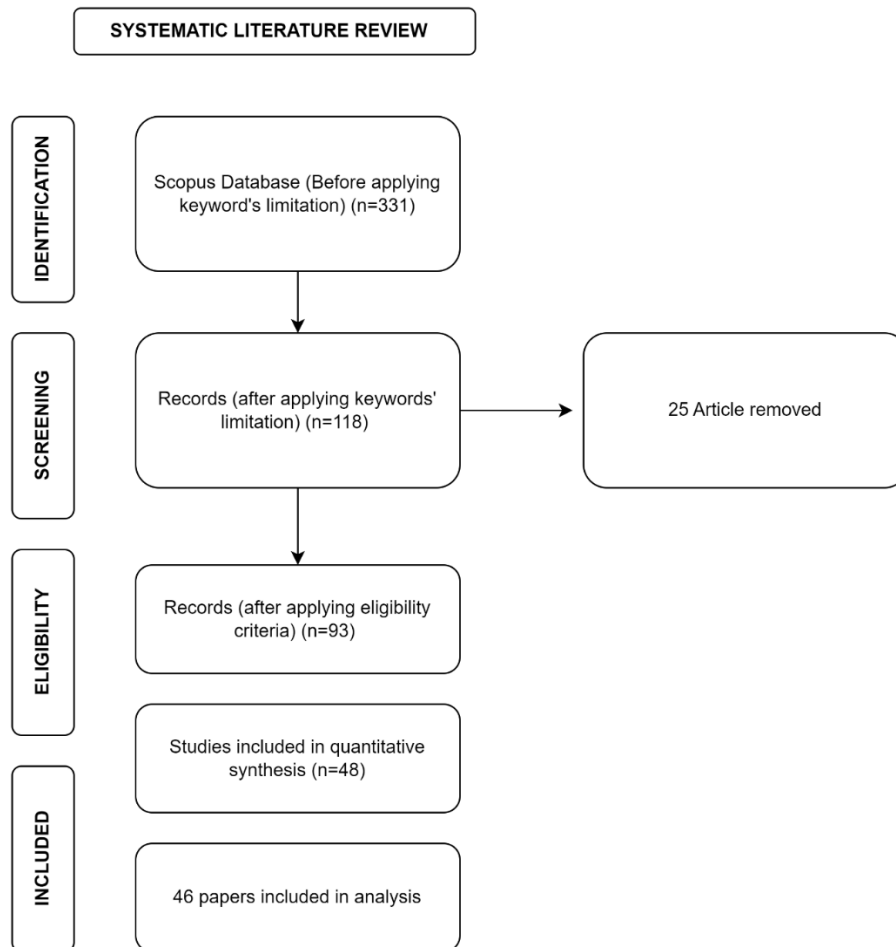
SYSTEMATIC LITERATURE REVIEW

Figure 1. PRISMA flow

3. RESULTS AND DISCUSSION

The results and discussion can be found in several sub-sections. In the results part, the researchers would equip the research questions with some answers obtained from the process of conducting literature reviews. The phase of answering research questions would be constructed by its subsequent set of questions.

3.1. What is the most suggested way of enhancing secondary school teachers' digital literacy?

Enhancing teachers' digital literacy in the digitization era has been high. Some of the studies conducted research using various designs in order to improve teachers' digital literacy. Those research designs include experimental, quasi-experimental, and suggestion studies to level up teachers' and students' digital literacy. It has been implemented at higher education levels, such as by providing opportunities for students to engage more in online learning platforms [35] and self-regulated learning strategies (SLRS) for teachers. Therefore, in this study, the researchers will give further suggestions that might be implemented to enhance teachers' digital literacy in secondary schools. There were 18 selected articles out of 46 that brought up some suggestions on how to enhance the teachers' digital literacy after measuring their level.

