

THE USE OF INTERACTIVE FLAT PANELS IN ELEMENTARY SCHOOL LEARNING AND ITS IMPLICATIONS FOR STUDENTS' DIGITAL LITERACY

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ARTICLE HISTORY

Received : 20-04-2026

Revised : 07-05-2026

Accepted : 30-06-2026

KEYWORDS

*Interactive Flat Panels;
digital literacy;
elementary school;
interactive learning;
educational
technology;*

ABSTRACT

The increasing digitalization of elementary education in Indonesia has encouraged the use of Interactive Flat Panels (IFP) as interactive learning media. However, their contribution to students' digital literacy remains insufficiently clarified in the literature. This article examines patterns of IFP use in elementary schools, its impact on learning processes and outcomes, and its implications for strengthening students' digital literacy. The study used a narrative literature review with thematic synthesis based on fourteen core papers identified through project-based literature search and selected for their relevance to IFP use in elementary education, digital literacy, and interactive board research. The reviewed studies were published between 2005 and 2026 and included empirical, review, and conceptual works. The findings show that IFP most consistently enhance motivation, engagement, collaboration, and conceptual understanding through visualization, simulation, interactive quizzes, and touchscreen interaction. However, direct evidence of improved digital literacy remains limited because most studies do not measure digital literacy dimensions explicitly. The strongest conclusion is that IFP function less as a direct cause of digital literacy improvement than as a pedagogical medium that can support information literacy, media literacy, technical skills, and digital collaboration when integrated into interactive and formative learning design. Their effectiveness depends on teacher TPACK, digital content readiness, infrastructure, and school support. Therefore, their educational value lies in shifting classroom use from presentation-oriented practice toward participatory pedagogical use.

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INTRODUCTION

Digital transformation in Indonesian basic education has encouraged schools to integrate interactive learning technologies into teaching and learning activities. One increasingly prominent technology is the Interactive Flat Panels (IFP), an interactive screen that combines the functions of a digital whiteboard, presentation media, internet access, multimedia, and touch interaction in a single device (Patta dkk., 2025; Sari dkk., 2026). The presence of this device is often seen as a marker of classroom modernization because it can present videos, animations, simulations, interactive maps, digital quizzes, and direct on-screen annotations (Riyadi dan Ningsih, 2025; Sari dkk., 2026).

Recent studies suggest that IFP can enhance motivation, engagement, collaboration, and conceptual understanding in elementary classrooms (Hartanto dan Wahyuningsih, 2026; Hasanah, 2025; Indriansyah, 2025). However, when linked to elementary school students' digital literacy, the available evidence remains insufficient. Most studies report increased enthusiasm, participation, and subject-based learning outcomes, while digital literacy dimensions such as the ability to use technology appropriately, evaluate digital information, collaborate through digital media, and understand media messages have rarely been measured directly (Naila dkk., 2021; Alfian dkk., 2025).

This gap is especially important at the elementary school level, where digital literacy should be understood as a foundational educational competence rather than as mere device operation. Naila, Ridlwan, and Haq explain that elementary students' digital literacy includes information literacy, media literacy, and ICT literacy (Naila dkk., 2021). At a more operational level, the relevant indicators include technical skills, digital information evaluation, digital ethics, and digital collaboration (Alfian dkk., 2025). These indicators clarify the research problem of this article: the key question is not whether IFP simply make lessons more attractive, but whether and in what ways their classroom use supports the development of digital literacy among elementary students.

This distinction also requires a clearer pedagogical reading of technology use in elementary classrooms. The literature on interactive boards has long warned that the presence of technology is not identical to improved learning quality. Smith, Higgins, Wall, and Miller argue that positive responses from teachers and students toward interactive boards are not sufficient evidence of improved learning achievement (H. J. Smith dkk., 2005). Kennewell, Tanner, Jones, and Beauchamp further show that technical interactivity only becomes meaningful when it is directly linked to learning goals and the level of student participation in learning activities (Kennewell dkk., 2008). For this reason, the main analytical focus should be placed on whether IFP are used merely as presentation tools or as pedagogical media that structure participation, interaction, and meaning-making in learning.

The novelty of this article lies in its attempt to bring together two strands of literature that have often developed separately, namely studies on the effectiveness of IFP use in classrooms and studies on elementary students' digital literacy. Through this synthesis, the article not only maps the impact of the device on motivation and learning comprehension, but also critically examines the extent to which that impact is actually related to digital literacy dimensions.

This article makes two main contributions. First, it synthesizes recent findings on the use of IFP in Indonesian elementary schools by placing them within the discourse of students' digital literacy. Second, it argues that IFP are best understood as a pedagogical medium that can function as an enabler of digital literacy rather than as a single direct cause of improved digital literacy. Based on these contributions, this article addresses three questions. First, what patterns characterize the use of IFP in elementary school learning. Second, what impacts do they have on students' learning processes and outcomes. Third, what are the implications of these findings for strengthening digital literacy and for innovating learning methods in elementary schools.

