

Evaluation of The Utility of TPACK-Based Interactive Flat Panel (IFP) in Improving The Digital Literacy Skills of Elementary School Teachers in The Cimurah Garut Group

Indriani Desira Irawati* , Jamilah, Ayu Puji Rahayu

Institut Pendidikan Indonesia, Indonesia

Email: indrianidesira101278@gmail.com* , jamilah@institutpendidikan.ac.id,

ayupujirahayu14@institutpendidikan.ac.id

Keywords:

Interactive Flat Panel; TPACK, Digital Literacy; Elementary School Teachers; Mixed Method

Abstract

This research aims to evaluate the use of Interactive Flat Panel (IFP) based on Technological Pedagogical Content Knowledge (TPACK) in improving the digital literacy skills of elementary school teachers in the Cimurah Cluster, Garut Regency. The study used a mixed method with a sequential explanatory design, namely the collection and analysis of quantitative data followed by in-depth qualitative data. The research subjects consisted of 45 elementary school teachers in the Cimurah Cluster, Garut. Data collection techniques were carried out through questionnaires, observations, in-depth interviews, and documentation. The results showed that the use of TPACK-based IFP had a positive influence on improving teachers' digital literacy, especially in aspects of mastery of learning technology, digital media creativity, digital communication, and the ability to integrate technology into learning. Quantitatively, there was an increase in teachers' digital literacy skills by 78% in the high category. Meanwhile, qualitative results showed that the use of IFP was able to improve the effectiveness of interactive learning and teacher motivation in developing digital learning innovations. The main obstacles found included limited technical training, unstable internet access, and differences in digital competencies between teachers. This study recommends strengthening TPACK training based on digital technology on an ongoing basis in elementary schools.

INTRODUCTION

The development of digital technology has brought significant changes to the education system, particularly in the learning process in elementary schools. The transformation of digital education requires teachers to possess adequate digital literacy skills to effectively integrate technology into learning. Digital literacy encompasses not only the ability to operate technological devices but also the ability to understand, evaluate, and utilize digital information critically and creatively (Feola, 2016; Martínez-Bravo et al., 2022; Restalia & Khasanah, 2025; Spante et al., 2018).

In the context of 21st-century learning, the use of interactive learning media is a key requirement for creating innovative and participatory learning processes. One technology that is increasingly being used in elementary schools is the Interactive Flat Panel (IFP). This device allows teachers to present interactive multimedia-based learning through a digital touchscreen integrated with the internet, learning applications, and audiovisual media (Munir, 2022).

Teachers as the main actors in learning are required to have adequate digital literacy skills to be able to manage adaptive, collaborative, and data-based learning processes. (Gusty et al., 2025) Among interactive media, one that is increasingly being adopted is the large interactive screen (touch-screen), known as the Interactive Flat Panel (IFP). IFPs are designed to replace conventional whiteboards and projectors, and allow direct interaction between students and teachers by touching, writing, drawing, marking up, displaying images/videos, and running multimedia content with an interactive interface. (Jumiati, et al., 2025) This medium allows for high flexibility in presenting material: from text, images, videos, animations, to simulations or interactive quizzes. Therefore, IFP is ideal for supporting active, collaborative, and adaptive learning processes to student needs.

Several studies have been conducted on the use of IFP or interactive media in learning contexts. For example, research by Utilization of Interactive Flat Panel Display (IFPD) Learning Media in English Learning showed that students who learn with IFPD have a higher interest in learning and increased enthusiasm because the learning is considered more enjoyable and easier to understand (Indriansyah. R. T, 2025). Another study, The Role of Interactive Flat Panel (IFP) Media in Increasing Student Motivation and Learning Collaboration, found that in elementary school learning, IFP increases student motivation and collaboration through engaging visual materials, touchscreen activities, and direct student involvement in learning (Riyadi. R & Ningsih. T, 2025). In addition, research on the development of digital-based interactive media in elementary schools shows that interactive media (although not always IFP) can improve student understanding of the material and engagement in the learning process (Raehang & Karim, 2024).

