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The Effect of Teachers' Digital Competence and the use of Digital-Based Learning Media on The Effectiveness of Learning in The Classroom

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Abstract

This research is motivated by the phenomenon of increasing use of technology in education that has not been balanced with teachers' digital competence and optimal use of digital learning media. The purpose of this study is to determine the effect of teachers' digital competence (X1) and the use of digital-based learning media (X2) on the effectiveness of classroom learning (Y). This study uses a quantitative approach with a survey method and data analysis through multiple linear regression. The population in this study were teachers at the elementary school level, with a sampling technique using purposive sampling. The results show that teachers' digital competence (X1) has a significant effect on learning effectiveness (Y), while the use of digital-based learning media (X2) has no significant effect on learning effectiveness. These findings demonstrate the importance of improving teachers' digital competence as a major factor in supporting the effectiveness of classroom learning, rather than relying solely on the use of digital media.

Keywords: Digital Competence; Digital Learning Media; Learning Effectiveness.

Introduction

In the era of the Industrial Revolution 4.0, the education sector is experiencing an acceleration of transformation through the integration of digital technology in the teaching and learning process which makes conventional methods no longer sufficient; Educators are required to master Information and Communication Technology (ICT) in depth so that learning becomes more effective, inclusive, and adaptive. In Indonesia, these changes encourage curriculum development and improvement of digital infrastructure in schools, introducing the implementation of the Internet of Things (IoT), Artificial Intelligence (AI), elearning, and cloud computing that support wider access to education and a more personalized and interactive learning process (Fitrianti, Annur, & Afrriantoni, 2024). International studies also confirm that educators' digital competencies including technology literacy, digital pedagogy, and content management are the main prerequisites for producing engaging and impactful learning experiences, as well as ensuring the fit between tasks and technology (tasktechnology fit) in learning platforms such as Moodle. This digital transformation not only improves administrative efficiency, but also enables flexible, collaborative, and data-driven network-based learning to address global challenges and prepare learners for the dynamics of the future

Since the pandemic COVID19 hit in early 2020, all levels of education in Indonesia have been forced to adopt online learning as an emergency solution, which then transitions into a permanent habit in the education ecosystem; The implementation of the "Learning from Home" program through TVRI, Quota Assistance, and digital platforms such as Merdeka Learning and the Merdeka Curriculum has received great support from the government, but it is also faced with challenges of infrastructure, teacher capacity, and student accessibility. Although the emergency conditions have subsided, the culture of using digital media in learning continues to develop consistently, along with efforts to strengthen teacher competencies and the use of mobile learning, elearning, and blended learning platforms to increase learning effectiveness, accessibility, and interactivity. The Freedom of Learning Policy, followed by the transformation of the school's digital system, demonstrates the government's innovative push to digitize education services in a sustainable manner, strengthening the foundation of technology and digital pedagogy, although infrastructure disparities between regions remain a major obstacle (Saputro, Chauhan, Waliyansyah, & Novita, 2022).

Although the digitalization of education in Indonesia continues to grow, there are still many obstacles faced in education units, especially at the elementary school level, where the digital competence of teachers is not evenly distributed; Research shows that many teachers still have difficulty in using and managing digital devices and applications optimally, because their understanding of technology is limited and the adoption of digital media is still carried out in a hurry without a strategy that is integrated with learning objectives (Silvester, Purnasari, Saputro, & Jesica, 2023). In line with national findings Inspiration, the implementation of digital literacy that is not sustainable causes low motivation and ability of teachers to design digital learning creatively and effectively, which actually hinders the potential for learning innovation in the future(Rachman et al., 2025).

An international metareview by Brugliera (2024) revealed that the effectiveness of digital platforms is highly dependent on teacher readiness, the quality of pedagogical integration, and the suitability of technology with learning needs; Without these factors, the improvement in learning outcomes does not occur even though technology is

available(Brugliera, 2024). In Indonesia, research by Wardana et al. (2022) found that digital media is often only used to attract students' attention, but is less used to encourage competency achievement due to the lack of systematic digital pedagogical training and strategies. These factors show that the presence of digital media alone is not enough; The success of learning depends on how the media is integrated into learning planning and evaluation so that it truly contributes to the achievement of student competencies (Wardana, Rulyansah, Izzuddin, & Nuriyanti, 2022).

