

Analysis of Teachers' Digital Competencies on the Quality of Learning in Elementary Schools in Jaken Sub-district, Pati Regency

Dwiati, A.¹, Utaminingsih, S.¹, & Chamid, A. A.¹

¹Muria Kudus University
Kudus Regency, Jawa Tengah 59327, INDONESIA

*Corresponding Author: anies.dwiati@gmail.com

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Abstract: This study aims to analyze the influence of understanding ICT policies in education, digital literacy, and digital pedagogical skills on the quality of learning in elementary schools in Jaken sub-district, Pati district. The research approach used was quantitative with survey method, involving 148 teachers selected through purposive sampling technique. Data collection was conducted using a closed questionnaire with a five-level Likert scale, which was then analyzed using Structural Equation Modeling (SEM) with AMOS 24 software. The results showed that understanding ICT policy has a significant influence on learning quality with a CR value of 2.211 > 1.967 and $P 0.027 < 0.05$, although smaller than the other two variables. Digital literacy has a stronger influence with a CR value of 6.913 > 1.967 and $P 0.001 < 0.05$, indicating that teachers' mastery of digital literacy can improve learning effectiveness. Meanwhile, digital pedagogical skills have the most dominant influence on learning quality with a CR value of 6.844 > 1.967 and $P 0.001 < 0.05$. These results confirm that improving teachers' digital competencies, especially in digital literacy and technology-based pedagogical skills, is crucial in creating more interactive and innovative learning. Therefore, this study recommends increasing digital training for teachers, providing adequate technology facilities, and strengthening education policies that support digital transformation in learning.

Keywords: Teacher digital competence, information and communication technology, digital literacy, digital pedagogical skills, learning quality.

1. Introduction

The development of information and communication technology (ICT) in the digital era has significantly changed the world of education. The integration of technology in learning allows wider access to learning resources, creates a more interactive experience, and improves the quality of learning (Szymkowiak et al., 2021; Rachmi et al., 2024). The first grand theory relevant in this context is Constructivism Theory, proposed by Piaget and Vygotsky, which emphasizes that students construct their understanding through interaction with the environment and technology can be an effective means in this process. In addition, Siemens and Downes' Connectivism Theory is also relevant, which states that learning in the digital age occurs through technology-based networking and collaboration. Therefore, flexible and comprehensive educational reforms are needed to accommodate these changes (Liao et al., 2020). Education in the digital era refers to a learning process that integrates digital technology intensively, to support and facilitate teaching and learning activities (Ebyatiswara Putra et al., 2023).

The role of teachers is a key factor in ensuring the success of technology integration in education. Teachers are no longer just information deliverers, but also facilitators who help students develop digital skills relevant to the age of digitalization (Rahayuningsih & Muhtar, 2022). The third grand theory, Technological Pedagogical Content Knowledge (TPACK) introduced by Mishra & Koehler, explains that effective teaching requires a balance between technology, pedagogy and content. In addition, Digital Literacy Theory asserts that teachers need to have digital literacy to be able to guide students in understanding, assessing, and using digital information effectively (Ngongo et al., 2022). However, many teachers still experience a digital divide with students, which can cause an imbalance in the learning process (Latif, 2020). Teachers are required to have digital competencies with optimal mastery to keep up with digital students with various characteristics (Sitompul, 2022; Syahid et al., 2022).

The challenge of improving teachers' digital competencies remains a major issue in education, particularly at the primary school level. Barriers such as lack of training, limited access to technology and low motivation hinder the integration of ICT in learning (Hibana & Surahman, 2021). The fifth relevant grand theory is Rogers' Innovation Diffusion Theory, which explains how individuals or groups adopt innovations, in this case technology in education. To overcome these challenges, a strategy to develop teacher competencies through training, collaboration between educators, and support from the government and educational institutions is needed (Setiawati et al., 2023). Teachers must respond with changes to adapt themselves in order to support the use of technology that students are interested in (von Gillern et al., 2024). With this approach, teachers can be better prepared for the digital era and improve the quality of learning that suits the needs of students in the 21st century.

