



SYSTEMATIC REVIEW OF ADAPTIVE TEACHER COMPETENCE IN DIGITAL SKILLS FOR PRIMARY EDUCATION

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Abstract. The rapid advancement of digital technology has transformed education, making digital competence essential for teachers, especially primary school teachers who play a key role in fostering students' digital readiness. This article represents a systematic literature review aimed at identifying the essential components to be considered during the development and design of adaptive teacher competence in digital skill accessibility. The methodology followed a rigorous and systematic approach, involving a thorough search for relevant texts pertaining to the subject of study, followed by careful selection, evaluation, and analysis. The research findings reveal that a considerable proportion of primary school teachers possess a moderate to high level of adaptive teacher competence in digital skills accessibility. These teachers demonstrate the ability to adapt instructional practices and effectively incorporate technology into their teaching processes. The findings also suggest that successful implementation of digital tools in education requires not only technical skills but also the ability to critically evaluate and integrate digital resources to enhance student learning outcomes. As digital transformation in education continues to evolve, it is crucial for educators to stay updated with emerging technologies and pedagogical strategies. Therefore, the study emphasizes the need for ongoing training programs and policy support to strengthen teachers' digital readiness and foster adaptive teaching practices across diverse educational settings.

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INTRODUCTION

In recent years, scholars have shown a substantial interest in providing students in primary education with accessible digital competence (Falloon, 2020). Investigators have made significant efforts to support technology education, from building teacher curricula to addressing the diverse demands of students from learning settings. Many countries and international organizations, including the European Union (EU), the Council of Europe (CoE), the United Nations International Children's Emergency Fund (UNICEF), and UNESCO, encourage efforts to integrate technology into primary education (DoCarmo, 2019). High-quality education is one of the Sustainable Development Goals of the United Nations. This objective is to guarantee that all disadvantaged groups, including teachers, parents, and elementary school students, have equitable access to all levels of education and vocational training (Palmer et al., 2019).

In the past twenty years, there has been a rise in the application of information and communications technology (ICT) in the classroom setting (Aceto et al., 2018). The use of digital technology is extremely beneficial for a large number of students as well as faculty members (in this study, they include both academic and administrative employees). Traditional classroom settings have the potential to benefit from the enhancements that are made possible by learning management systems (LMSs) and digital learning materials. This will result in more efficient learning environments (Howells et al., 2022). Over fifty percent of students in the United States benefit from online learning because they return to school after beginning a job or continuing their education while working; many of these students are also raising families while

seeking primary education (Rossen & Cowan, 2014). Students also have the option of enrolling in online classes, such as massive open online courses (MOOCs), which are designed to assist in overcoming challenges associated with time and distance (DoCarmo, 2019).

COVID-19 has presented the higher education sector all around the world with a number of serious issues. Because of this epidemic, the use of information and communication technology (ICT) by educational institutions at a higher level has been emphasized more than it ever has before. Because of lockdowns, a considerable number of works need to be converted to digital formats (Palau et al., 2021), and a significant number of instructional activities need to take place online (Adedoyin & Soykan, 2020). According to Juchnowicz & Kinowska (2021), the significant impact of COVID-19, which is the widespread use of digital works, would set new trends for the future; as a result, it is now more pressing to ensure that digital learning environments provided by higher education institutions are accessible to all students.

The study of accessibility and development of teachers' digital competencies in primary education is a very important topic to be reviewed, especially in the context of educational transformation in the digital era. Digital competence is an essential 21st-century skill that teachers must possess in order to be able to equip students from an early age with the ability to adapt to technological developments (Falloon, 2020). International institutions such as UNESCO, UNICEF, the European Union (EU), and the Council of Europe (CoE) also emphasize the importance of integrating digital technology in education as an effort to improve the quality of learning while reducing access gaps (Docarmo, 2019). This change is even more urgent since the COVID-19 pandemic which accelerated digitalization at various levels of education, including primary education, when teachers were forced to adapt to online learning even though most of them did not have adequate readiness (Adedoyin & Soykan, 2020).

