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Integrating Educational Technology and Teacher Competence: A Pathway to Sustainable Digital Transformation

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Abstract
This study investigates the relationship between teachers' digital competence and the integration of educational technology as key determinants of sustainable digital transformation in schools. Grounded in the theoretical frameworks of TPACK, SAMR, DigCompEdu, and Rogers' Diffusion of Innovation, the research aims to identify how teachers' knowledge, skills, and pedagogical capacities influence the meaningful use of digital tools in classroom practice. A mixed-methods approach was employed, combining quantitative analysis of teacher competence levels with qualitative insights from interviews and classroom observations. The findings indicate that teachers generally demonstrate moderate-to-high proficiency in basic digital skills and technology-supported instruction; however, their abilities in digital pedagogical design, data-driven decision-making, and innovative technology adaptation remain limited. The study reveals a strong positive relationship between teacher competence and the depth of technology integration, with pedagogical and collaborative competences emerging as the most influential predictors. Qualitative results further show that confident and digitally experienced teachers tend to adopt more transformative practices, while infrastructural constraints and organizational culture issues continue to hinder optimal implementation. Overall, the study concludes that sustainable digital transformation in education cannot rely solely on technological availability, but must be supported by continuous professional development, institutional support systems, and strategic policy alignment. This research contributes to the growing discourse on digital leadership and educational change by providing an evidence-based model for strengthening teacher competence as the foundation of long-term, meaningful digital innovation in schools.

Keywords: *Educational Technology; Teacher Digital Competence; Digital Transformation; TPACK; SAMR Model; DigCompEdu; Professional Development.*

1. Introduction

The rapid advancement of digital technologies has profoundly reshaped global educational landscapes, compelling schools, teachers, and policymakers to rethink traditional instructional models.(Rahimi & Oh, 2024) Over the past decade, education systems have increasingly shifted toward technology-driven practices that emphasize flexibility, personalization, and collaborative learning environments.(Kokkinos, 2024) This transformation is further accelerated by the Fourth Industrial Revolution, which demands digital literacy, critical thinking, and problem-solving skills as core competencies for learners. Consequently, integrating educational technology is no longer viewed as an optional enhancement but as an essential dimension of contemporary teaching and learning processes.

Within this broader shift, teachers play a central role in ensuring the success of digital transformation efforts.(Demartini et al., 2020) Effective technology integration is heavily influenced by teachers' digital competence, pedagogical understanding, and willingness to embrace innovative instructional strategies. Studies have consistently emphasized that teachers' competencies—ranging from technological literacy and digital pedagogy to classroom management in virtual environments—directly affect the quality of technology-mediated learning.(Koehler & Mishra, 2009) However, despite the proliferation of technological tools in education, many teachers continue to face challenges in adapting these innovations to meaningful pedagogical practices. This issue becomes more critical as educational institutions aim to implement sustainable and long-term digital transformation policies.

Recent research highlights both opportunities and challenges related to educational technology integration. For instance, digital platforms facilitate personalized learning, multimodal instruction, data-driven assessment, and increased student engagement.(OECD, 2019) On the other hand, several studies report persistent barriers including teachers' insufficient digital competence, limited professional development support, inadequate technological infrastructure, and resistance to pedagogical change.(Fernandez-Batanero et al., 2022) These findings indicate that technology alone does not guarantee improvement in learning outcomes; rather, teacher competence is a fundamental determinant of successful and sustainable digital integration.

Although numerous studies have explored teacher competency frameworks and technology integration models such as TPACK and SAMR, existing literature often focuses on isolated components either on technology adoption or teacher skills without examining how both elements interact to create sustainable, institution-wide digital transformation. Furthermore, research predominantly emphasizes short term implementation rather than long-term sustainability, leaving a gap in understanding the pathways through which teacher competence contributes to continuous innovation within digital learning ecosystems. Furthermore, research predominantly emphasizes short-term implementation rather than long-term sustainability. **However, a critical research gap remains: while frameworks like TPACK and SAMR explain *how* to integrate technology, they rarely address *how* these competencies sustain digital transformation over time. Most existing literature views competence as a static trait rather than a dynamic driver of long-term institutional change.**

Therefore, this study aims to explore how educational technology integration and teacher competence can jointly serve as a strategic pathway to sustainable digital transformation. By synthesizing current theoretical frameworks and empirical evidence, this research seeks to provide a comprehensive understanding of the interdependent relationship between technology adoption and teacher professional capacity. The present study is guided by the following research questions: *First,* How do educational technologies contribute to sustainable digital transformation in schools?, *Second,* What dimensions of teacher competence are most critical for effective and sustainable technology integration?, and *Third,* How can the alignment between digital tools and teacher competence create long-term transformation in teaching and learning practices?