1.1 Conceptual framework

The In improving the quality of learning in the digital era, Constructive Alignment Theory-based approach becomes the main foundation in designing effective learning strategies. The alignment between learning objectives, methods and evaluation should be integrated with constructivism theory, which emphasizes the active role of students in building their own understanding through experience and reflection. Alignment between learning objectives, teaching methods, and evaluation to create an effective learning experience (Biggs et al., 2019). Technology-based learning can be systematically designed to support optimal student engagement. The implementation of the industrial revolution 4.0 requires new skills so that the preparation of human resources who are competent with technological developments is a non-negotiable demand (Maryanti et al., 2020; Mia & Sulastri, 2023; Sopandi, 2019). The use of Information and Communication Technology (ICT) in the teaching and learning process has led to new ways and models of learning for teachers (Junaedy Abu Huraerah et al., 2024). ICT improves access to educational resources, enabling personalized learning experiences and increased interactivity (Efendi & Zulhendra, 2024; Retta et al., 2024; Tavares et al., 2024). This is reinforced by Ratheeswari, (2018) who states that the influence of ICT in schools is more pronounced and more tangible and broader.

In the context of improving teacher skills, the *UNESCO ICT Competency Framework for Teachers : Version 3, (2018)* emphasizes the importance of digital competencies for educators in designing more innovative learning experiences. Teachers need to understand ICT policies and apply them in digital-based learning strategies. The importance of teachers' digital competencies in improving the quality of learning through technology integration. According to Bitegeko et al., (2024), UNESCO's ICT Competency Framework for Teachers (ICT-CFT) based approach can improve the quality of learning through more effective, systematic, and sustainable use of technology. Through this framework, teachers can develop digital skills, integrate technology in lesson planning and implementation, and create learning experiences that are more interactive, innovative and in line with 21st century needs. Thus, the development of innovative and technology-based learning strategies must continue to ensure a more meaningful learning experience for learners. Schunk, (2020) added that the quality of learning can be measured through student engagement, relevant methods, and technology utilization.

The successful implementation of this strategy is strongly influenced by leadership factors in education. Principals and teachers as learning leaders have a strategic role in creating an innovative, interactive and adaptive learning environment. The quality of learning depends not only on how the teacher delivers the material, but also on how students build their understanding through interaction and reflection in the learning process (Biggs, 2003; Ghufron & Hardiyanto, 2017). This is in accordance with (Fatima et al., 2023; Papanthymou & Darra, 2023) who explained that the quality of primary school learning is influenced by factors such as qualified teachers, effective curriculum, class size, teacher-student ratio and community involvement. Continuous professional development for teachers is essential to improve their teaching skills and enhance educational outcomes. By integrating leadership principles oriented towards teacher professional development, schools can ensure that digital-based learning strategies run effectively and sustainably.

1.2 Research objectives

The purpose of this research is to analyze the effect of understanding ICT policy in education, digital literacy, and digital pedagogical skills on learning quality in primary schools in Jaken sub-district, Pati district. This study aims to determine the extent to which teachers' digital competencies contribute to improving the effectiveness of the learning process, as well as provide recommendations for the development of technology-based learning strategies to improve the quality of basic education in the age of digitalization.

2. Method

2.1 Research design

This study employs a quantitative approach with a survey research design to analyze the causal relationships between the primary variables. Specifically, the research aims to explain how the understanding of ICT policy (X_1), digital literacy

(X₂), and digital pedagogical skills (X₃), acting as independent variables, influence the quality of learning (Y), which serves as the dependent variable.

2.2 Respondents of the study

The respondents were 148 primary school teachers in Jaken sub-district, Pati district, who were selected through purposive sampling technique. Data was collected using a closed questionnaire with a five-level Likert scale. Data were collected using a closed questionnaire with a five-level Likert scale. To ensure the validity and reliability of the instrument, validity test and reliability test were conducted before data analysis. Data analysis using Structural Equation Modeling (SEM) with AMOS 24 software, which begins with confirmatory factor analysis (CFA) of exogenous and endogenous variables, followed by the preparation of measurement models and structural models until a fit model is obtained.