A landmark study by Hizam et al. (2021) used SEM analysis and found that technology literacy and Task–Technology Fit (TTF) affect Moodle usage and teacher performance (Hizam, Akter, Sentosa, & Ahmed, 2021). The lack of studies that apply regression analysis or explanatory methods to test the direct relationship between teachers' digital competence, digital media use, and learning effectiveness in elementary schools shows a research gap. Therefore, measurable quantitative research such as multiple regression is needed to answer these gaps empirically and make methodological and practical contributions in the field.

Furthermore, most of the research so far has only highlighted the impact of the use of digital media in learning without examining the readiness and competence of teachers as the main users of the technology. In fact, the effectiveness of digital learning is greatly influenced by teachers' ability to plan, choose, manage, and evaluate the use of technology pedagogically (Sulistyarini & Fatonah, 2022). Empirical studies show that the existence of technology alone is not enough; Teachers with high digital literacy and good pedagogic competence result in more effective learning (Ebyatiswara Putra, Taufiqur Rohman, Linawati, & Hidayat, 2023). In addition, research in Saudi Arabia also noted that teachers' positive perceptions of technology and its use play a significant role in shaping their digital competencies (Althubyani, 2024). Therefore, it is important to conduct a comprehensive study that examines the simultaneous influence between teachers' digital competence and the use of digital media on learning effectiveness, in order to encourage more appropriate and adequate professional development strategies.

In an effort to strengthen the understanding of the relationship between teachers' digital competencies and the use of digital-based learning media on learning effectiveness, this study uses a quantitative approach with multiple regression analysis to measure the simultaneous and partial influence of the two variables on student learning outcomes. The results of the study from the Basicedu Journal show that teachers' digital literacy has a significant effect of 47.6% on learning outcomes, while the digital learning environment contributes an additional 4.9%, and together explains 88.6% of variance in learning outcomes (Yuliana, Nirmala, & Ardiasih, 2023). longitudinal research in the journal Sustainability in 2025 reported a significant increase in teachers' digital competence during the COVID19 pandemic, which correlated positively with student learning achievement (Ivanov et al., 2025). These findings underscore the need for a comprehensive study examining the combined influence of teachers' digital competencies and the use of digital media on learning effectiveness as the basis for professional development policies and investment in digital education supporting infrastructure.

Thus, this research is not only relevant in answering the actual problems faced by educators in the field, but also contributes to the development of scientific studies in the field of educational technology. The results of this research are expected to be a reference in optimizing the role of teachers as learning facilitators in the digital era, with competencies and media that support each other for the creation of an effective and meaningful learning process

Methodology

This study uses a quantitative approach with the type of explanatory research, which aims to determine the influence between two independent variables, namely teachers' digital competence and the use of digital-based learning media, on the dependent variable, namely the effectiveness of learning in the classroom. The quantitative approach was chosen because it allows researchers to measure the relationships between variables objectively and measurably using statistically analyzed numerical data. The population in this study is all elementary school teachers who are actively teaching in the current semester in one of the districts/cities. The sample used in this study amounted to 53 teachers, which was determined through saturated sampling techniques, because the entire available population

was considered to be sufficiently representative of the characteristics of the overall population. The sample selection was carried out directly by paying attention to the involvement of teachers in learning activities that integrate the use of digital media.

Data collection was carried out using an instrument in the form of a closed questionnaire which was compiled based on indicators from each research variable. This questionnaire uses a Likert scale with four answer choices, namely: strongly disagree, disagree, agree, and strongly agree. The validity and reliability of the instruments were first tested through limited trials before being disseminated to the main study respondents. Data analysis was carried out using multiple linear regression analysis techniques. This technique is used to determine how much influence teachers' digital competence (X_1) and the use of digital-based learning media (X_2) simultaneously or partially affect the effectiveness of learning in the classroom (Y). Before the regression analysis is carried out, an analysis prerequisite test is first carried out which includes the normality test, the multicollinearity test, and the heteroscedasticity test to ensure that the data meets the basic assumptions in the regression. After that, regression testing was carried out to obtain the value of the determination coefficient (R^2), significance value, and regression coefficient of each independent variable. The entire data processing process is carried out with the help of the latest version of SPSS software. The results of this analysis are used to draw conclusions about the causal relationship between the variables studied and provide practical implications for strategies to improve the quality of digital learning in the classroom.