Although many teachers have a positive attitude towards the application of technology (Sahin, 2006), research shows that their actual competencies are still limited, so there is a need for continuous training to increase digital capacity (Lopez-littleton & Blessett, 2018; Shinohara et al., 2018). In addition, the limitations of infrastructure, accessibility, and digital skills gaps among students are also major challenges that need attention (Arkorful et al., 2021). This systematic study is important to map research trends, publication distribution, research methodology, and factors that support and hinder teachers in integrating digital competencies into basic learning. Thus, this review is expected to make a significant contribution to the development of more effective education strategies, policy design, and teacher training, as well as support the achievement of the Sustainable Development Goals (SDGs), especially the fourth goal of inclusive and equitable quality education.

According to Gull et al. (2020), who conducted a review of the relevant literature, one of the challenges that teachers working in elementary education face are a lack of accessible information and communication technology (ICT). Another literature analysis on the experiences of students with technology education in elementary school found that the usage of information and communication technology (ICT) presented difficulties for students with digital competence (Arkorful et al., 2021). According to the findings of certain studies, the attitudes of faculty members toward technology education are typically favorable, and these views are critical elements that influence their desire to contribute to technology education (Sahin, 2006). However, faculty members lack the requisite knowledge and abilities to accomplish this aim; thus, training is required to raise their level of competence (Lopez-Littleton & Blessett, 2015). According to research, just 4.5% of the 1857 teachers who offer classes on accessibility feel that they are 'experts' in the subject; 66.1% of these teachers claim to have some knowledge, and 10.7% of these teachers say that they are 'not knowledgeable' 11% to 12% of college-bound pupils in the United States have already demonstrated that they are technologically competent (Shinohara et al., 2018). According to the findings of the 2018 European Student Survey (Laakso et al., 2021), an average of 18% of pupils enrolled in primary education have self-reported having a digital competence or chronic condition. Accessibility training should be conducted for faculty members in order to provide students with equal access to digital learning tools and materials. The goal of these pieces of training is to equip teachers in primary schools



with the knowledge and skills necessary to contribute to more accessible digital learning environments.

This systematic review aims to look at the condition of teachers in accessing and elaborating digital abilities in students at the basic education level, the authors have designed three research questions as follows:

- RQ 1 : How is the distribution of articles based on research years?
- RQ 2 : What is the distribution of countries and journal names for each article?
- RQ 3 : What are the research topics for each article?
- RQ 4 : What is the methodology used in research to accelerate the adaptation of teachers' digital capabilities?
- RQ 5 : What factors cause teachers to be able to explore digital abilities in the application of learning to students at the elementary education level?

RESEARCH METHODS

This study adopts the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) approach. Following the rules of systematic literature review, the researchers designed clear inclusion and exclusion criteria to ensure the quality and relevance of the selected studies. The process involved identifying, screening, and evaluating articles before final inclusion, as represented in the PRISMA flowchart (Figure 1). Ultimately, 34 research papers were selected to be analyzed and synthesized for this review.

The data collection process was conducted by searching for articles across five major databases (Taylor & Francis, IEEE, ACM, Scopus, and Springer). The search was conducted from January 25, 2023, to January 28, 2023. A range of keywords were used in different combinations, including 'development technology', 'digital accessibility', 'digital competence', 'primary education', 'digital skills', 'adaptive teacher', 'teacher competence', and 'teacher skills'. Before the search, the following criteria for what to look for and what to leave out were set, as shown in Figure 1, to do a systematic literature review. In the flowchart, we listed all the research papers the research papers that were used to do this literature review, from the Identification phase to the Included degree, where we finally got the thirty-four research papers for this literature review.