2.3 Research Procedures

The research process followed a systematic five-phase sequence to ensure the integrity of the data and the validity of the conclusions. During the initial preparation phase, research instruments were developed based on theoretical indicators for each latent variable, followed by content validation from experts. A subsequent pilot study phase involved testing the instrument on 30 teachers outside the primary sample to evaluate reliability through Cronbach’s Alpha and ensure construct validity. In the data collection phase, the finalized questionnaire was distributed digitally to the target sample in Jaken Sub-district. Following the collection, a rigorous data processing phase was executed to clean the dataset and ensure the absence of outliers or missing values. Finally, the reporting phase involved the interpretation of the structural model results to draw formal research conclusions.

2.4 Data Analysis

Data analysis was conducted using Structural Equation Modeling (SEM) facilitated by AMOS 24 software. This method was selected for its ability to test complex structural relationships between latent variables simultaneously. The analysis was executed in several distinct stages, beginning with the measurement model through Confirmatory Factor Analysis (CFA). This stage verified that indicators effectively measured their respective constructs by ensuring that the loading factors were ≥ 0.50 , construct reliability (CR) reached ≥ 0.70 , and the average variance extracted (AVE) met the threshold of ≥ 0.50 .

Following the measurement model, SEM assumption testing was performed to maintain the robustness of the results. This included a normality test assessing the Critical Ratio of skewness and kurtosis within the ± 2.58 range at a 0.01 significance level, as well as an outlier test using Mahalanobis Distance to identify observations deviating significantly from the centroid. The final structural model and hypothesis testing were evaluated based on the Full Model Fit to determine the alignment between theoretical models and empirical data. Goodness-of-fit (GOF) was assessed through indices including Chi-Square, CMIN/DF (≤ 2.00), GFI and AGFI (≥ 0.90), TLI and CFI (≥ 0.95), and RMSEA (≤ 0.08). Significance for each hypothesis was determined by a Critical Ratio (CR) exceeding 1.967 and a P-value below 0.05.

Table 1. Goodness of fit Index Cut-off value.

Criteria	Cut Off Value
<i>Chi Square</i>	be small
<i>Significanced Probability</i>	$\geq 0,05$
CMIN/DF	$\leq 2,00$
GFI	$\geq 0,90$
AGFI	$\geq 0,90$
TLI	$\geq 0,95$
CFI	$\geq 0,95$
RMSEA	$\leq 0,08$

3. Findings and discussion

The following are the results of the study with 148 primary school teachers in Jaken Sub-district, Pati Regency. The results showed that understanding ICT policy in education has a significant influence on learning quality, with a CR value of $2.211 > 1.967$ and $P 0.027 < 0.05$. However, the effect is smaller compared to digital literacy and digital pedagogical skills. This suggests that while understanding ICT policy is important, its implementation in learning still requires support from other factors such as teachers' skills in adapting technology effectively.

Another finding shows that digital literacy has a stronger influence on learning quality, with a CR value of 6.913 > 1.967 and $P 0.001 < 0.05$. This confirms that teachers' ability to access, evaluate and utilize digital resources contributes to improving the effectiveness and attractiveness of learning. Good digital literacy allows teachers to present materials in a more varied manner and in accordance with the needs of learners in the age digitalization.

Digital pedagogical skills were found to be the most dominant factor in improving learning quality, with a CR value of 6.844 > 1.967 and $P 0.001 < 0.05$. Teachers who have skills in designing, managing and adapting technology-based learning are able to create learning experiences that are more interactive, collaborative and relevant to students' needs. This result is in line with Constructive Alignment theory and UNESCO's ICT Competency Framework for Teachers (ICT-CFT), which emphasizes the importance of alignment between learning methods and technology utilization. Therefore, continuous training, policy strengthening, and provision of technology facilities are needed to improve teachers' digital competencies to support more innovative and quality learning.

Table 2. Goodness of Fit Test Results Model 4 Structural Fit.

Criteria	Cut Off Value
Chi Square 69.008	be small
Significanced Probability 0,757	≥ 0,05
CMIN/DF 0,885	≤ 2,00
GFI 0,947	≥ 0,90
AGFI 0,907	≥ 0,90
TLI 1,008	≥ 0,95
CFI 1,000	≥ 0,95
RMSEA 0,000	≤ 0,08

Based on the results of a study of 148 primary school teachers in Jaken sub-district, Pati district, it can be concluded that understanding ICT policy in education has a significant effect on learning quality, although the effect is smaller than digital literacy and digital pedagogical skills. Digital literacy has a stronger influence, indicating that teachers' mastery of technology contributes to improving learning effectiveness. Meanwhile, digital pedagogical skills are the most dominant factor in improving learning quality, as they enable teachers to create more interactive learning experiences that are relevant to students' needs. This finding is in line with UNESCO's Constructive Alignment and ICT-CFT theories, which emphasize the importance of aligning learning methods with technology utilization. Therefore, efforts are needed to improve teachers' digital competencies through continuous training, strengthening policies and providing technology facilities to support more innovative and quality learning.

