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# Teachers' Technological Readiness in Digital Learning: A Systematic Literature Review

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**Abstract**
Technology plays a central role in 21st century learning, yet teachers' readiness to integrate technology into digital learning remains a persistent challenge. This study aims to analyze research trends, supporting and inhibiting factors, and core competencies related to teachers' technological readiness in digital learning. A systematic literature review was conducted using the Publish or Perish search engine to retrieve peer reviewed journal articles from Scopus, Web of Science, and Crossref databases published between 2014 and 2024. Articles were selected based on clear inclusion criteria focusing on empirical studies of teachers' technological readiness in educational contexts, while non journal publications, non empirical studies, and articles outside the education domain were excluded. A total of 48 articles met the selection criteria and were analyzed using thematic analysis. The findings indicate that teachers' technological readiness varies across contexts. Low readiness is associated with limited technical skills, inadequate infrastructure, and low self confidence. Moderate readiness reflects basic technology acceptance but insufficient pedagogical integration. High readiness is characterized by well developed competencies, including ICT literacy, pedagogical technology skills, and integrated frameworks such as Technological Pedagogical Content Knowledge (TPACK). Supporting factors include targeted professional development, institutional support, and flexible educational policies, while inhibiting factors involve infrastructure gaps, technology related anxiety, and limited access to digital resources. Strengthening teachers' technological readiness requires continuous training, improved infrastructure, and competency development aligned with pedagogical and instructional needs in digital learning.

**Keywords:**
Digital Learning;
Teachers;
Technological Readiness

## 1. Introduction

Technology has transformed many aspects of life, including the education sector. Rapid advances in digital technology have reshaped the educational landscape, creating both opportunities and challenges for teachers (Eraku et al., 2021; Pablos et al., 2022; Spiteri & Chang Rundgren, 2020; Wohlfart & Wagner, 2023). The transformation toward digital learning has been driven by the increasing use of e learning platforms (Zizikova, 2021), learning management systems or LMS (Gorshenin, 2018), and various digital tools that support teaching and learning processes. This shift accelerated significantly during the COVID 19 pandemic, which forced educators to rapidly adopt technology based instructional practices (Alakrash & Razak, 2021; Haji et al., 2026; Isnawan et al., 2026; Monike et al., 2025; Sudirman et al., 2025; 2026; 2026). Nevertheless, many teachers continue to face challenges, particularly in managing virtual classrooms and accessing reliable internet infrastructure (Alakrash & Razak, 2021).

Digital learning refers to the application of technology in teaching and learning processes (Carrier, 2017). In the context of the Industrial Revolution 4.0, digital learning has become a key strategy to enhance student engagement and academic achievement through technology integration (Chik et al.,

2024). As digital learning becomes increasingly embedded in educational systems, teachers' technological readiness emerges as a critical factor influencing the quality and effectiveness of classroom instruction. Understanding teachers' readiness is therefore essential for informing educational policies and professional development programs that aim to support effective technology integration.

Despite the growing emphasis on digital learning, empirical evidence indicates that teachers' levels of technological readiness remain varied across educational contexts (Spiteri & Chang Rundgren, 2020; Pablos et al., 2022). While some teachers demonstrate strong digital competence and adaptability, others experience difficulties related to limited technical skills, low confidence, inadequate pedagogical integration, and restricted access to digital resources (Rasmitadila et al., 2020; Lukas & Yunus, 2021). This variation suggests a gap between the rapid pace of digital transformation in education and teachers' capacity to implement technology meaningfully at the classroom level.

Technological readiness is commonly defined as an individual's propensity to embrace and use new technologies. This study adopts Parasuraman's Technology Readiness Index (TRI) as its theoretical foundation, which conceptualizes technological readiness through four dimensions: optimism, innovation, discomfort, and insecurity (Parasuraman, 2000; Ahmad et al., 2021). In the context of teachers, technological readiness reflects not only technical capability but also psychological readiness, including confidence, openness to innovation, and perceived control in integrating digital technology into pedagogical practice (Hrytsenchuk et al., 2018; Cattaneo et al., 2022).

Teachers play a central role in translating digital technology into effective learning experiences. Their technological readiness influences instructional design, classroom interaction, and students' learning experiences. Without sufficient readiness, technology integration may remain superficial and limited to tool usage rather than supporting pedagogically meaningful learning (Spiteri & Chang Rundgren, 2020). Observations from a teacher interview conducted at a private elementary school in October 2024 illustrate this condition, revealing uneven access to digital facilities and limited practical application of teachers' technological competencies. This interview is included solely as a contextual illustration of the phenomenon and does not constitute empirical data for the present study.