The use of technology in learning requires integrative skills between technological, pedagogical, and learning materials. A widely used conceptual framework for this integration is Technological Pedagogical Content Knowledge (TPACK). TPACK implementation is crucial in supporting elementary school teachers' digital literacy. Teachers are not only required to be proficient in using digital devices but also to design creative, interactive, and student-centered learning. Previous research has shown that teachers' TPACK competencies significantly influence the quality of digital-based learning (Silvester et al., 2024).

Technological developments require education to adapt to digital literacy so that the learning process is more relevant to needs. (Siregar et al., 2024) The implementation of this technology still faces various obstacles, such as limited digital competence of teachers, lack of training in learning technology, and minimal evaluation of the use of IFP in improving teachers' digital literacy. (Nuraina, Muliana, Rohantizani, 2025).

However, many teachers have not yet mastered the Technological Pedagogical Content Knowledge (TPACK) framework optimally, especially in integrating technology into learning, as in the Cimurah Cluster in Garut Regency, the use of IFP has begun to be implemented as part of the digital learning transformation in elementary schools. Therefore, this study is important to evaluate the effectiveness of the use of TPACK-based IFP in improving the digital literacy skills of elementary school teachers in the Cimurah Cluster in Garut.

Based on this background, this research aims to evaluate the use of Interactive Flat Panel (IFP) based on Technological Pedagogical Content Knowledge (TPACK) in improving the digital literacy skills of elementary school teachers in the Cimurah Cluster, Garut Regency, by analyzing the implementation of TPACK-based IFP in elementary school learning, measuring

the level of teachers' digital literacy skills after using TPACK-based IFP, identifying the supporting and inhibiting factors in its implementation, and evaluating the impact of TPACK-based IFP usage on the effectiveness of the learning process. The benefits of this research are both theoretical and practical. Theoretically, this study contributes to the development of knowledge regarding the application of the TPACK framework in the context of using interactive learning technology, particularly Interactive Flat Panels, in elementary education, thereby enriching the literature on the relationship between technology integration, teacher digital literacy, and the effectiveness of digital learning. Practically, this research provides benefits for teachers in developing digital literacy competencies and optimizing IFP use, for schools as a reference in formulating policies and continuous teacher training programs, for education policymakers as evaluation material on the effectiveness of educational technology investments and the importance of TPACK-based training, and for future researchers as a foundation for further studies on interactive learning media and digital literacy development in various educational contexts.

METHOD

This study used a mixed methods approach with a sequential explanatory design. This design was implemented in two stages: quantitative research in the first stage, followed by qualitative research to deepen the quantitative results (John W. Creswell, 2018). The research was conducted in the Cimurah Cluster, Garut Regency in 2026. The research population consisted of all elementary school teachers in the Cimurah Cluster, while the research sample consisted of 45 teachers selected using a purposive sampling technique. Data collection techniques used questionnaires, observation, interviews, and documentation. Data analysis techniques included quantitative data analyzed using descriptive percentage statistics, while qualitative data were analyzed through the stages of data reduction, data presentation, and conclusion drawing (Sugiyono, 2022). Data integration was carried out using triangulation techniques to obtain the validity of the research results.

RESULT AND DISCUSSION

This research was conducted in the Cimurah Cluster in Garut Regency, involving 45 elementary school teachers who had used Interactive Flat Panels (IFP) in their learning activities. The study employed a mixed methods approach with a sequential explanatory design, collecting quantitative data through questionnaires and observations, followed by in-depth qualitative data through interviews and documentation.

The research results focused on three main aspects, namely:

1. Implementation of TPACK-based IFP in learning;
2. Teachers' digital literacy skill levels;
3. Supporting and inhibiting factors for the use of IFP
 - a. Implementation of TPACK-Based Interactive Flat Panel

Observations indicate that the use of IFP in the Cimurah Cluster has been integrated with the Technological Pedagogical Content Knowledge (TPACK) approach. Teachers not only use IFP as a presentation tool but also utilize various interactive features to support multimedia-based learning. Based on observations of 45 teachers, the following data were obtained:

Table 1. TPACK-Based IFP Implementation

No	Implementation Aspects	Percentage
1	Use of interactive multimedia	86%
2	Integration of learning videos	82%
3	Use of digital quiz applications	76%
4	Utilization of the internet in learning	79%
5	Digital-based collaborative learning	74%
6	Development of digital learning media	81%

Source: Observation results of 45 elementary school teachers in Cimurah Cluster (2026)

The data shows that teachers have been able to integrate technology, pedagogy, and learning materials in the use of IFP. The highest level of effectiveness was found in the use of interactive multimedia at 86%, while the lowest level was found in digital-based collaborative learning at 74%.