There are several strategies to enhance teachers' digital literacy. However, the most suggested way is to conduct a further training program, which could be organized by the school or governance [36]–[44]. Additionally, other ways of leveraging teachers' digital literacy in secondary schools are by providing study programs or related courses for the teachers [45], requiring teachers to practice working with application systems used in online learning, such as the learning management system (LMS) [46], having digital regional school agendas [47], [48], implementing an educational video game for developing teachers' digital literacy [49], and conducting the standardized evaluation which could certify the teachers' digital literacy [50]. The distribution of the articles is pictured in Figure 2.
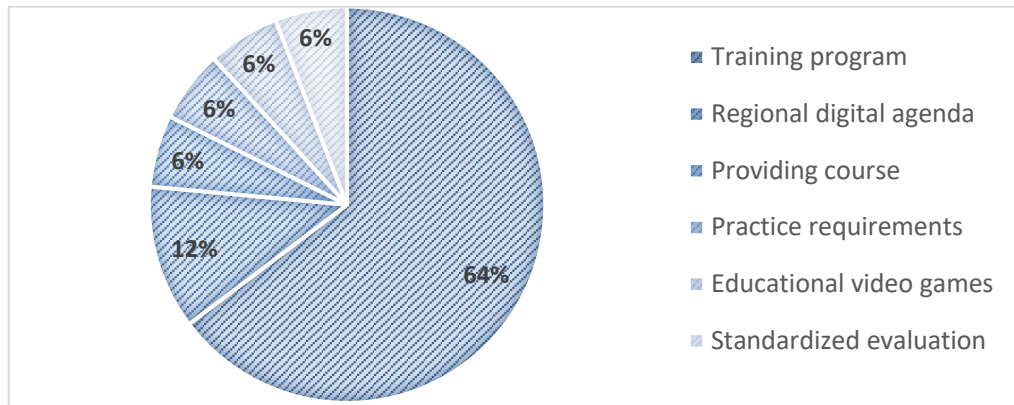
Figure 2. Most suggested enhancement of digital literacy

3.2. What are digital literacy research trends' factors in the last five years, mainly focused on secondary school teachers?

Based on the graphic from the Scopus database, the growth of digital literacy research has begun in the last five years, which is portrayed in Figure 3. It has been clearly illustrated that the most notable year for the research trends of teachers' digital literacy in secondary schools happened in 2021. The changes to the class system since the worldwide COVID-19 outbreak are a significant factor in this leap. It makes the teacher ready to handle online classes.
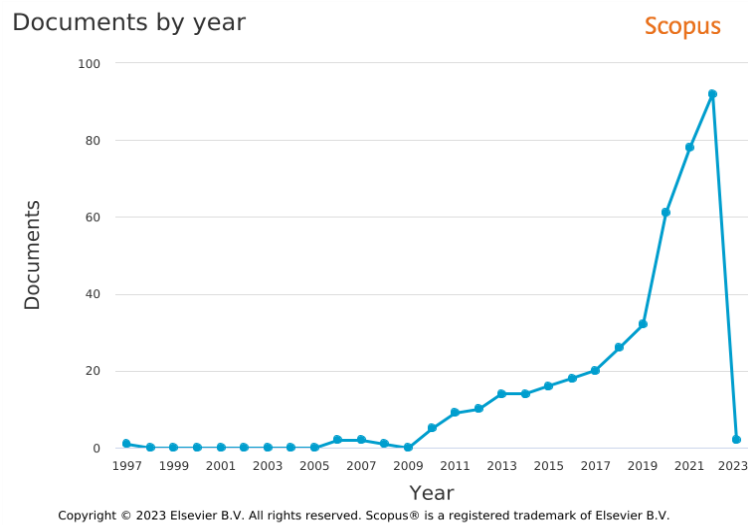
Figure 3. Scopus documents analysis