Previous research has examined teachers' technological readiness from various perspectives, including digital competence, technology acceptance, and e learning readiness (Al Araibi et al., 2016; Akram et al., 2022). However, existing studies tend to be fragmented, focusing on specific technologies, educational levels, or regional contexts. There is limited synthesis that integrates research trends, enabling and inhibiting factors, and competency requirements related to teachers' technological readiness in digital learning.

This gap highlights the need for a systematic literature review that comprehensively synthesizes empirical evidence on teachers' technological readiness. Therefore, this study aims to systematically review existing research on teachers' technological readiness in digital learning by focusing on three aspects: research trends, supporting and inhibiting factors, and core competencies required for effective technology integration in educational practice.

## 2. Method

### 2.1 Research Methods

This study uses the Systematic Literature Review (SLR) method which aims to comprehensively evaluate available research related to a particular topic and interpret the findings thoroughly. SLR is a systematic approach in identifying, assessing, and synthesizing relevant research to provide a clear picture of developments or gaps in a field of study (Tremmel et al., 2017). In this study, the focus of the study lies in the readiness of teachers' technology in facing digital learning. The SLR process in this study was conducted following a structured and transparent procedure to ensure methodological rigor and replicability.

### 2.2 Data Search Strategy

The steps in this study include: establishing relevant inclusion and exclusion criteria; formulate a search strategy; search for and filter potential studies; assessing the quality of the study; as well as analyzing and synthesizing findings. The inclusion and exclusion criteria are presented in Table 1.