All journals published to date have been included in this analysis. To explore trends in the scientific and professional literature regarding adaptive teacher of technology, the time range from 2010-2024, which is considered the most recent and relevant, was set for analysis. Initially, 434 documents were obtained, then several filters were applied to refine the selection to a number of suitable articles. In the specified time frame, a total of 34 scientific articles were carefully identified from the journal. Furthermore, the final dataset, carefully curated to ensure the inclusion of the most relevant articles, consists of only these 34 articles. All 34 documents are included in this research. The inclusion and exclusion process, as detailed in the article, is visually represented in Figure 1.

The search returned 434 results: 17 from Taylor & Francis, 37 from IEEE, 39 from ACM, 328 from Scopus, and 13 from Springer. After the duplicates were eliminated, there were still 374 records. The titles and abstracts of these papers were read, and their content was checked against the criteria for what should be included and what should be left out. When the records were checked, 251 were thrown out. The full texts of the 42 records that were included were then checked to see if they were eligible. At this point, 8 papers were thrown out: 1 because they didn't focus on adaptive teacher of technology, 1 because they didn't focus on digital accessibility, 1 because the competence wasn't happening at the time the paper was written, and 5 because the digital competence wasn't aimed at primary education. There were 34 papers that were found to be useful, so they were added to a quantitative synthesis. Because the data in these 34 papers varied so much, there was no qualitative synthesis done on them. The authors have completed all the processes from the PRISMA flowchart. As such, the selected articles will be used as a sample and discussed further to support the research topic. The authors developed



this systematic literature review utilizing 34 research articles as a reference to be learnt and reviewed.

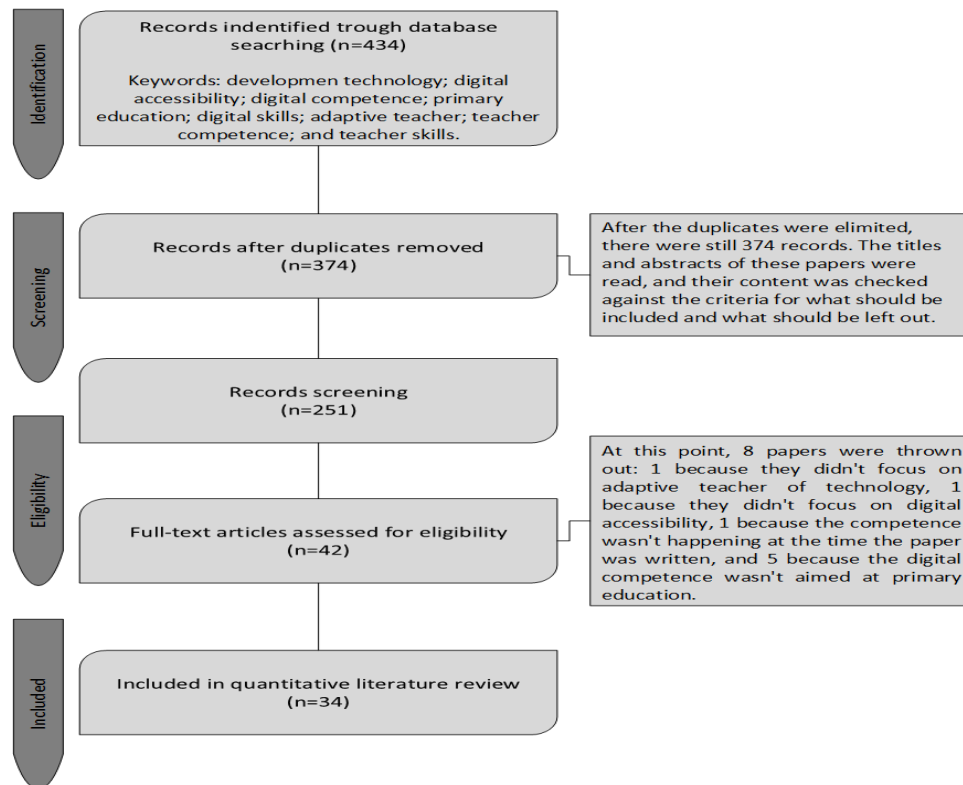


Figure 1. Inclusion and Exclusion Data of PRISMA Flowchart

RESULTS AND DISCUSSION

According to the authors' study, using the search keywords "development technology", "digital accessibility", "digital competence", "primary education", "digital skills", "adaptive teacher", "teacher competence", and "teacher skills". After evaluating thirty-four eligible papers and the number of articles per journal included in the current scoping review is listed in [Table 1](#).