In sharp contrast, the author only found 10 out of 46 articles about COVID-19 from 2020 to 2022 that talked about digital literacy for high school teachers. Those ten articles of secondary school teachers' digital literacy during the pandemic period mainly discussed about undeniable challenge of teachers' digital literacy after the COVID-19 outbreak, teachers' adaptation to virtual classrooms [51], teachers' digital literacy evaluation during the pandemic, teachers' self-awareness of digital literacy [52], [53], E-learning evaluation [54], preparation through technology integration in education [55], and teachers' digital literacy level. Therefore, after further analysis, the research trends of teachers' digital literacy are highly concerned with the rapid advancement of technology in the 21st century particularly in education. On that account, teachers as the doers who have duties to organize the classroom and deliver the knowledge should be exceptionally skilled in digital literacy. Digital literacy has a huge impact on the teachers' professionalism such as opportunities, responsibilities, and outcomes.

3.3. What is the majority level of teachers' digital literacy in secondary school?

Of all the 46 articles, 27 articles investigated the level of teachers' digital literacy in secondary education. However, many of the studies found that secondary teachers' digital literacy is at the intermediate level, which requires them to enhance and learn more advanced skills in digital literacy. Some studies highlighted the teachers' weaknesses in digital literacy, such as copyright and assessment of online information [56], content creation, and problem-solving, and facilitating learners' needs in digital literacy [57]. However, the teachers' digital literacy weaknesses and strengths could be different based on their digital activities or access to the digital tools in their area [58]. The distribution of teachers' digital literacy levels in secondary education in the selected articles was described in Figure 4.
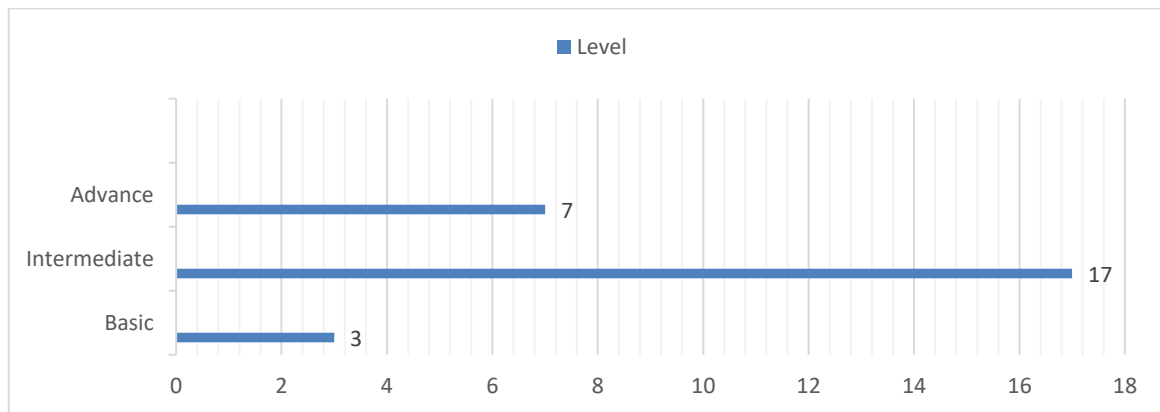

Figure 4. Digital literacy level summary

The researchers found that some prior studies examined the teachers' digital literacy level during the COVID-19 pandemic. The studies analyzed the teachers' readiness to face emergency remote learning, which required the teachers to combine the teaching and learning process with technology tools. According to the findings of these studies, teachers have recently received digital literacy training. It means that the training must be conducted before COVID-19 or other pandemics. It is because digital literacy training is fundamental to the teaching and learning process and makes teachers ready for many kinds of unexpected situations and conditions. Even though the results indicated that the teachers' digital literacy was at an intermediate level, further analysis of the teachers' digital literacy evaluation and testing for screening the ability is required.

The current study sought to assess the trends in teachers' digital literacy at the secondary education level and teachers' digital literacy enhancement. The first problem of this study was specified in this review by analyzing the average and standard levels of teachers' digital literacy skills as determined by previous literature. Overall, given that teachers' average level of digital literacy was intermediate, this result was similar to a study conducted at the higher education level, indicating that secondary and higher education teachers have a basic understanding of digital literacy. Teachers' levels of digital literacy have a significant impact not only on digital learning integration but also on students' digital skill improvement. In this example, teachers should be a role models of how they filter and validate information [59]. According to the results, teachers' digital literacy, especially in secondary and higher education, has been at an intermediate level, but it is important that teachers elevate their digital literacy regularly to keep up with the new advancements of technology.