Table 1

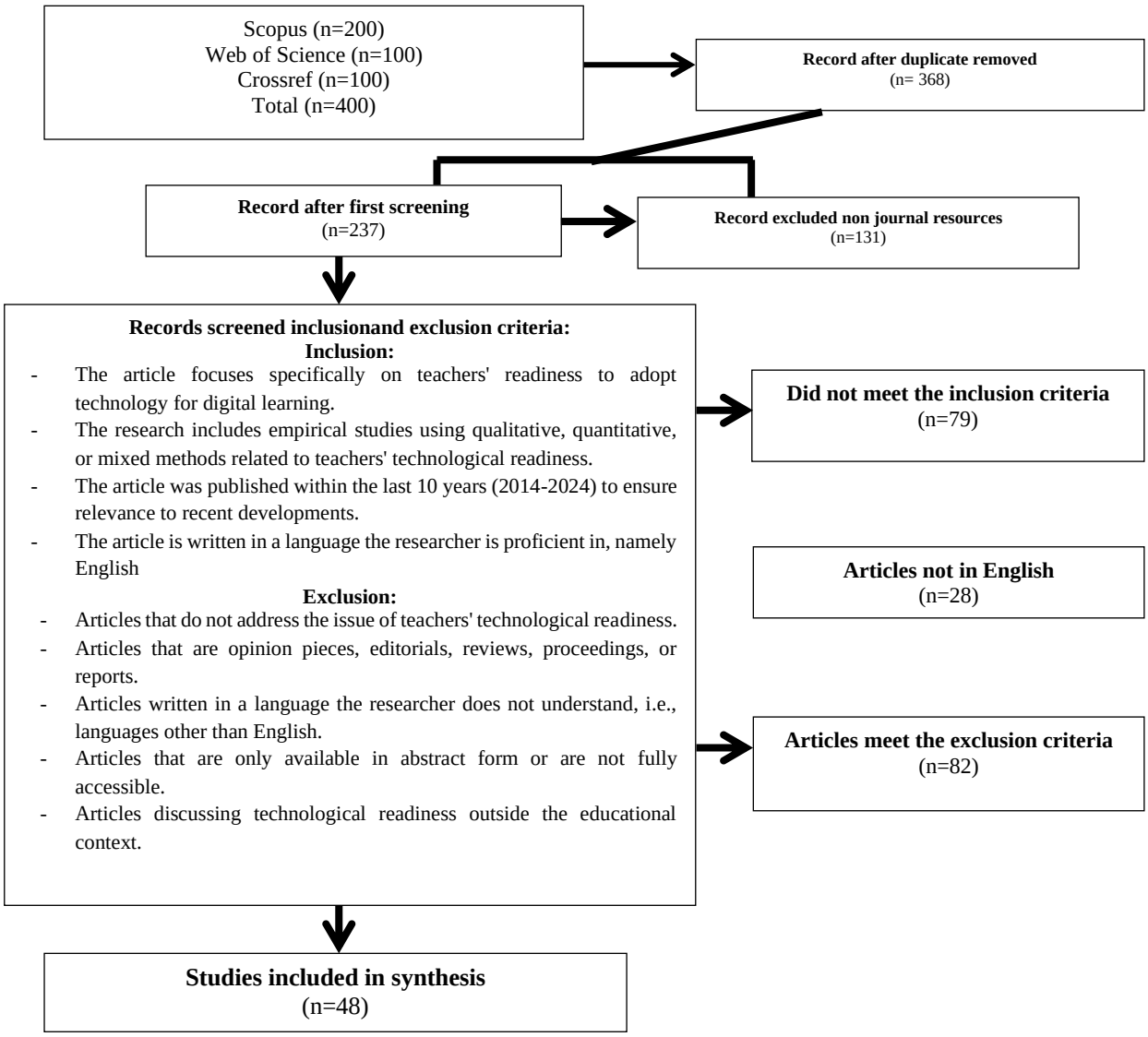
*Inclusion and Exclusion Criteria*

| Inclusion Criteria | Exclusion Criteria |
|---|---|
| 1. The article discusses teachers' readiness to adopt technology for digital learning specifically.<br>2. The research includes empirical studies that use qualitative, quantitative, or mixed methods related to teacher technology readiness.<br>3. Articles published in the last 10 years (2014-2024) to be relevant to the latest developments.<br>4. The article is written in the language that the researcher masters, namely English. | 1. Articles that do not mention the issue of teacher technology readiness.<br>2. Articles in the form of opinions, editorials, reviews, proceedings, or reports.<br>3. Articles in languages that are not mastered by the researcher, i.e. other than English.<br>4. Articles that are only available in abstract form or are not fully accessible.<br>5. Articles that discuss technology readiness beyond the context of education. |

The literature search was conducted between March and May 2024. Article retrieval was performed using the Publish or Perish (PoP) 8 software by accessing the Scopus, Web of Science, and Crossref databases, ensuring consistency with the databases reported in the abstract. The search was carried out using the following Boolean keyword combinations: ("technology readiness" OR "technology readiness index") AND teacher AND ("digital learning" OR "online learning" OR "e-learning").

Articles published between 2014 and 2024 were included to ensure relevance to recent developments in digital education. Articles identified through the search process were filtered using predefined inclusion and exclusion criteria. The screening process followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, consisting of identification, screening, eligibility, and inclusion stages. Duplicate records were removed prior to screening. The PRISMA flow diagram is presented in Figure 1 in a simplified and non-repetitive format to clearly illustrate the article selection process.

Figure 1
*Search, methods, inclusion, criteria, and result Diagram*




## 2.4 Data Analysis

The analysis used in this review study is by thematic analysis. Thematic analysis is a method for identifying and understanding patterns of meaning in qualitative data that is flexible and can be applied in a variety of theoretical and research frameworks (Clarke & Braun, 2017). Thematic analysis involves identifying and analyzing patterns of meaning in qualitative data, emphasizing research transparency and methodological reflectivity throughout the planning and implementation stages (Herzog et al., 2019). The thematic analysis in this study followed six systematic steps: (1) familiarization with the data through repeated reading of the selected articles, (2) generation of initial codes related to teachers' technological readiness, (3) development of preliminary themes, (4) reviewing and refining themes to ensure coherence, (5) defining and naming the final themes, and (6) reporting and interpreting the findings in relation to the research objectives.

## 2.5 Quality Appraisal

The quality assessment process is carried out to ensure that the methodology and analysis used in the selected studies have been implemented according to appropriate standards. For this purpose, the authors refer to the guidelines proposed by (Kitchenham, B & Charters, 2007). Accordingly, this study applies six Quality Assessment (QA) questions:
QA 1: Is the research objective clearly stated?

QA 2: Is the significance and usefulness of the study clearly presented?
QA 3: Is the research methodology explicitly defined?
QA 4: Is the conceptual approach clearly articulated?
QA 5: Is the study compared and measured against similar works?
QA 6: Are the study's limitations explicitly mentioned?
With the assistance of two experts in education and technology, the corresponding author reviewed each document and assigned scores based on the following assessment procedure: Yes (Y) = 1, Partial = 0.5, or No = 0.

## 3. Results and Discussion

This section presents the results of the selection and mapping of articles analyzed in this literature review. A total of 48 articles that met the inclusion criteria were selected based on their relevance to the topic of teacher readiness in integrating technology, including online learning, blended learning, and other digital-based innovations. These articles originate from various countries and employ diverse research approaches, including qualitative, quantitative, and mixed methods. This diversity provides a comprehensive overview of research trends, focal issues, and the development of teacher readiness in responding to educational transformation in the digital era. The complete list of the reviewed articles is presented in Table 2 below.