Table 1. Overall result database journal included

No	Author & Year	Topic	Journal	Method	Study Location
1	(Adam & Metljak 2022)	Professional teacher of distance education use of ICT during	Social Sciences & Humanities Open	Quantitative	Slovenian Primary Education
2	(Chaipidech et al. 2022)	Teacher professional development	Computers and Education: Artificial Intelligence	Quantitative	Northeastern Region of Thailand
3	(Safitri et al. 2022)	Implementation of online learning	International Journal of Evaluation and Research in Education	Quantitative	Labuhanbatu Regency, Indonesia
4	(Ahmad et al. 2022)	E-learning issues and solutions for students with disabilities	International Journal of Experiment Evaluation and Research in Education	Experiment	Al-Zaytoonah University of Jordan
5	(Astuti et al. 2022)	Digital technology competence	International Journal of Evaluation and Research in Education	Quantitative	Sleman, Yogyakarta, Indonesia



No	Author & Year	Topic	Journal	Method	Study Location
6	(Sukirman et al. 2022)	Blended learning	International Journal of Experiment Evaluation and Research in Education	Computer Adopted A Very Organic Approach	Special Region of Yogyakarta, Indonesia.
7	(Singh et al. 2022)	E-learning in bridging digital divide	Procedia Science	Computer Adopted A Very Organic Approach	Poland
8	(Crescenzi-Lanna 2022)	Digital games impact	International Journal of Child-Computer Interaction	Investigation	Catalonia (Spain)
9	(Tso et al. 2022)	Digital competence	The Lancet Health - Western Pacific	Quantitative	Hong Kong
10	(Rubach & Lazarides 2021)	21st-century digital skills	Computers in Human Behavior	Quantitative	Germany
11	(Moreno-Morilla et al. 2021)	Literacy digital	Learning, Culture and Social Interaction	Non-Experiment	Spanish Primary
12	(Laakso et al. 2021)	Digital competence	Computers and Education	Quantitative	Finland
13	(Çetin 2021)	Literacy digital	Thinking Skills and Creativity	Mix Method	Turkey
14	(Purnama et al. 2021)	Literacy digital	Heliyon	Quantitative	Yogyakarta of Indonesia
15	(Hofmann 2021)	Implementation of app-based learning	International Journal of Educational Research Open	Mix Method	Swiss Elementary School
16	(Agaton & Cueto 2021)	Experiences on distance learning during	International Journal of Evaluation and Research in Education	Qualitative	Philippines
17	(Hämäläinen et al. 2021)	Teaching professionals' digital competence	Computers in Human Behavior	Quantitative	Finland
18	(Costa et al. 2021)	Schools' digital capacity	Computers and Education	Quantitative	Portugal
19	(Amir et al. 2020)	Implementation of technology	Heliyon	Mix Method	Sidoarjo, Indonesia
20	(Brevik et al. 2019)	Professional digital competence	Teaching and Education	Mix Method	Norway
21	(Instefjord & Munthe 2017)	Professional digital competence	Teaching and Education	Quantitative	Norway
22	(Ramírez-Montoya et al. 2017)	Digital competence	Computers in Human Behavior	Quantitative	Mexico
23	(Ucus 2015)	Implementation of technology	Procedia - Social and Behavioral Sciences	Quantitative	Turkey
24	(Aesaert et al. 2014)	Implementation of technology	Computers and Education	Quantitative	Belgium
25	(Bratitsis & Ziannas 2015)	Implementation of technology interactive	Procedia Science	Computer Experiment	Greece
26	(Ozdamli & Ozdal 2015)	Information-communication technologies	Procedia - Social and Behavioral Sciences	Quantitative	Cyprus
27	(Rambousek	ICT competencies	Procedia - Social and	Mix Method	Czech Republic