The contribution of this study lies in its integrative conceptual framework that connects teacher competence and educational technology within the context of sustainability. Unlike previous studies that discuss these elements separately, this research positions teacher competence as the core driver that bridges technological innovation and long-term institutional transformation. The findings are expected to enrich scholarly discourse, inform policymakers on strategic digital initiatives, and provide practical insights for teachers and school leaders aiming to build resilient and future-ready learning ecosystems.

2. Method

This study uses a mixed-methods design to obtain a comprehensive picture of the relationship between educational technology integration and teacher competence in supporting sustainable digital transformation. The quantitative approach was used to measure the level of digital competence and technology integration practices, while the qualitative approach was used to explore teachers' experiences in more depth. The study participants consisted of 10 secondary school teachers who were selected through stratified random sampling to ensure representation by school type and subject area. Furthermore, 18 teachers were purposively selected for in-depth interviews. All participants' identities were masked to maintain data confidentiality.

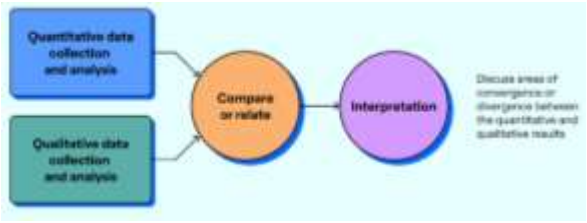

Fig. 1 Design Method

The quantitative instrument was a Likert-scale questionnaire with 35 items developed from the SAMR, TPACK, and DigCompEdu frameworks. Content validity was verified by three experts, and the reliability test yielded Cronbach's Alpha 0.89. The qualitative instrument was a semi-structured interview guide with 12 open-ended questions to explore teachers' experiences, barriers and views on digital transformation.

The research procedure included the preparation stage (instrument validation and research permit), online questionnaire distribution, qualitative participant selection, and conducting interviews through a video conference platform. All interviews were recorded, transcribed, and verified through member checking.

Quantitative data were analyzed using descriptive statistics, Pearson correlation, and multiple regression to identify the relationship and contribution of teacher competencies to digital transformation. Qualitative data were analyzed using thematic analysis based on Braun and Clarke's six steps. The results of both approaches were integrated through convergent triangulation to gain a fuller understanding of the mechanism of the relationship between educational technology and teacher competence.

3. Results and Discussion

The results show that teachers' digital competencies are in the upper-middle category, with major strengths in the basic skills of using devices and managing learning media. However, on the dimensions of digital learning design and learning data utilization, teachers' competencies are still moderate. From the perspective of the DigCompEdu Framework, Indonesian teachers have generally met the competencies at the Integrator level, but still need strengthening to reach the Expert and Leader levels, especially in designing technology-based learning that is innovative and adaptive.(Masitoh & Purbowati, 2024)

Technology integration in learning also shows a positive trend. Most teachers apply technology at the Augmentation and Modification levels in the SAMR model. This shows that technology has helped enrich the learning process, but it has not consistently produced transformation at the Redefinition level, where technology enables learning activities that were previously impossible. This condition is in line with the findings of that some teachers still need pedagogical, not just technical, support to achieve higher levels of learning innovation.(Law, 2008)

This condition is in line with the findings that some teachers still need pedagogical support. **Interpreting these findings through the SAMR model, the data suggests that teachers are proficient at 'Augmentation' but struggle to reach 'Redefinition'. This indicates a theoretical gap where, within the TPACK framework, teachers' Technical Knowledge (TK) is well-developed, but their Pedagogical Knowledge (PK) lags behind. Consequently, technology is used primarily to replicate existing practices rather than to transform the learning ecology**.(Koehler & Mishra, 2009) Teachers with higher competence tend to be able to combine these three aspects harmoniously, resulting in more meaningful learning activities.