Table 2.
*List of the 48 selected articles reviewed in this study*

| ID | Authors, Year | Title | Countries | Type of Research |
|---|---|---|---|---|
| 1. | (Kim & Kwon, 2023) | Exploring the AI competencies of elementary school teachers in South Korea | South Korea | Mixed Method |
| 2. | (M. Park & Son, 2022)M. Park | Pre-service EFL teachers' readiness in computer-assisted language learning and teaching | Hong Kong | Qualitative |
| 3. | (B. Li, 2022) | Ready for Online? Exploring EFL Teachers' ICT Acceptance and ICT Literacy During COVID-19 in Mainland China | China | Mixed Method |
| 4. | (Sulaeman et al., 2022) | Teacher Readiness In STEM Education: Voices Of Indonesian Physics Teachers | Indonesia | Qualitative |
| 5. | (Ngao et al., 2022) | Understanding Teacher Educators' Perceptions and Practices about ICT Integration in Teacher Education Program | Tanzania | Qualitative |
| 6. | (Almusawi et al., 2021) | Innovation in physical education: Teachers' perspectives on readiness for wearable technology integration | Kuwait | Qualitative |
| 7. | (Nikolopoulou et al., 2021) | Teachers' Readiness to Adopt Mobile Learning in Classrooms: A Study in Greece | Greece | Quantitative |
| 8. | (Perifanou et al., 2021) | Teachers' Digital Skills Readiness During COVID-19 Pandemic | Greece | Quantitative |
| 9. | (Asghar et al., 2021) | Mobile learning technology readiness and acceptance among pre-service teachers in Pakistan during the COVID-19 pandemic | Pakistan | Quantitative |
| 10. | (Lukas & Yunus, 2021) | ESL teachers' challenges in implementing e-learning during COVID-19 | Malaysia | Qualitative |
| 11. | (Aditya, 2021) | Embarking Digital Learning Due to COVID-19: are Teachers Ready? | Indonesia | Quantitative |
| 12. | (Bardach et al., 2021) | The power of feedback and reflection: Testing an online scenario-based learning intervention for student teachers | Australia | Mixed Method |

| | | | | |
|---|---|---|---|---|
| 13. | (Rodríguez-Muñiz et al., 2021) | Secondary mathematics teachers' perception of their readiness for emergency remote teaching during the covid-19 pandemic: A case study | Spain | Quantitative |
| 14. | (Rashid et al., 2021) | Teachers' perceptions and readiness toward the implementation of virtual learning environment | Malaysia | Quantitative |
| 15. | (Andarwulan et al., 2021) | Elementary teachers' readiness toward the online learning policy in the new normal era during Covid-19 | Indonesia | Quantitative |
| 16. | (Archibald et al., 2021) | Validating a blended teaching readiness instrument for primary/secondary preservice teachers | USA | Quantitative |
| 17. | (Batac et al., 2021) | Qualitative content analysis of teachers' perceptions and experiences in using blended learning during the COVID-19 pandemic | Philiphine | Qualitative |
| 18. | (Joseph et al., 2021) | Impact of Technology Readiness and Techno Stress on Teacher Engagement in Higher Secondary Schools | India | Quntittaive |
| 19. | (Caner & Aydin, 2021) | Self Efficacy Beliefs of Pre-service Teachers on Technology Integration | Turkey | Quantitative |
| 20. | (Apak et al., 2021) | Measuring teacher creativity-nurturing behavior and readiness for 21st century classroom management | Malaysia | Quantitative |
| 21. | (Rasmitadila et al., 2020) | The perceptions of primary school teachers of online learning during the covid-19 pandemic period: A case study in Indonesia | Indonesia | Qualitative |
| 22. | (Lie et al., 2020) | Secondary School Language Teachers' Online Learning Engagement During The Covid-19 Pandemic in Indonesia | Indonesia | Qualitative |
| 23. | (Valtonen et al., 2020) | Fresh perspectives on TPACK: pre-service teachers' own appraisal of their challenging and confident TPACK areas | Finnish | Qualitative |
| 24. | (Anisimova et al., 2020) | Formation of design and research competencies in future teachers in the framework of STEAM education | Russia | Quantitative |
| 25. | (Leacock & Warrican, 2020) | Helping teachers to respond to COVID-19 in the Eastern Caribbean: issues of readiness, equity and care | Carribean | Qualitative |
| 26. | (Fuad et al., 2020) | Exploring teachers' tpck: Are indonesian language teachers ready for online learning during the covid-19 outbreak? | Indonesia | Mixed Method |
| 27. | (Krasnova & Shurygin, 2019) | Blended learning of physics in the context of the professional development of teachers | Russian | Qualitative |
| 28. | (Alda et al., 2020) | Teacher education institutions in the philippines towards education 4.0 | Philiphine | Quantittaive |
| 29. | (Chou et al., 2020) | Developing and validating a scale for measuring teachers' readiness for flipped classrooms in junior high schools | Taiwan | Quantitative |