No	Author & Year	Topic	Journal	Method	Study Location
	et al. 2015)		Behavioral Sciences		
28	(Butter et al. 2014)	ICT competences	Computers in Human Behavior	Quantitative	Chile
29	(Aesaert et al. 2014)	ICT competence	Computers and Education	RND	Flanders
30	(Rambousek et al. 2014)	ICT literacy education	Procedia - Social and Behavioral Sciences	Quantitative	Czech Republic
31	(Badia et al. 2014)	Digital technology factor	Procedia - Social and Behavioral Sciences	Quantitative	Spain
32	(Tuparova et al. 2014)	ICT competence	Procedia - Social and Behavioral Sciences	Experience	Bulgarian
33	(Campbell 2012)	Implementation of technology interactive	Procedia - Social and Behavioral Sciences	Action Research	Canada
34	(Yuda 2011)	Digital educational materials	Procedia - Social and Behavioral Sciences	Experiment	Japan

Table 1 shows that the journals included in the screening through the PRISMA stage obtained several topics that will be analysed in this article, including topics, journal publishers, methods, and countries. Each journal will be analysed through several indicators, namely by looking at the distribution of journals and viewing each content in each journal. Journals obtained and selected as many as thirty-four journals from various aspects, methods, and countries show variations in selecting journals for each publisher, so the problems obtained will have different results. Because these thirty-four journals will be reviewed through several aspects in each journal that has been selected and will be analysed comprehensively.

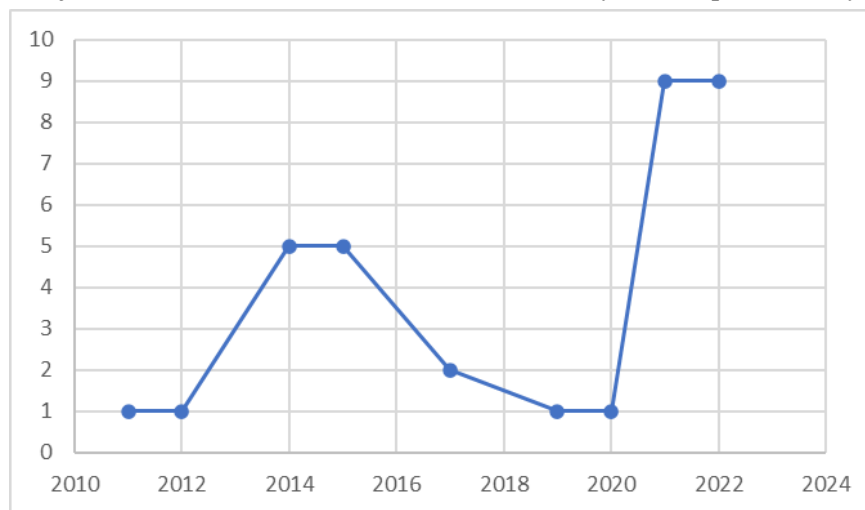


Figure 2. Distributions of years in the article

Articles with a distribution that has been distributed every year can be seen in Figure 2 which shows the most in 2021 and 2022, namely 9 articles, because at the time of journal selection it was taken in January-February 2023, so journals can be taken in 2022 and not yet exist in 2023 or 2024. Meanwhile in 2014 and 2015 there were also a total of 5 journals each, while other articles were scattered in 2011, 2012, 2017, 2019, and 2020. These results show the variation in each journal included in the discussion so that a trend will be obtained that will be seen in each article.

The characteristics of the articles obtained as shown in Table 2 show that these articles were taken from reputable international journals, each journal has different characteristics in this case, namely the adaptation of teachers in accessing digital to see the abilities possessed by each teacher in implementing digital platforms both learning face to face or virtual face to face.



