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The Influence Of Interactive Flat Panel Utilization And Teachers' Pedagogical Competence On Students' Learning Outcomes In Public Elementary Schools Of Muara Telang District

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Abstract

The improvement of educational quality in elementary schools is an important aspect of developing human resources. Students' learning outcomes are influenced by various factors, including the use of educational technology and teachers' pedagogical competence. This study focuses on the utilization of Interactive Flat Panels (IFP) and teachers' pedagogical competence as determinants of students' learning outcomes in public elementary schools in Muara Telang District, Banyuasin Regency, Indonesia. Interactive Flat Panels provide multimedia-based learning experiences that support student engagement and conceptual understanding, while pedagogical competence enables teachers to integrate technology effectively into instructional practices. Previous studies have generally examined these variables separately, leaving a gap regarding their combined influence, particularly in rural elementary school contexts. Therefore, this study aims to analyze the effect of Interactive Flat Panel utilization and teachers' pedagogical competence on students' learning outcomes, both partially and simultaneously.

Keywords: Interactive Flat Panel, Pedagogical Competence, Learning Outcomes, Elementary School, Educational Technology

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INTRODUCTION

Educational quality improvement is a fundamental component of national development because it contributes directly to the formation of competent human resources. At the elementary school level, education serves not only to develop academic competencies but also to foster critical thinking, literacy, numeracy, and character development. Students' learning outcomes are commonly used as indicators of educational success because they reflect the achievement of learning objectives through systematic instructional processes.

The rapid advancement of digital technology has transformed educational practices worldwide. Technology integration is no longer considered an option but a necessity for improving learning effectiveness in the twenty-first century. Studies have shown that educational technology can enhance student engagement, motivation, and academic achievement when implemented appropriately. One technological innovation increasingly adopted in schools is the Interactive Flat Panel (IFP), a digital learning device that combines touchscreen functionality, multimedia content, and interactive applications into a single platform.

Interactive Flat Panels enable teachers to present learning materials through text, images, videos, simulations, and interactive activities. According to Mayer's Cognitive Theory of Multimedia Learning, students learn more effectively when information is presented through both visual and verbal channels. Consequently, IFPs have the potential to transform traditional teacher-centered instruction into student-centered learning experiences.

However, technology alone does not guarantee improved learning outcomes. The effectiveness of technology integration largely depends on teachers' pedagogical competence. Teachers play a central role in designing, implementing, and evaluating instructional activities. Pedagogical competence includes understanding student characteristics, selecting appropriate teaching methods, integrating technology into instruction, and conducting meaningful assessments.

In Muara Telang District, the government has introduced Interactive Flat Panels to support educational digitalization. Although these devices are available in several public elementary schools, preliminary observations indicate variations in their utilization. Some teachers effectively employ IFP features to encourage interaction and collaboration, while others use them merely as presentation tools. Such differences suggest that pedagogical competence may influence the effectiveness of IFP utilization.

Previous studies have investigated either educational technology or pedagogical competence separately. Research examining the combined effect of Interactive Flat Panel

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utilization and teachers' pedagogical competence on students' learning outcomes remains limited, especially in rural elementary school settings. This research gap highlights the need for empirical investigation. Therefore, this study aims to examine the influence of Interactive Flat Panel utilization and teachers' pedagogical competence on students' learning outcomes in public elementary schools in Muara Telang District, both individually and simultaneously.

LITERATURE REVIEW

Interactive Flat Panel Utilization

Interactive Flat Panels (IFPs) are digital learning devices that integrate touchscreen technology, multimedia applications, and interactive instructional tools. These devices support student-centered learning by enabling active participation through annotations, simulations, videos, quizzes, and collaborative activities.

The theoretical foundation of IFP utilization is largely based on Mayer's Cognitive Theory of Multimedia Learning, which states that meaningful learning occurs when learners process information through visual and verbal channels simultaneously. Additionally, Sweller's Cognitive Load Theory emphasizes the importance of reducing unnecessary cognitive load to facilitate effective learning. Interactive Flat Panels can support these principles by presenting information in a structured and engaging format.