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|---|---|---|---|---|
| 30. | (Wu et al., 2020) | Teacher's Perceptions and Readiness to Teach Coding Skills: A Comparative Study Between Finland, Mainland China, Singapore, Taiwan, and South Korea | Singapore | Qualitative |
| 31. | (Al-Furaih & Al-Awidi, 2020) | Teachers' Change Readiness for the Adoption of Smartphone Technology: Personal Concerns and Technological Competency | Kuwait | Quantitative |
| 32. | (Y. Li et al., 2019) | Predicting High School Teacher Use of Technology: Pedagogical Beliefs, Technological Beliefs and Attitudes, and Teacher Training | USA | Quantitative |
| 33. | (Kuzminska et al., 2019) | Study of Digital Competence of the Students and Teachers in Ukraine | Ukraine | Qualitative |
| 34. | (Stojšić et al., 2019) | The readiness of geography teachers to use mobile devices in the context of immersive technologies integration into the teaching process | Serbia | Mixed method |
| 35. | (Petko et al., 2018) | The Interplay of School Readiness and Teacher Readiness for Educational Technology Integration: A Structural Equation Model | Swiss | Qualitative |
| 36. | (Rienties et al., 2018) | Making sense of learning analytics dashboards: A technology acceptance perspective of 95 teachers | UK | Qualitative |
| 37. | (Valtonen et al., 2018) | Differences in pre-service teachers' knowledge and readiness to use ICT in education | Finnish | Quantittaive |
| 38. | (Cuhadar, 2018) | Investigation of pre-service teachers' levels of readiness to technology integration in education | Turkey | Quantitative (Survey) |
| 39. | (Park et al., 2017) | Early childhood teachers' beliefs about readiness for teaching science, technology, engineering, and mathematics | USA | Quantitative (Survey) |
| 40. | (İncek, 2017) | The relationship among pre-service teachers' computer competence, attitude towards computer-assisted education, and intention of technology acceptance | Turkey | Quantitative |
| 41. | (Osakwe et al., 2017) | Where learners' and teachers' perceptions on mobile learning meet: A case of Namibian secondary schools in the Khomas region | Namibia | Mixed Method |
| 42. | (Al-Awidi & Aldhafeeri, 2017) | Teachers' readiness to implement digital curriculum in Kuwaiti schools | Kuwait | Mixed Method |
| 43. | (Sun et al., 2017) | The impact of student teaching experience on pre-service teachers' readiness for technology integration: A mixed methods study with growth curve modeling | USA | Mixed Method |
| 44. | (Bicer & Capraro, 2017) | Longitudinal effects of technology integration and teacher professional development on students' mathematics achievement | USA | Quantitative |
| 45. | (L. Clarke & Abbott, 2016) | Young pupils', their teacher's and classroom assistants' experiences of iPads in a Northern | Ireland | Qualitative |

| | | | | |
|---|---|---|---|---|
| | | Ireland school: "Four and five years old, who would have thought they could do that?" | | |
| 46. | (Zyad, 2016) | Integrating computers in the classroom: Barriers and teachers' attitudes | Morrocco | Mixed Method |
| 47. | (Alfarani, 2015) | Influences on the adoption of mobile learning in Saudi women teachers in higher education | Saudi Arabia | Quantitative |
| 48. | (Looi et al., 2014) | Enacting a technology-based science curriculum across a grade level: The journey of teachers' appropriation | Singapore | Qualitative |

Based on the results of the thematic analysis, there are three main themes discussed in this study, namely: trends in teacher technology readiness in digital learning, factors supporting and inhibiting teachers' technology readiness in digital learning, and teachers' ability to apply technology in digital learning.

**Trends in teacher technology readiness in digital learning**

Figure 2

*Publication Year*

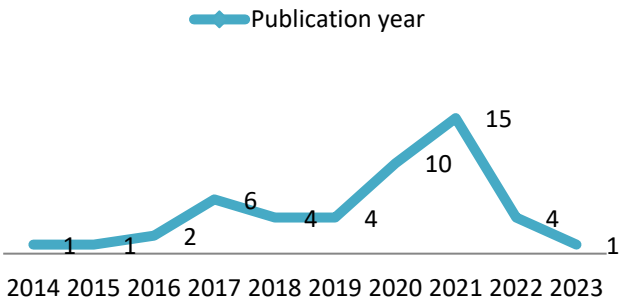



Figure 2 shows the distribution of the publication of the articles referenced in this study, with the range of 2014-2023. 2021 was recorded as the year with the highest number of articles related to teacher technology readiness, namely 15 articles. 2020 is the year with the second highest number of articles, namely 10 articles, followed by 2017 with 6 articles. In 2018, 2019, and 2022, 4 articles were published each, while in 2016 2 articles were published. In 2014, 2015, and 2023, each has 1 published article related to the readiness of teacher technology in digital learning.