Table 2. Journals of included articles

Journal	Number of articles per journal
Computers and Education	5
Computers in Human Behavior	4
Heliyon	2
International Journal of Child-Computer Interaction	1
International Journal of Educational Research Open	1
International Journal of Evaluation and Research in Education	5
Learning, Culture and Social Interaction	1
Procedia - Social and Behavioral Sciences	8
Procedia Computer Science	2
Social Sciences & Humanities Open	1
Teaching and Teacher Education	2
The Lancet Regional Health - Western Pacific	1
Thinking Skills and Creativity	1

The results of the journals obtained have a different distribution, namely the journal with the most selected articles, namely *Procedia - Social and Behavioural Sciences* with 8 articles and *Computers and Education* with 5 articles, apart from that, various journals were distributed with a total of 34 journals. The results obtained show that many contain elements of accessibility, the adaptability of teachers in implementing digital learning.

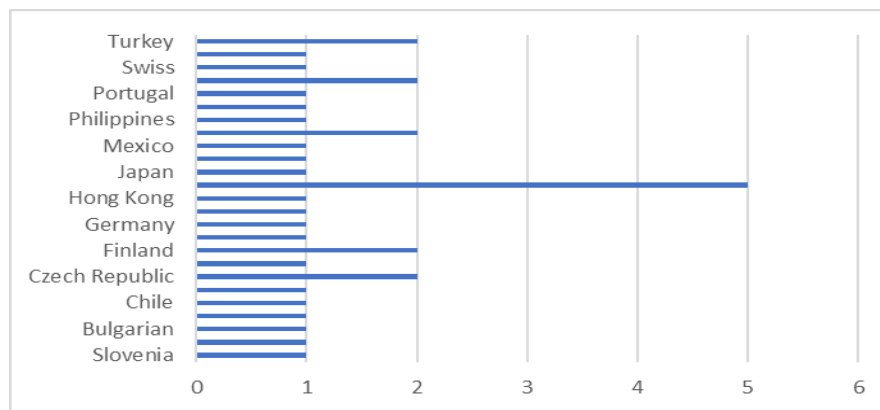


Figure 3. Distributions of countries covered by competence in digital skills

The distribution of countries in each journal shown in [Figure 3](#) has thirteen different countries, where the most journals are Japan, while the others are spread across Turkey, Switzerland, Philippines, Finland, and the Czech Republic have many of the same journals. Meanwhile, other journals are scattered in several other countries. These results show that the adaptability of teachers' digital abilities in implementing learning is most found in Japan.

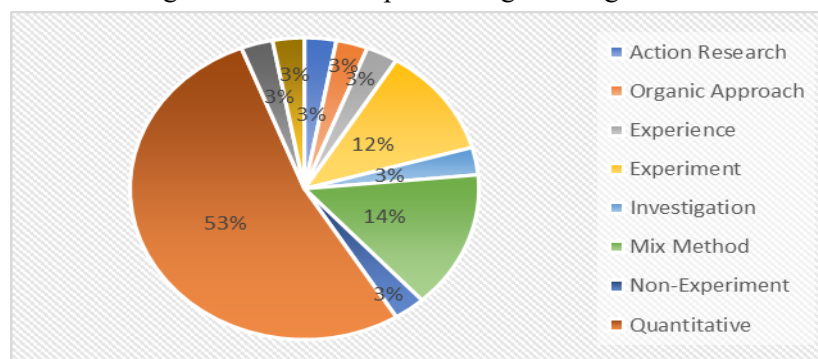


Figure 4. Distributions of methodology in research

The methodology in each article is different as shown in [Figure 4](#). The highest methodological results were in the Quantitative study as much as 53% and Mix Method as much

as 14%, while the others had different methods. Quantitative in the journals that have been studied indeed suggests related to how teachers teach students related to digital competence, several problems also arise for teachers in accessing learning through digital, so this is to measure effectiveness and practicality can be done through quantitative methods.