Empirical studies have demonstrated the positive impact of IFPs on student achievement, engagement, and motivation. Meta-analyses conducted by Akar (2020) and Bluum (2025) reported significant improvements in academic performance among students exposed to interactive learning technologies. These findings suggest that IFPs can serve as effective instructional tools when utilized appropriately.

Teachers' Pedagogical Competence

Teachers' pedagogical competence refers to the ability to design, implement, manage, and evaluate learning activities effectively. In the context of digital education, pedagogical competence extends beyond traditional instructional skills and includes the capacity to integrate technology meaningfully into teaching practices.

The Technological Pedagogical Content Knowledge (TPACK) framework developed by Mishra and Koehler provides a comprehensive perspective on teacher competence in technology-enhanced learning environments. According to this framework, effective teaching requires the integration of technological knowledge, pedagogical knowledge, and content knowledge.

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Research consistently demonstrates that pedagogically competent teachers contribute significantly to improved student learning outcomes. Teachers with strong pedagogical skills are more capable of creating engaging learning environments, adapting instruction to student needs, and maximizing the educational value of technological resources.

Students' Learning Outcomes

Learning outcomes refer to the knowledge, skills, attitudes, and competencies acquired by students as a result of educational experiences. Anderson and Krathwohl's revised Bloom's Taxonomy categorizes learning outcomes into cognitive processes ranging from remembering and understanding to analyzing, evaluating, and creating.

From a constructivist perspective, learning occurs through active interaction with the learning environment. Piaget emphasized cognitive development through experience, while Vygotsky highlighted the importance of social interaction and scaffolding in learning. Interactive technologies such as IFPs can facilitate these processes by providing opportunities for exploration, collaboration, and immediate feedback.

Research indicates that students' learning outcomes improve when technology integration is supported by effective pedagogical practices. Therefore, the interaction between educational technology and teacher competence is considered essential for maximizing student achievement.

CONCEPTUAL FRAMEWORK AND RESEARCH HYPOTHESES

This study proposes that students' learning outcomes are influenced by two independent variables: Interactive Flat Panel utilization (X_1) and teachers' pedagogical competence (X_2). Conceptual Framework :

X_1 (Interactive Flat Panel Utilization) → Y (Students' Learning Outcomes)

X_2 (Teachers' Pedagogical Competence) → Y (Students' Learning Outcomes)

$X_1 + X_2$ → Y (Students' Learning Outcomes)

Hypotheses

H1: Interactive Flat Panel utilization has a positive and significant effect on students' learning outcomes.

H2: Teachers' pedagogical competence has a positive and significant effect on students' learning outcomes.

H3: Interactive Flat Panel utilization and teachers' pedagogical competence simultaneously have a

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positive and significant effect on students' learning outcomes.

METHOD

Research Design

This study employed a quantitative approach with an Ex Post Facto research design to investigate the influence of Interactive Flat Panel (IFP) utilization and teachers' pedagogical competence on students' learning outcomes. The quantitative approach was selected because it enables researchers to examine relationships among variables objectively through statistical analysis. The Ex Post Facto design was considered appropriate because the researcher did not manipulate or provide treatment to the independent variables. Instead, the study examined phenomena that had naturally occurred within the educational environment. Multiple linear regression analysis was utilized to determine both the partial and simultaneous effects of the independent variables on the dependent variable.

Participants

The study was conducted in public elementary schools located in Muara Telang District, Banyuasin Regency, South Sumatra, Indonesia. The population consisted of 216 teachers from 21 public elementary schools that had implemented Interactive Flat Panels in classroom learning activities. Considering that the population size was relatively small and accessible, the study employed a saturated sampling technique, in which all members of the population were selected as participants. Therefore, the total sample consisted of 216 teachers. The use of saturated sampling ensured comprehensive representation of the population and increased the accuracy of the research findings.

Data Collection and Analysis

Data were collected through questionnaires, observations, and documentation. The questionnaire served as the primary research instrument and was designed to measure teachers' perceptions regarding Interactive Flat Panel utilization, pedagogical competence, and students' learning outcomes. The instrument employed a five-point Likert scale ranging from strongly disagree to strongly agree. Observation was conducted to obtain direct information regarding the implementation of Interactive Flat Panels and classroom learning practices, while documentation was used to collect supporting data related to school profiles, teacher information, and students' learning achievements.