Figure 3.

*Country*

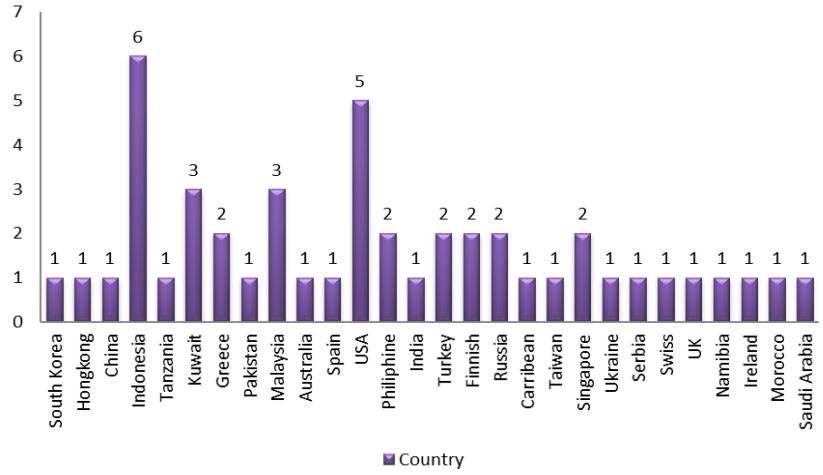
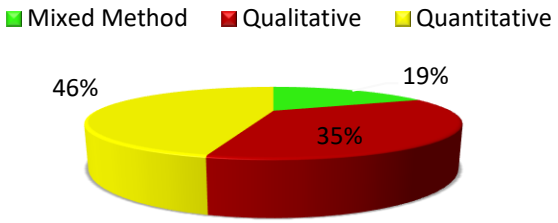


Figure 3 shows the countries where the study was conducted that were included in this study. Indonesia is the country that has the most research locations related to the readiness of teacher technology in digital learning. Furthermore, the USA is the second country after Indonesia followed by Kuwait and Malaysia where the research in the study is carried out.

Figure 4.
*Type of Research*




Based on Figure 4 about the type of research, the dominant type of research in 48 articles that meet these criteria is quantitative research as much as 46%, namely 22 articles. Quantitative research is designed to analyze large populations and test hypotheses through structured design, reliability and validity of measurements, and various analytical techniques (Little et al., 2024). The second dominant type of research is qualitative research as much as 35%, namely 17 articles. Qualitative research aims to obtain new findings and is often presented in a descriptive or narrative manner (Lee, 2024). Finally, mixed method research was used as much as 19%, namely 9 articles. Mixed methods combine quantitative and qualitative approaches sequentially to obtain a comprehensive understanding of the core problems in the research (Mufidah et al., 2024).

The results of the analysis of 48 articles found that the readiness of teacher technology in digital learning varies, with several challenges and strengths that need to be considered. Low readiness has been documented in a number of studies that show teachers face various obstacles, such as lack of technical skills, limited access, and low motivation. Many teachers feel less confident in mastering new technologies such as Artificial Intelligent (AI) (Kim & Kwon, 2023), online teaching (Andarwulan et al., 2021; Lukas & Yunus, 2021; Rasmitadila et al., 2020), and blended learning (Archibald et al., 2021; Batac et al., 2021).

The study also shows that teacher technology readiness is moderate among teachers, with the acceptance of technology, but still faces challenges in its implementation. For example, teachers in China have a positive view of technology but have difficulty integrating it in pedagogy (Li, 2022), as well as teachers involved in STEM teaching who need further training (Sulaeman et al., 2022). Some studies also noted moderate readiness associated with mobile learning (Nikolopoulou et al., 2021) and the use of digital tools (Lie et al., 2020; Perifanou et al., 2021; Valtonen et al., 2020), which indicates that teacher technology readiness varies and still needs further support (Almusawi et al., 2021; Caner & Aydin, 2021; Joseph et al., 2021).

Several studies also show a high readiness for the use of technology, especially in terms of mobile technology integration (Asghar et al., 2021; L. Clarke & Abbott, 2016; Looi et al., 2014) and digital learning (Aditya, 2021; Bicer & Capraro, 2017). Teachers who are actively involved in digital learning and have more than 20 years of experience in teaching show a high readiness to integrate technology (Apak et al., 2021), Although some obstacles such as access to information remain. Training programs and institutional support also play a major role in supporting technology readiness among teachers (Chou et al., 2020). Teachers' positive perceptions and attitudes towards technology also play an important role in readiness. Highly motivated teachers (Aditya, 2021), positive perception (Asghar et al., 2021; Ngao et al., 2022; Nikolopoulou et al., 2021; Rashid et al., 2021), optimism and innovation (Joseph et al., 2021) tend to be more ready to adopt technology in learning. Self-efficacy and motivation to learn independently are also very influential in the readiness to use technology effectively in digital learning (Bardach et al., 2021).