Table 3. Topic research of included articles

Topic	Number of topics per journal	Percentage
Digital Technology Competence Develop	16	47%
ICT Competencies	5	15%
Implementation Blended Learning	1	3%
Implementation Online Learning	4	12%
Information-Communication Technologies	1	3%
Literacy digital	3	9%
Professional Teacher in Technology	4	12%

The research topics shown in [Table 3](#) show the most widely discussed topics, namely those related to Digital Technology Competence Develop as much as 47% and the other 53% have different topics. The results of this research topic are divided into seven different topics, while the most results reveal that the ability to develop digital technology competencies is still very familiar among researchers to realize research in the current digital era. Another topic that is no less important, namely ICT competence and online learning is still a hot topic and teacher professionalism in technology is still often experienced and developed to date to equalize every teacher to be able to access digital competencies according to current educational developments.

The results of this study underscore the significance of adaptive teacher competence in promoting digital skills accessibility in primary education. The findings support the idea that adaptive teachers play a critical role in creating learning environments where all students can access, engage with, and benefit from digital skills instruction. The high level of adaptive teacher competence observed in the study suggests that teachers recognize the importance of integrating digital skills into their instructional practices ([Sánchez-Cruzado et al., 2021](#)). Possess the necessary knowledge and skills to adapt their teaching methods to accommodate diverse student needs and promote equal access to digital resources ([Ali, 2020](#)).

The strategies employed by adaptive teachers, such as differentiated instruction, UDL, and collaborative learning, align with best practices for enhancing digital skills accessibility. These strategies provide opportunities for students to develop their digital literacy, collaborate with peers, and leverage technology to support their learning. The positive correlation between adaptive teacher competence and students' learning outcomes highlights the significant impact of adaptive teaching on student achievement ([Fauth et al., 2019](#)). By fostering digital skills accessibility, adaptive teachers empower students to become active participants in the digital age, equipping them with the necessary skills for future success.

These findings have implications for teacher professional development and educational policy. It is crucial to provide ongoing training and support for teachers to enhance their adaptive competence in digital skills accessibility. Professional development programs should focus on developing pedagogical strategies, technology integration, and inclusive instructional practices ([Fernández-Batanero et al., 2022](#)). Furthermore, educational policies should prioritize the integration of digital skills in primary education curricula, with an emphasis on adaptive teaching approaches. Adequate resources should be allocated to schools to ensure equitable access to technology and digital resources for all students.

In conclusion, the results of this research study highlight the importance of adaptive teacher competence in promoting digital skills accessibility for primary education. Adaptive teachers, equipped with the necessary knowledge, skills, and strategies, play a vital role in creating inclusive learning environments and fostering students' digital skills development ([Alexander & Byrd, 2020](#)). By investing in teacher professional development and educational

policies that support adaptive teaching, we can ensure that all primary school students have equal opportunities to acquire essential digital skills.

CONCLUSIONS AND SUGGESTIONS

The research study on the adaptive teacher competence in digital skills accessibility for primary education highlights the crucial role of adaptive teachers in creating inclusive and equitable learning environments. The findings demonstrate that a significant proportion of primary school teachers possess a moderate to high level of adaptive teacher competence in digital skills accessibility. Their ability to adapt instructional practices, integrate technology effectively, and address diverse student needs ensures that digital skills are accessible to all learners. The study reveals that adaptive teachers employ various strategies to promote digital skills accessibility, including differentiated instruction, universal design for learning (UDL), and collaborative learning. These strategies enable personalized learning experiences, ensure equal access to digital resources, and foster collaboration among students. By utilizing these approaches, adaptive teachers bridge the digital divide and provide opportunities for all students to develop their digital skills. Importantly, the research findings establish a positive correlation between adaptive teacher competence and students' learning outcomes. Students taught by adaptive teachers demonstrate improved digital literacy skills, increased engagement, and higher levels of achievement. This correlation emphasizes the critical impact of adaptive teacher competence on students' ability to thrive in the digital age. The study's implications point to the need for continuous professional development programs that enhance adaptive teacher competence in digital skills accessibility. These programs should focus on equipping teachers with the knowledge, skills, and strategies needed to effectively integrate digital skills into their instructional practices.

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