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Prior to data collection, the research instrument was tested for validity and reliability. Item validity was examined using Pearson Product Moment correlation, while reliability was measured using Cronbach's Alpha coefficient. The results indicated that the instrument met the required standards of validity and reliability and was therefore suitable for data collection.

RESULTS

This study investigated the influence of Interactive Flat Panel (IFP) utilization and teachers' pedagogical competence on student learning outcomes in public elementary schools in Muara Telang District. The study involved 216 teachers who had experience using Interactive Flat Panel technology in classroom instruction.

Prior to hypothesis testing, classical assumption tests were conducted, including normality, linearity, multicollinearity, and heteroscedasticity tests. The results indicated that all assumptions were satisfied; therefore, the data were appropriate for multiple regression analysis. Descriptive statistics were employed to describe the characteristics of each research variable. The results are presented in Table 1.

Table 1. Descriptive Statistics of Research Variables

No	Variable	N	Mean	SD
1	Interactive Flat Panel Utilization (X_1)	216	78.42	7.214
2	Teachers' Pedagogical Competence (X_2)	216	81.37	6.845
3	Teachers' Pedagogical Competence (X_2)	216	83.15	6.102

Table 1 indicates that Interactive Flat Panel utilization achieved a mean score of 78.42, suggesting that teachers generally utilized interactive technology effectively during classroom instruction. Teachers' pedagogical competence obtained a mean score of 81.37, while student learning outcomes achieved a mean score of 83.15. These findings demonstrate that all variables were categorized at a relatively high level. To determine the influence of the independent variables on student learning outcomes, multiple regression analysis was performed. The results are presented in Table 2.

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Table 2. Multiple Regression Analysis**

No	Variable	B	Beta	T	Sig
1	Constant	18.427	-	4.709	.000
2	Interactive Flat Panel Utilization (X_1)	0.421	0.398	5.929	.000
3	Teachers' Pedagogical Competence (X_2)	0.367	0.362	5.392	.000

As presented in Table 2, Interactive Flat Panel utilization significantly influenced student learning outcomes (β = 0.398, p < .05). Similarly, teachers' pedagogical competence significantly influenced student learning outcomes (β = 0.362, p < .05). These results indicate that both variables positively contribute to improving students' academic achievement.

The simultaneous influence of Interactive Flat Panel utilization and teachers' pedagogical competence was further analyzed through the F-test and coefficient of determination. The results are presented in Table 3.

Table 3. Model Summary

R	R^2	Adjusted R^2	F	Sig
0.626	0.392	0.386	68.521	.000

Table 3 shows that the regression model was statistically significant (F = 68.521, p < .05). The coefficient of determination (R^2 = 0.392) indicates that 39.2% of the variation in student learning outcomes can be explained by Interactive Flat Panel utilization and teachers' pedagogical competence. The remaining 60.8% may be influenced by other factors not included in this study, such as student motivation, parental support, school facilities, and learning environment.

DISCUSSION

Effect of Interactive Flat Panel Utilization on Student Learning Outcomes

The findings revealed that Interactive Flat Panel utilization had a positive and significant effect on student learning outcomes. This result suggests that the integration of interactive digital technology can improve the effectiveness of classroom instruction and support better student achievement. Interactive Flat Panels provide multimedia features such as videos, animations, simulations, digital whiteboards, and touch-screen interactions that enable students to participate

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actively in the learning process. Such features create more engaging learning experiences and help students understand abstract concepts through visual representation. Consequently, students become more motivated and actively involved during classroom activities.

This finding supports Mayer's Multimedia Learning Theory (2009), which states that students learn more effectively when information is presented through both visual and verbal channels. The combination of text, images, audio, and interactive activities helps students process information more efficiently and improves knowledge retention.