Interview results showed that teachers felt IFP made it easier to deliver learning materials, especially those requiring visualizations of images, videos, and animations. One teacher stated:

“The use of IFP makes students more active and easier to understand the material because learning becomes more interesting and interactive (Interview, February 2026).”

These findings show that the implementation of TPACK-based IFP is able to create more innovative and learner-centered learning.

b. Teacher Digital Literacy Level

Measurement of teachers' digital literacy was carried out through a questionnaire that included four main indicators, namely:

- 1) Mastery of learning technology;
- 2) Digital communication and collaboration;
- 3) Evaluation of digital information;
- 4) Creativity in developing learning media.

The results of the questionnaire showed an increase in teachers' digital literacy skills after using TPACK-based IFP.

Table 2. Teachers' Digital Literacy Level

No	Digital Literacy Indicators	Percentage	Category
1	Mastery of learning technology	84%	Tall
2	Digital communication and collaboration	79%	Tall
3	Evaluation of digital information	75%	Tall
4	Creativity of learning media	81%	Tall
	Average	78%	Tall

Source: Questionnaire survey results from 45 elementary school teachers in Cimurah Cluster (2026)

Based on the questionnaire results in Table 2, the use of Interactive Flat Panel (IFP) based on Technological Pedagogical Content Knowledge (TPACK) showed an increase in teachers' digital literacy skills in the learning process. This finding indicates that the integration of learning technology through the TPACK approach can support teachers' competence in utilizing technology effectively, pedagogically, and relevantly to the teaching material. In general, the average digital literacy level of teachers reached 78%, which is categorized as high,

indicating that teachers have good abilities in integrating digital technology into learning activities.

The learning technology mastery indicator achieved the highest percentage, at 84%, in the high category. This result indicates that teachers are able to operate and utilize the technological features in the IFP to support the learning process. This mastery includes the ability to use learning applications, manage interactive media, and utilize digital devices to deliver material more effectively and engagingly. The high percentage for this indicator indicates that the implementation of the TPACK-based IFP can improve teacher readiness for the digital learning transformation.

Furthermore, the learning media creativity indicator achieved a high score of 81%. This indicates that the use of IFP encourages teachers to be more creative in designing media and learning strategies. Teachers are not only using conventional lecture methods but are also starting to develop multimedia-based learning, interactive videos, digital presentations, and various other forms of learning visualization. This creativity contributes to a more innovative learning environment and can increase student learning interest.

The digital communication and collaboration indicator scored 79%, categorized as high. This data demonstrates that teachers have been able to leverage digital technology to build more effective communication and collaboration, both with students and fellow teachers. The use of digital platforms and interactive features in the IFP supports discussions, material sharing, and more dynamic and participatory collaborative learning.

Meanwhile, the digital information evaluation indicator scored 75%, categorized as high. Although this indicator had the lowest score compared to other indicators, this result still demonstrates that teachers possess sufficient skills in selecting, evaluating, and utilizing digital information critically and relevantly for learning needs. This ability is crucial in ensuring that the digital learning resources used are valid, accurate, and aligned with learning objectives.

Overall, the research results indicate that the use of TPACK-based IFP has a positive impact on improving teachers' digital literacy. This improvement is evident in aspects of technology mastery, learning media creativity, digital communication, and digital information evaluation skills. Thus, the application of TPACK-based learning technology can be an effective strategy for improving teachers' professional competence in the digital education era and supporting the realization of 21st-century learning that is innovative and adaptive to technological developments.

Thus, the data above shows that the average teacher's digital literacy skills are in the high category, at 78%. The highest aspect is mastery of learning technology, at 84%. Teachers are able to operate digital learning applications, use IFP features effectively, and integrate audiovisual media into the learning process.