METHOD

This article uses a narrative literature review approach with thematic synthesis. This approach was chosen because the purpose of the article is not to calculate effect sizes statistically, but to organize, compare, and interpret patterns across diverse findings in order to build a more complete conceptual argument. Narrative review was therefore considered appropriate for integrating empirical findings, review articles, and conceptual works that address IFP use in elementary education and its relation to students' digital literacy.

The literature search was conducted in a structured scholarly search environment covering journal articles, conference papers, theses, and preprints relevant to education and learning technologies. The search focused on studies discussing IFP, IFP Display, smartboard, or interactive whiteboard use in elementary or primary education, especially when linked to student engagement, conceptual understanding, collaboration, assessment, or digital literacy. The search and screening process were completed for works published between 2005 and 2026. This time range was selected to capture both foundational interactive board studies and more recent literature on IFP in Indonesian schools.

The initial search used combinations of topic terms related to IFP technology, primary or elementary education, classroom learning, and digital literacy. After identification of potentially relevant studies, titles and abstracts were screened for topical relevance. Full-text reading was then conducted for papers that met the inclusion criteria and were judged central to the research focus. The inclusion criteria were as follows: (1) the study examined IFP, IFP Display, smartboard, or interactive whiteboard use in school learning contexts; (2) the study focused on elementary, primary, or equivalent basic education settings, or provided conceptual evidence directly relevant to such settings; (3) the study reported findings or arguments related to learning processes, learning outcomes, interactivity, assessment, or digital literacy; and (4) the paper provided sufficient conceptual or empirical detail to support thematic interpretation. Exclusion criteria included studies focused on unrelated technologies, higher education contexts without clear relevance to primary education, and publications that mentioned interactive devices only superficially without analyzable findings.

Following this screening process, fourteen core papers were selected for in-depth analysis. These papers were treated as the principal review corpus because they represented the most relevant and conceptually useful evidence for the article's research questions. The analyzed papers fall into four groups. The first group consists of empirical studies on the use of IFP in Indonesian elementary schools (Hartanto dan Wahyuningsih, 2026; Hasanah, 2025; Indriansyah, 2025; Naitboho dkk., 2025; Riyadi dan Ningsih, 2024; Sari dkk., 2026). The second group consists of review studies discussing implementation, impact, and readiness for the use of interactive devices (Patta dkk., 2025; Purwanto, 2019; Setiawan, 2025). The third group consists of foundational papers on digital literacy among elementary school students (Alfian dkk., 2025; Naila dkk., 2021). The fourth group consists of conceptual and international papers used as theoretical grounding for understanding interactivity, formative assessment, and the limits of evidence regarding interactive boards (Chen dkk., 2020; Kennewell dkk., 2008; Smith dkk., 2006).

Study quality was not assessed through a formal scoring instrument because the purpose of the review was interpretive rather than aggregative. Instead, analytical weight was given to papers based on topical relevance, methodological clarity, contextual proximity to elementary education, and their contribution to the conceptual argument developed in this article.

The analysis was conducted in three stages. The first stage involved identifying the central themes of each paper, including forms of device use, impacts on learning, supporting and inhibiting factors, and their relation to digital literacy. The second stage involved grouping recurring findings into broader themes. The third stage involved argumentative synthesis to formulate the pedagogical position of IFP in elementary school learning. The synthesis is presented in four main themes, namely the landscape of device use, its impact on learning processes and outcomes, its relationship to dimensions of digital literacy, and its implications for innovation in learning methods.

RESULT AND DISCUSSION

The landscape of IFP use in elementary schools

Across the reviewed studies, a relatively consistent pattern emerges: IFP are used not only as display devices but also as platforms for organizing multimodal, screen-based classroom activity. In Indonesian elementary school settings, they appear in science and social studies, social studies, mathematics, language learning, and thematic instruction. (Hasanah, 2025; Naitboho dkk., 2025; Riyadi dan Ningsih, 2024; Sari dkk., 2026; Setiawan, 2025). In classroom practice, these devices are most often used to present multimodal materials, visualize abstract concepts, provide direct on-screen annotation, run interactive quizzes, and facilitate classroom discussion based on a shared display (Hartanto dan Wahyuningsih, 2026; Indriansyah, 2025; Sari dkk., 2026).