In the context of elementary education, visual and interactive learning media are particularly important because elementary school students are still in the concrete operational stage of cognitive development. Learning experiences supported by Interactive Flat Panels enable students to observe, explore, and interact with learning materials more directly, thereby enhancing comprehension and learning outcomes. The findings are consistent with previous studies conducted by Bluum (2025), Naitboho et al. (2025), and Hartanto and Wahyuningsih (2026), which reported that interactive learning technologies positively affect student engagement, motivation, and academic achievement. Therefore, the effective use of Interactive Flat Panels can be considered an important component of digital learning implementation in elementary schools.

Effect of Teachers' Pedagogical Competence on Student Learning Outcomes

The study also found that teachers' pedagogical competence significantly influenced student learning outcomes. This result indicates that teachers play a central role in determining the quality and effectiveness of learning, regardless of the availability of educational technology. Pedagogical competence includes understanding student characteristics, designing instructional strategies, managing classroom activities, conducting assessments, and providing appropriate feedback. Teachers who possess strong pedagogical competence are generally more capable of creating learning environments that encourage active participation and meaningful learning experiences.

The findings support the Technological Pedagogical Content Knowledge (TPACK) framework proposed by Mishra and Koehler (2006). According to this framework, effective teaching occurs when teachers successfully integrate technological knowledge, pedagogical knowledge, and content knowledge. In technology-rich classrooms, pedagogical competence becomes increasingly important because technology alone cannot guarantee successful learning outcomes.

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The results also indicate that teachers with stronger pedagogical competence are better able to utilize Interactive Flat Panels effectively. Rather than merely using technology as a presentation tool, competent teachers can transform technology into an interactive learning medium that promotes collaboration, discussion, and student-centered learning. These findings are consistent with studies conducted by Putri and Suyanto (2020), Ning et al. (2022), and Sari et al. (2026), which concluded that pedagogical competence significantly contributes to students' academic achievement. Therefore, continuous professional development programs remain essential for improving teachers' pedagogical capabilities in the digital era.

Simultaneous Effect of Interactive Flat Panel Utilization and Teachers' Pedagogical Competence on Student Learning Outcomes

The findings further revealed that Interactive Flat Panel utilization and teachers' pedagogical competence jointly influenced student learning outcomes. The coefficient of determination showed that both variables explained 39.2% of the variance in student learning outcomes. This finding suggests that technology and pedagogy should not be viewed as separate components. Educational technology can provide significant benefits only when teachers possess sufficient pedagogical competence to integrate it effectively into instructional practices. Likewise, pedagogical competence can be strengthened through the support of innovative educational technologies.

The results indicate that technology serves as a facilitating factor, while teachers remain the primary determining factor in successful learning. Even advanced technological devices may fail to improve learning outcomes if teachers are unable to design meaningful learning experiences. Conversely, competent teachers can maximize the educational benefits of available technologies and create more engaging learning environments. These findings have important implications for educational policy and school management. Investments in educational technology should be accompanied by continuous teacher training programs, pedagogical development initiatives, and technical support systems. Such efforts will help ensure that technology is utilized effectively to improve educational quality and student achievement.

For elementary schools in Muara Telang District, the findings demonstrate that digital transformation can be successfully implemented when technological infrastructure is supported by competent teachers and effective educational management. Therefore, improving educational quality requires a balanced integration of technological innovation and teacher professional competence.

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CONCLUSION

This study concludes that Interactive Flat Panel utilization has a positive and significant effect on student learning outcomes in public elementary schools in Muara Telang District. The use of interactive digital technology enhances student engagement, facilitates understanding of learning materials, and supports more effective learning processes. Teachers' pedagogical competence also has a positive and significant influence on student learning outcomes. Teachers with strong pedagogical competence are better able to design, implement, and evaluate learning activities that meet students' educational needs and encourage academic achievement.

Furthermore, Interactive Flat Panel utilization and teachers' pedagogical competence simultaneously contribute significantly to student learning outcomes. These findings emphasize the importance of integrating educational technology with pedagogical competence to support digital transformation and improve the quality of elementary education. Therefore, efforts to improve educational quality should focus not only on providing technological resources but also on strengthening teachers' professional and pedagogical competencies through continuous development programs.

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