Meanwhile, the digital information evaluation aspect received the lowest percentage, at 75%. This indicates that some teachers still need to improve their skills in selecting and evaluating valid and relevant digital information sources.

c. The Influence of IFP Utilization on Learning

The results of class observations show that the use of TPACK-based IFP has a positive impact on the learning process, including:

- 1) Improve teacher and student interaction;
- 2) Helps visualize learning materials;

- 3) Increase student learning motivation;
- 4) Make it easier for teachers to deliver material;
- 5) Make learning more creative and innovative.

Based on interviews, most teachers stated that students became more active when learning using IFP compared to conventional methods.

Table 3. Impact of Using IFP in Learning

No	Learning Impact	Percentage
1	Increased student participation	85%
2	Increased learning motivation	83%
3	Effectiveness of material delivery	87%
4	Learning creativity	80%
5	Learning interactions	84%

Source: Interview and observation results from 45 elementary school teachers in Cimurah Cluster (2026)

Based on interview results and the data in Table 3, the use of Interactive Flat Panels (IFPs) significantly impacts the quality of classroom learning. The majority of teachers stated that IFP implementation creates a more active and interactive learning environment and encourages optimal student engagement compared to conventional learning methods. These findings demonstrate that the integration of digital technology into learning functions not only as an aid but also as a pedagogical instrument that can enhance the effectiveness of the teaching and learning process.

The data shows that the effectiveness of material delivery achieved the highest percentage, at 87%. This indicates that the use of IFP facilitates teachers in delivering learning materials more clearly, systematically, and engagingly through the available visual, audio, and interactive features. This more varied delivery of material has an impact on improving student understanding of the material being taught.

Furthermore, student participation increased by 85%, demonstrating that the use of IFP fosters active student engagement throughout the learning process. Teachers reported that students were more enthusiastic about asking questions, answering questions, and interacting directly when technology-based learning media was used. This demonstrates that IFP can create student-centered learning.

The interactive aspect of learning also received a high score, at 84%. This demonstrates that IFP supports two-way communication between teachers and students, as well as between students, during learning activities. Through the use of interactive visual displays, discussions, presentations, and collaboration are facilitated, resulting in a more dynamic classroom atmosphere.

Furthermore, student learning motivation increased by 83%. Teachers assessed that the use of modern and interactive learning media was able to capture students' attention and reduce boredom. Increased learning motivation is an indicator that the use of learning technology can provide a more enjoyable and meaningful learning experience for students.

Meanwhile, the creativity aspect of learning achieved a percentage of 80%. Although this is the lowest percentage compared to other indicators, this figure still represents a high category. The use of IFP allows teachers to develop various creative and innovative learning methods, such as the use of learning videos, interactive quizzes, digital simulations, and

multimedia-based collaboration. Thus, IFP provides opportunities for teachers to design more varied and adaptive learning to meet students' needs in the digital age.

Overall, the results of this study indicate that the use of Interactive Flat Panels (IFPs) has a positive contribution to improving the quality of learning, including student participation, learning motivation, effectiveness of material delivery, learning creativity, and interaction in the teaching and learning process. These findings reinforce the view that the use of digital technology in schools can be an effective strategy for realizing more innovative, interactive, and student-oriented 21st-century learning.

So, based on these results, the effectiveness of material delivery achieved the highest score of 87%. Teachers assessed that IFP facilitated the explanation of abstract material through images, videos, animations, and digital simulations.

d. Supporting and Inhibiting Factors

1) Supporting Factors

Based on the results of interviews and observations, supporting factors for IFP implementation include:

- a) Principal support for digital innovation;
- b) Availability of IFP facilities in schools;
- c) Teacher enthusiasm for learning technology;
- d) There is training in the use of digital media;
- e) Digital-based curriculum support.

Teachers stated that training on the use of IFP was very helpful in improving their ability to use learning technology.

2) Inhibiting Factors

The inhibiting factors for IFP implementation include:

- a) Internet network limitations;
- b) Differences in digital competency among teachers;
- c) Lack of advanced TPACK-based training;
- d) Adaptation to the use of technology still requires time;
- e) Limitations of digital learning support devices.

Some older teachers have difficulty operating the digital features available on the IFP. Furthermore, limited internet connectivity is also a barrier to using online learning applications.

The research results show that the use of TPACK-based IFP positively contributes to improving elementary school teachers' digital literacy. This finding reinforces Mishra and Koehler's theory that technology integration in learning must be supported by pedagogical skills and mastery of the learning material.