These findings can be theoretically interpreted using established technology adoption frameworks. Variations in teachers' readiness reflect the Technology Readiness Index (TRI), which conceptualizes readiness through optimism and innovation as enabling dimensions, and discomfort and

insecurity as inhibiting dimensions (Parasuraman, 2000; Ahmad et al., 2021). Teachers demonstrating high readiness tend to exhibit greater optimism and innovation, whereas low readiness is often associated with anxiety and insecurity toward technology use (Joseph et al., 2021; Lukas & Yunus, 2021).

From a pedagogical perspective, these variations are consistent with the Technological Pedagogical Content Knowledge (TPACK) framework, where teachers with integrated technological, pedagogical, and content knowledge demonstrate higher readiness to implement digital learning meaningfully (Valtonen et al., 2020; Fuad et al., 2020). In addition, the Technology Acceptance Model (TAM) helps explain teachers' adoption behavior, particularly through perceived usefulness and perceived ease of use, which influence attitudes toward technology integration in classrooms (Rienties et al., 2018; Rashid et al., 2021).

The publication trend also indicates a noticeable increase in studies during and after the COVID-19 pandemic, suggesting that teacher technology readiness gained heightened attention following emergency remote teaching (Rasmitadila et al., 2020; Wohlfart & Wagner, 2023). However, this increase does not necessarily imply improved readiness, as several studies report that technology adoption during the pandemic was often driven by necessity rather than pedagogical preparedness (Andarwulan et al., 2021; Lukas & Yunus, 2021).

A comparison across contexts further reveals differences between developing and developed countries. Studies conducted in developing countries frequently emphasize challenges related to infrastructure, access, and basic ICT skills (Rasmitadila et al., 2020; Ngao et al., 2022), whereas studies from developed countries tend to focus on pedagogical integration, advanced digital competencies, and innovation-oriented practices (Valtonen et al., 2018; Clarke & Abbott, 2016). This contrast highlights the contextual nature of technological readiness across educational systems.

**Supporting and inhibiting factors for teachers' technological readiness in digital learning**

Supporting factors for teacher technology readiness include infrastructure support and educational resources (Almusawi et al., 2021; Andarwulan et al., 2021), and adequate accessibility, including internet access and decent devices (Rasmitadila et al., 2020), which plays an important role in facilitating the adoption of technology in the school environment. In addition, flexible policy support (Batac et al., 2021; Park & Son, 2022), collaboration between educators (Sulaeman et al., 2022), goverment (Rasmitadila et al., 2020), and school environment support is indispensable to accelerate technology adoption among teachers (Joseph et al., 2021). The factor of training and development of technological competencies is also one of the key factors (Andarwulan et al., 2021). Technology-based training programs such as blended learning (Krasnova & Shurygin, 2019) and digital platforms (Leacock & Warrican, 2020) has been proven effective in improving teachers' technology skills (Rienties et al., 2018), helping teachers adapt to ever-evolving learning technologies (Bicer & Capraro, 2017).

Factors that hinder teachers face in technology readiness include infrastructure challenges (Almusawi et al., 2021; Rasmitadila et al., 2020), limited internet access hinders widespread use of technology (Andarwulan et al., 2021). In addition, many teachers experience anxiety (Lukas & Yunus, 2021), lack of confidence in using new technologies (Rashid et al., 2021; Wu et al., 2020), and inconveniences that impact teachers' technological readiness (Joseph et al., 2021). Demographic factors such as age, gender, and education level also affect technology readiness (Zyad, 2016; Li et al., 2019; Nikolopoulou et al., 2021; Rodríguez-Muñiz et al., 2021). Senior or poorly trained teachers face more obstacles than younger teachers or those with better training (Joseph et al., 2021).

To strengthen analytical clarity, the supporting and inhibiting factors identified in this review can be categorized into four interrelated levels: individual, institutional, technical, and policy-related factors. At the individual level, teachers' self-efficacy, motivation, and attitudes toward technology significantly influence readiness (Caner & Aydin, 2021; Joseph et al., 2021). Institutional factors include school leadership, professional development, and organizational culture, which shape teachers' opportunities to experiment with and sustain technology use (Pablos et al., 2022; Spiteri & Chang Rundgren, 2020).