In revealing the enhancement of digital literacy, previous studies suggested that teachers' digital literacy should be elevated through a training program. In reverse, a preceding study proved that digital literacy training could definitely diminish the teachers' digital literacy skills. By following the training program, the teacher did not intend to increase their digital literacy or confidence in integrating the teaching-learning process [60]. However, almost 80% of the previous studies suggested the training program as the most effective program for uplifting the teachers' digital literacy in continuing education. Furthermore, some studies have chosen a different approach to increase teachers' digital literacy, such as incorporating a digital component into the curriculum, utilizing an educational video to increase teachers' digital literacy, providing a tutorial to aid comprehension, requiring teachers to practice directly using self-regulated learning without prior training, or even making a standardized evaluation that discusses digital literacy [61].

The authors of the reviewed studies demonstrate that, while there have been numerous enhancements to digital literacy, including the training program, a more flexible and adaptable method of enhancing teachers' digital literacy is required in order to understand the teachers' needs and weaknesses, as well as their personal development. Digital literacy is critical in various sectors, and, as a trend, critical competence and future skill in knowledge-intensive teaching and learning contribute to education's digital transformation. As a result of the COVID-19 pandemic, digital literacy has become even more critical for comprehending how to use digital technologies in educational settings. After that, the training program should be done before any emergency remote learning because of unexpected situations [62].

Furthermore, we need to understand educators' digital literacy to support their professional development. As a result, the quality of education is more than just teaching and learning, which occur online. The research established a link between emerging new technologies and educators' barriers to technology integration, which warrants further examination. Analyzed research revealed that the emphasis was on developing digital literacy rather than evaluating it in numerous instances, but frequently included the level of digital literacy. The enhancement of digital literacy does not only depend on situations like COVID-19, which shifted all the offline classes to online, but digital literacy should be mastered by the teachers along with their teaching skills.

It is critical to include a digital literacy evaluation following the implementation of some training or another measure aimed at improving teachers' digital literacy as a starting point for developing digital literacy when developing a holistic and systematic approach. The study's weakness is that it does not highlight teachers' digital literacy in secondary education, despite the fact that there have been numerous previous studies combining their studies with other educational stages such as primary education and higher education. This recent literature review could raise some biases about the study's validity. Furthermore, the reviewed articles discussed not only general digital literacy, but some studies divided the competence measurements into digital literacy branches, such as ICT literacy, digital safety literacy, internet literacy, and information literacy. Along with it, this study has generally given a summary of teachers' digital literacy, especially in secondary education, which hopefully has an impact on further studies.

4. CONCLUSION

This systematic review provides an overview of current research on digital literacy in secondary education settings, including the research purpose, methodology, instrument, outcomes, and limitations. It summarizes research on digital literacy in secondary education over the last five years. A total of 46 publications were analyzed in this review. To begin, the most frequently suggested method for enhancing digital literacy is discussed. In general, the published article advocated for teacher training programs aimed at increasing their digital literacy. Additionally, only a few publications have expanded on these training programs for enhancing secondary teachers' digital literacy. To sum up, secondary school teachers mainly have an intermediate level of digital literacy.

Future research might examine the evaluation of digital literacy training programs for teachers to know what should be fixed in delivering the training and evaluate the existing frameworks often used in measuring the teachers' digital literacy. This literature study could give a further suggestion on how to measure teachers' digital literacy by not only using a questionnaire but a real digital literacy test, for example, using artificial intelligence that could screen the level directly. Overall, this systematic review will assist other scholars in developing a thorough understanding of the definition and application of digital literacy in secondary education and identify any remaining gaps in the literature.

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