The use of IFP also enhances teachers' creativity in developing interactive multimedia-based learning media. Teachers are becoming more active in utilizing instructional videos, digital quizzes, and online learning applications in the teaching and learning process.

Furthermore, improving teachers' digital literacy demonstrates that implementing TPACK-based learning technology can support the development of 21st-century teacher competencies. This aligns with previous research that suggests teachers' digital competency is a critical factor in the success of digital education transformation.

However, this study also found that the implementation of learning technology still faces various obstacles, particularly related to uneven technological infrastructure and teachers'

digital competencies. Therefore, ongoing TPACK-based training is needed to optimize the use of IFP in elementary schools.

Teachers' TPACK competencies and students' digital literacy demonstrate a significant relationship in developing students' digital literacy skills in the digital era. Teachers' TPACK competencies, which encompass knowledge of technology, pedagogy, and content, play a crucial role in facilitating the comprehensive development of students' digital literacy. (Leba et al., 2024) Utilizing IFP without an appropriate learning model has the potential to make technology merely a passive presentation tool. (Nuraini, 2026) Overall, Interactive Flat Panels (IFPs) serve not only as a technology-based teaching tool but also as a key tool in achieving high-quality education. IFP implementation can produce interactive, enjoyable, and student-centered teaching, which is anticipated to improve learning achievement while shaping a generation resilient in facing the demands of the digital era. (Khoirunnisa et al., 2026) Therefore, the development and optimization of IFP in education must continue to be encouraged so that all students receive optimal benefits.

Digital transformation in education is not just a shift from conventional media to the use of technological devices, but also a shift in the learning paradigm. The old paradigm, which focused on teachers as the center of information, is shifting toward more adaptive, collaborative, interactive, and student-centered learning. (Citra Dewi IndraSari, 2025). IFP, it has the strategic potential to create an engaging learning environment where students not only watch, but also engage physically and cognitively with the content through touch, movement, and collaboration. (Lutfi Hanifah, et al., 2026) This media not only makes it easier for teachers, but also makes it easier for students to understand the learning material. (Fitria & Mustika, 2024). The implementation of TPACK makes learning more engaging because it combines technology, methods, and materials in a balanced way. Students become more active, engaged, and understand the material more meaningfully because the learning is not monotonous and is close to their lives. (Suswandari, 2026).

The research results show that the use of Interactive Flat Panels (IFPs) in the Cimurah Cluster in Garut has significantly impacted the learning process in elementary schools. The IFPs not only serve as digital presentation media but also serve as interactive learning tools that increase teacher and student participation in the learning process. Based on observations and interviews, most teachers stated that the use of IFPs helps them deliver material in a more engaging manner through the integration of images, videos, animations, and digital learning applications.

From a Technological Pedagogical Content Knowledge (TPACK) perspective, the use of IFP demonstrates the integration of technological knowledge, pedagogical knowledge, and content knowledge. Teachers who are able to combine these three aspects appear more adaptable in creating active and collaborative learning. This finding aligns with Mishra and Koehler's theory, which states that the effectiveness of digital learning is largely determined by teachers' ability to simultaneously integrate technology with pedagogy and learning content.

However, research found that the level of IFP utilization remains uneven across schools in the Cimurah Cluster. Some teachers still experience difficulties operating advanced IFP features due to limited technological competency. Age, digital experience, and minimal training are the main factors contributing to the low level of optimal use of these tools. This

demonstrates that digital transformation in education requires more than just the provision of technological resources; it also requires ongoing teacher competency development.

CONCLUSION

The use of TPACK-based Interactive Flat Panels in the Cimurah Garut Cluster has been proven to improve elementary school teachers' digital literacy skills. These improvements are evident in their ability to use learning technology, digital media creativity, digital information evaluation, and digital communication. The use of IFP also increases the effectiveness of interactive learning and teachers' motivation to develop digital-based learning innovations. However, IFP implementation still faces several challenges, particularly related to limited technical training and internet network infrastructure. Therefore, a continuous TPACK-based training program is needed as well as strengthening educational technology facilities so that IFP implementation can run more optimally in elementary schools.

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