Technical factors primarily involve infrastructure availability, internet access, and device adequacy, which remain critical barriers in many educational contexts (Almusawi et al., 2021; Rasmitadila et al., 2020). Policy-related factors encompass curriculum flexibility, government support, and digital education strategies that enable or constrain technology integration at the school level (Batac

et al., 2021; Park & Son, 2022). This categorization demonstrates that teachers' technological readiness is shaped by a dynamic interaction between personal dispositions and systemic conditions rather than by isolated factors.

**Teachers' ability to implement technology in digital learning**

Based on the results of the analysis of 48 articles, it was found that teachers' ability to use technology for distance teaching and learning plays an important role in the success of digital education. Teachers' readiness to implement technology depends on adequate ICT skills to deliver digital content, which often faces challenges in the preparation of online teaching materials (Lukas & Yunus, 2021). Teachers are also increasingly integrating specific technologies such as AI-based Internet of Things (IoT) (Kim & Kwon, 2023), wearable devices, mobile learning (Asghar et al., 2021), and virtual learning environments (VLE) (Rashid et al., 2021), which provides a more interactive and immersive learning experience. However, readiness in this specific technology requires instructional design skills (Looi et al., 2014) and better technological literacy (Alda et al., 2020; Kim & Kwon, 2023). Teachers' cognitive abilities and involvement in the technology-based teaching process are also important, where reflection-based interventions have been shown to improve cognitive readiness so as to support the application of technology tools in the classroom (Bardach et al., 2021; Joseph et al., 2021).

The competencies identified in this review align with international digital competence frameworks such as the European DigCompEdu framework and the UNESCO ICT Competency Framework for Teachers, which emphasize pedagogical integration, digital content creation, assessment practices, and professional engagement alongside technical skills (Alda et al., 2020; Valtonen et al., 2018). The findings suggest that while many teachers possess basic ICT skills, higher level competencies related to instructional design and reflective digital pedagogy remain limited.

These results also raise a critical question regarding the meaning of technological readiness itself. Readiness does not automatically translate into effective instructional competence. Teachers may demonstrate positive attitudes toward technology yet struggle to apply digital tools in pedagogically meaningful ways (Fuad et al., 2020; Bardach et al., 2021). This finding suggests that training alone may be insufficient unless it is sustained, practice-oriented, and embedded within supportive institutional contexts (Bicer & Capraro, 2017; Rienties et al., 2018).

Furthermore, school culture emerges as a key factor influencing technological readiness. Collaborative environments, peer learning, and supportive leadership can significantly enhance teachers' capacity to integrate technology effectively, whereas rigid organizational cultures may hinder innovation regardless of individual readiness levels (Spiteri & Chang Rundgren, 2020; Wohlfart & Wagner, 2023).

## 4. Conclusion

This systematic literature review demonstrates that teachers' technological readiness in digital learning is not uniform but exists along a continuum ranging from low to high readiness. Differences in readiness are shaped not only by teachers' technical skills but also by psychological factors, pedagogical competence, institutional support, and broader policy contexts. While some teachers exhibit high readiness supported by experience, professional development, and positive attitudes toward technology, others continue to struggle due to limited infrastructure, low confidence, and insufficient pedagogical integration of digital tools. The findings indicate that technological readiness should not be interpreted merely as access to technology or willingness to use digital tools. Rather, readiness reflects teachers' ability to integrate technology meaningfully into instructional design and classroom practice. This distinction is critical, as increased technology adoption does not automatically translate into improved teaching quality or learning outcomes. From a practical perspective, the results have several implications. For policymakers, strengthening teachers' technological readiness requires policies that go beyond infrastructure provision by ensuring equitable access, sustained funding, and coherent digital education strategies. For schools, leadership and organizational culture play a central role in fostering collaborative environments, continuous professional learning, and reflective technology use. For teachers, professional development should emphasize pedagogical integration, instructional design, and reflective practice rather than focusing solely on technical skills. This review also highlights important directions for future research. First, more empirical studies are needed to examine the gap between perceived technological readiness and actual classroom practices. Second, longitudinal research could

provide deeper insights into how teachers' readiness evolves over time, particularly in post-pandemic contexts. Third, future studies should explore the role of school culture, leadership, and contextual factors in shaping sustainable technology integration. Finally, comparative studies across regions and educational systems would contribute to a more nuanced understanding of how technological readiness is influenced by socio-cultural and policy environments. Improving teachers' technological readiness in digital learning requires an integrated approach that combines individual competency development, institutional support, and coherent policy frameworks. Addressing these dimensions holistically is essential to ensure that digital learning initiatives lead to meaningful and sustainable improvements in educational practice.

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