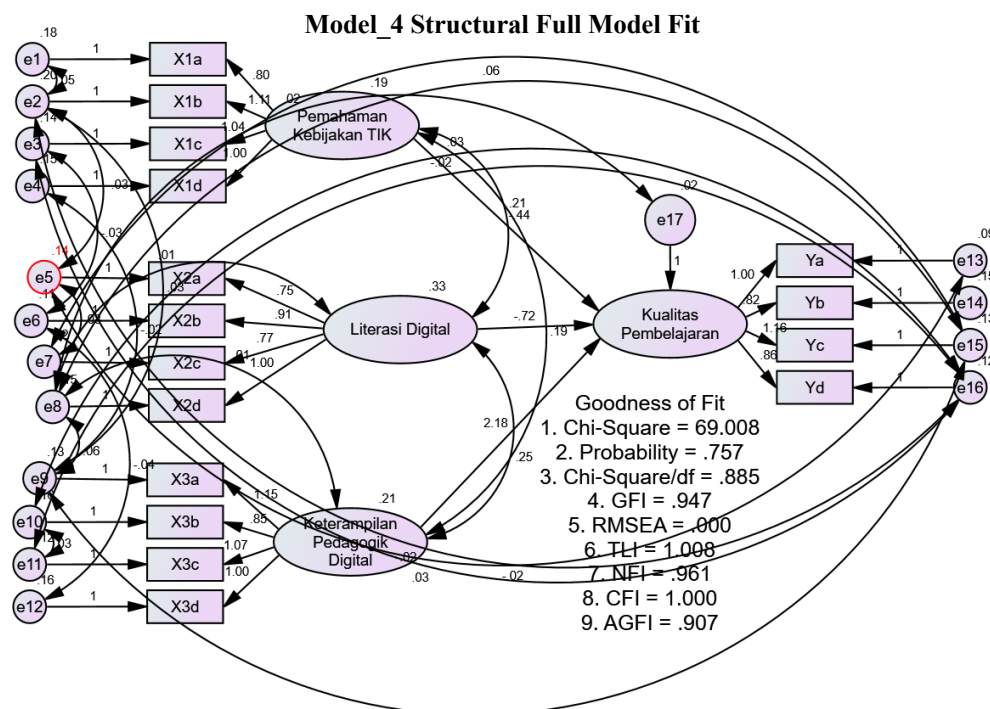


Figure 1. Model 4 Structural Full Model Fit

4. Conclusions and recommendations

The results of this study show that the understanding of ICT policy in education, digital literacy, and digital pedagogical skills have a significant influence on the quality of learning in elementary schools in Jaken sub-district, Pati district. ICT policy understanding has a smaller influence compared to digital literacy and digital pedagogical skills, which indicates that ICT policies need to be supported with more effective implementation in the school environment. Digital literacy contributes greatly to increasing the effectiveness and attractiveness of learning, while digital pedagogical skills are the most dominant factor in creating a more interactive learning experience that is relevant to students' needs. This finding is in line with Constructive Alignment theory and UNESCO's ICT Competency Framework for Teachers (ICT-CFT), which emphasizes the importance of alignment between learning methods and technology utilization. Based on the findings, it is recommended that teachers improve their digital competencies through continuous training focused on the utilization of technology in learning. Schools need to provide adequate technology facilities and support innovation in digital-based teaching. In addition, education policies should further emphasize strengthening digital literacy and digital pedagogical skills for teachers by providing greater access to technology resources and professional training. Collaboration between schools, government and other stakeholders is needed to ensure that ICT policy implementation is effective and can improve the quality of learning in the age of digitalization.

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Conflict of Interest

The authors declare no conflicts of interest.

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