Results

The results of this study show that both teachers' digital competence and the use of digital-based learning media have a positive influence on the effectiveness of learning in the classroom. From the results of multiple linear regression analysis conducted on 53 elementary school teacher respondents, a determination coefficient value (R^2) of 0.428 was obtained, which means that the two independent variables were able to explain 42.8% of the variation in learning effectiveness, while the rest was influenced by other factors outside the model. These findings show that digital competence and utilization cannot be ignored in designing strategies to improve the quality of learning.

Partially, teachers' digital competence makes a significant contribution to learning effectiveness. This is in line with the results of research by Hizam et al. (2021) which underlines the importance of digital literacy, professional skills, and teachers' presentation skills in supporting academic performance through *Task-technology fit* (Hizam et al., 2021). Teachers with high digital competence tend to be more adaptive to technological developments, able to operate a Learning Management System (LMS), and create learning content that suits the needs of students.

The use of digital-based learning media has a not significant effect on the effectiveness of learning in the classroom. The results of the t-test showed that digital media was not able to increase students' motivation and involvement in the learning process. Research by Wardana et al. (2022) even confirms that digital media is able to support the development of students' life skills, including in the academic, social, and vocational realms, after the Covid-19 pandemic (Wardana et al., 2022). These findings strengthen the argument that learning media is not only a tool, but also a bridge between teaching materials and the real world that is more contextual.

The two variables in this study interact synergistically with each other. Teachers who have digital competence tend to be more optimal in exploring and integrating digital learning media into the teaching and learning process. Research by Silvester et al. (2023) shows that teachers' low ability to use digital applications and devices is one of the dominant causes of the use of conventional methods in the classroom (Silvester et al., 2023). Therefore, improving teachers' digital competence will encourage the use of more varied and innovative media.

One of the important notes of the results of this study is that there is a competency gap between younger and more senior teachers. Younger teachers tend to adapt to technology more quickly because they are used to interacting with digital devices in their daily lives. This is in line with the study of Tika Puspita et al. (2025) which shows that digital literacy training and assistance for elementary school teachers provides a significant increase in learning planning and implementation (Rachman et al., 2025). However, the

training must be continuous so that it does not stop only at the use of tools, but develops on content creation and digital pedagogical thinking.

The results of field observations and respondents' responses also show that learning effectiveness increases when the digital media used is interactive and contextual. Media such as learning videos, digital quizzes, and interactive animations are more engaging and make it easier to understand abstract concepts. Research by Ning Yulin and Danso (2024) also found that positive perceptions of digital media and pedagogical readiness are the main keys in the process of integrating technology in learning (Yulin & Danso, 2025).

However, the effectiveness of learning is also affected by the availability of infrastructure. Some respondents stated that limited internet access and digital devices are the main obstacles in integrating technology into learning. Therefore, institutional support and inclusive education policies are important factors in supporting the digital transformation process in the elementary school environment. As revealed by Putra et al. (2023), digitalization is not enough only at the teacher level, but must be supported by an adequate ecosystem (Ebyatiswara Putra et al., 2023).

The implications of these findings suggest that the professional development of teachers in the form of digital training should be designed not only oriented to the technical aspect, but also to pay attention to the pedagogic dimension. Successful training is training that is able to change the mindset of teachers in utilizing technology not just as a tool, but as an integral part of a student-centered learning strategy. The training curriculum must be aligned with the needs of the field and complemented by ongoing mentoring.

These findings also make a theoretical contribution in strengthening the model of the relationship between individual competence, technology utilization, and learning outcomes. Models *Task-technology fit* as stated by Goodhue and Thompson proves relevant to explain how the fit between teaching tasks and the technology used, as well as the role of individual characteristics such as digital literacy as an intermediate factor in improving teacher performance (Hizam et al., 2021).