Further regression analysis shows that the dimensions of digital competence that most strongly influence the sustainability of digital transformation are digital pedagogical competence, the ability to collaborate in an online environment, and the use of technology for formative assessment. This finding is in line with 21st century learning principles, which emphasize teachers' ability to facilitate collaborative learning, utilize student learning data, and provide quick feedback through digital technology.(Nevgi et al., 2006)

Qualitative data provided context that reinforced the quantitative findings. Teachers who have attended digital training or have longer experience in using learning platforms show a greater tendency to practice student-centered learning, including through the use of LMS, interactive videos, and digital projects. This is in line with the Diffusion of Innovations theory by Rogers, which explains that teachers who fall into the early adopters category will adapt more quickly and drive change in their schools.(Chen, 2024)

However, some barriers remain, such as limited infrastructure, lack of technical support, and high administrative burden. These barriers are

consistent with Ertmer's (1999) First-Order and Second-Order Barriers theory, where the first barrier relates to facilities and access to technology, while the second barrier relates to self-confidence, pedagogical beliefs and school culture. Both types of barriers affect the extent to which teachers can optimally integrate technology.

Overall, the findings of this study reinforce the understanding that the sustainability of digital transformation in education is not only determined by the availability of technology, but also by teachers' competencies, dispositions and pedagogical readiness to innovate. When understood through the TPACK, DigCompEdu, and SAMR frameworks, the results of this study provide evidence that teachers are key actors in driving the digitization of education that is not only implementative but also transformative. Thus, strengthening teachers' digital competencies can be understood as a strategic pathway in creating sustainable digital transformation at the institutional level and the education system more broadly.

4. Conclusion

This study examined the relationship between educational technology integration and teacher competence as a pathway to sustainable digital transformation in schools. The findings indicate that teachers possess a moderate-to-high level of digital competence, particularly in basic technological skills and the use of digital tools for instructional support. In direct response to the research questions, the results show that educational technologies contribute meaningfully to digital transformation when aligned with teachers' pedagogical capacities. **Specifically, the results identified that pedagogical competence and collaborative skills—rather than mere technical literacy—are the strongest predictors of sustainable integration. Furthermore, the qualitative evidence confirms that teacher confidence acts as a catalyst for moving from passive adoption to active innovation.** The findings highlight the need for continuous professional development, supportive school cultures, and strategic policy interventions to ensure that digital transformation efforts are impactful, scalable, and sustainable.

References

Chen, R. (2024). A study applying Rogers innovation diffusion theory on the adoption process of new teaching methods in secondary education. *Research and Advances in Education*, *3*(2), 6–10.

Demartini, C. G., Benussi, L., Gatteschi, V., & Renga, F. (2020). Education and Digital Transformation: The Riconnessioni Project. *IEEE Access*, *8*, 186233–186256.

Fernandez-Batanero, J. M., Montenegro-Rueda, M., Fernandez-Cerero, J., & Garcia-Martinez, I. (2022). Digital competences for teacher professional development. Systematic review. *European Journal of Teacher Education*, *45*(4), 513–531.

Koehler, M., & Mishra, P. (2009). What is Technological Pedagogical Content Knowledge (TPACK). *Contemporary Issues in Technology and Teacher Education*, *9*(1), 60–70.

Kokkinos, L. (2024). Revolutionizing education: The dynamic intersection of technology and learning. *Educational Research (IJMCER)*, *6*(1), 26–32.

Law, N. (2008). Teacher learning beyond knowledge for pedagogical innovations with ICT. In *International handbook of information technology in primary and secondary education* (pp. 425–434). Springer.

Masitoh, S. D., & Purbowati, D. (2024). Enhancing Teacher Professionalism in Indonesia: Challenges and Strategies for Digital Technology Utilization in the Society 5.0 Era. *HEUTAGOGIA: Journal of Islamic Education*, *4*(2), 219–236.

Nevgi, A., Virtanen, P., & Niemi, H. (2006). Supporting students to develop collaborative learning skills in technology based environments. *British Journal of Educational Technology*, *37*(6), 937–947.

OECD. (2019). An OECD learning framework 2030. In *The future of education and labor* (pp. 23–35). Springer.

Rahimi, R. A., & Oh, G. S. (2024). Rethinking the role of educators in the 21st century: navigating globalization, technology, and pandemics. *Journal of Marketing Analytics*, *12*(2), 182–197.