Overall, this study emphasizes that the effectiveness of learning in the digital era cannot be separated from the quality of teachers' digital competencies and their ability to utilize digital-based learning media. Both support and strengthen each other in creating a more participatory, fun, and meaningful learning process. Therefore, improving the quality of teachers through digital training and the provision of appropriate digital learning media is a strategic step to encourage the creation of effective learning in the classroom.

Discussion

The rapid development of information and communication technology in the era of the Industrial Revolution 4.0 has encouraged the education sector to transform towards digital learning that is adaptive and responsive to the needs of the 21st century. In the midst of this unstoppable flow of digitalization, teachers are required not only as facilitators, but also as the main actors in integrating technology into the learning process. Teachers' digital literacy and competence are fundamental prerequisites in creating an effective learning environment that is relevant to the characteristics of digital native students. However, the reality on the ground shows that most teachers, especially at the primary education level, still face various obstacles in terms of mastery of digital learning devices and media. Rachman et al.'s (2025) research, for example, highlights the weakness of teachers' digital literacy in designing innovative learning, as well as the low level of technology integration in daily teaching practices (Rachman et al., 2025).

On the other hand, the results of a study by Silvester et al. (2023) corroborate these findings by emphasizing that many teachers still depend on conventional learning media and are less able to make optimal use of digital devices and applications (Silvester et al., 2023). Inadequate digital competencies have direct implications for the low effectiveness of digital-based learning, which is ideally able to increase student interaction, understanding, and motivation. This situation is exacerbated by the lack of ongoing training and low institutional support, which has an impact on the gap between digital-based pedagogical demands and factual readiness in the field (Yulin & Danso, 2025).

Conceptually, various previous studies have discussed the importance of digital literacy and technology-based learning media. For example, a study by Hizam et al. (2021)

used the Task-Technology Fit (TTF) approach and showed that teachers' digital competencies significantly affected the use of digital platforms such as Moodle and had a positive impact on the performance of teaching tasks (Hizam et al., 2021). However, the focus of the research is still limited to the context of higher education, while at the basic education level, similar research is still rare, especially those that integrate the two main variables of digital competence and the simultaneous use of digital learning media in measuring the effectiveness of learning in the classroom.

In addition, research from Putra et al. (2023) found a positive correlation between digital literacy and teachers' pedagogic competence, but has not explained how this interaction affects learning outcomes such as the effectiveness of learning as a whole (Ebyatiswara Putra et al., 2023). Some studies also tend to focus on one-dimensional evaluations, for example, only the competence of teachers or only the type of media used, without paying attention to the synergy between the two. In other words, there is a significant research gap in seeing how the integration between teachers' digital competency levels and the practice of using digital media simultaneously can affect the effectiveness of learning in the classroom.

Based on this mapping, this research is here to fill the existing scientific gap (research gap), by focusing on the direct and simultaneous influence of teachers' digital competence and the use of digital-based learning media on the effectiveness of learning in the classroom. This research will not only enrich academic discourse in the field of educational technology, but also provide practical implications for teacher professional development and the design of digital learning policies in the future.

Conclusion

Based on the results of the analysis and research findings, it can be concluded that teachers' digital competence has a significant influence on the effectiveness of learning in the classroom. Teachers who have the ability to access, manage, and utilize digital technology appropriately have proven to be able to create a more interactive, adaptive, and meaningful learning atmosphere for students. On the other hand, the use of digital-based learning media in this study showed a not significant influence on learning effectiveness. This indicates

that the success of digital learning is not only determined by the availability of media, but rather by the competence of teachers in designing and implementing the media pedagogically according to the needs of students.

Seeing these results, it is suggested that improving the quality of learning in the digital era be more focused on developing teachers' digital competencies in a comprehensive and sustainable manner. The training and mentoring carried out is not enough to only introduce the types of digital media, but must also equip teachers with a deep understanding of digital pedagogics, including how to choose, design, and evaluate learning media according to student characteristics and learning goals. In addition, schools and policy makers need to provide conducive support both in terms of infrastructure and regulations so that digital transformation in education can run optimally and have a real impact on increasing the effectiveness of learning in the classroom.

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Declaration of Interest Statement

The authors declare that there is no conflict of interest regarding the publication of this study.

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