Table 1. Patterns of IFP Use in Indonesian Elementary School Classrooms

PAPER	CONTEXT	FORM OF USE	MAIN FINDING
(Naitboho dkk., 2025)	Science and social studies in three elementary schools in Kupang	Videos, animations, visual materials, teacher demonstration	Interest and focus increased, but use remained dominant at the substitution level
(Sari dkk., 2026)	SDN Pelambuan 4 Banjarmasin	Slides, videos, Wordwall, Quizizz, Blooket, direct evaluation	Participation, motivation, collaboration, and understanding improved
(Hartanto dan Wahyuningsih, 2026)	SDN 1 Sempu	Interactive quizzes, drag and drop, multimedia, group discussion	Behavioral engagement, cognitive engagement, and motivation strengthened
(Indriansyah, 2025)	Fifth-grade social studies at SD Islam Sabilillah 1 Malang	Stylus, multi-touch, interactive maps, shared-screen discussion	Motivation and collaboration increased
(Hasanah, 2025)	Fifth-grade mathematics	Digital manipulatives, digital ruler, area and perimeter simulations	Mathematical abstraction and conceptual understanding improved significantly
(Riyadi & Ningsih, 2025)	Fifth-grade social studies at MI Darwata Sikampuh	Digital maps, historical videos, real-time quizzes, touchscreen interaction	Interest, focus, and student activeness increased

Taken together, these studies suggest two broad patterns of use. The first is presentational use, in which the device mainly replaces the whiteboard or projector and supports visually enriched but still teacher-centered instruction (Naitboho dkk., 2025; Setiawan, 2025). The second is pedagogically interactive use, in which the device becomes part of the learning structure itself through discussion, object manipulation, collaborative response, and immediate feedback (Hartanto dan Wahyuningsih, 2026; Indriansyah, 2025; Sari dkk., 2026). This distinction is not merely descriptive. It serves as the main interpretive thread of the review, because the educational value reported across the literature appears to depend less on the device itself than on which of these two patterns dominates classroom practice.

From this synthesis, it can be inferred that technical interactivity should not be equated with pedagogical interactivity. The broader literature on interactive boards has already shown that technology can remain functionally modern yet pedagogically conventional (F. Smith dkk., 2006). Accordingly, the reviewed studies are most meaningful when read not as isolated reports of device use, but as evidence that the same technology can support very different classroom dynamics depending on instructional design (Kennewell dkk., 2008).

Impact on students' learning processes and outcomes

The review of the core papers reveals four of the most consistent impacts of IFP use in elementary school learning: increased motivation and engagement, improved conceptual understanding, stronger collaboration, and wider opportunities for formative assessment. These should be understood as patterns emerging from synthesis rather than as uniform direct effects produced by every study in the same way.

First, the literature consistently associates IFP use with heightened student motivation and engagement. In the study conducted at SDN 1 Sempu, the use of IFP Display strengthened behavioral engagement through increased questioning frequency, involvement in group tasks, focus on tasks, and participation in interactive activities (Hartanto dan Wahyuningsih, 2026). At SD Islam Sabilillah 1 Malang, student engagement increased through the use of stylus features, multi-touch functions, and shared-screen discussion (Indriansyah, 2025). At SDN Pelambuan 4 Banjarmasin, the integration of Wordwall, Quizizz, and Blooket through the interactive screen created a more interesting and

enjoyable learning atmosphere (Sari dkk., 2026). Read together, these studies indicate that motivation gains are most visible when the device invites direct student response rather than passive viewing.

Second, the reviewed literature suggests that IFP can support conceptual understanding, especially for topics that benefit from visualization and guided manipulation. The study in Kupang shows that the visualization of science and social studies materials made it easier for students to understand topics such as ecosystems, food chains, and natural phenomena that are difficult to grasp through verbal explanation alone (Naitboho dkk., 2025). In mathematics learning, the use of digital manipulatives, virtual square units, and a digital ruler was shown to help students transition from concrete experience to symbolic representation (Hasanah, 2025). The quasi-experimental findings in that paper show that the group using IFP achieved a gain score of 30.33, while the control group achieved 16.53, with a high N-gain in the experimental group and a significant posttest difference (Hasanah, 2025). Within the synthesis as a whole, these findings support the interpretation that the device is especially useful when it helps make abstract content visible, movable, and discussable.

Third, collaborative learning emerges as a recurrent benefit, particularly in studies where the screen functions as a shared workspace. Touchscreen and multi-touch features allow students to work within the same visual space. In Indriansyah's study, students discussed, marked maps, wrote answers, and solved problems in turns and together (Indriansyah, 2025). In Sari and colleagues' study, educational games and screen-based evaluation also encouraged group work and collective participation (Sari dkk., 2026). The broader significance of this pattern lies in showing that collaboration is not simply a side effect of technology use; rather, it becomes more likely when classroom tasks are deliberately structured around collective interaction with digital content (Alfian dkk., 2025; Naila dkk., 2021).

Fourth, the reviewed studies indicate that IFP are particularly promising when integrated into formative assessment practices. Chen and colleagues show that the use of interactive boards in a formative assessment system over one year was significantly associated with elementary students' mathematics achievement (Chen dkk., 2020). The theoretical value of this paper is high because it shows that the benefits of the device become stronger when combined with direct feedback, social discussion, personalized learning, and game-based activities. This pattern is consistent with Indonesian studies that place interactive quizzes and real-time evaluation among the major strengths of IFP use. This suggests that one of the strongest pedagogical affordances of the technology lies in its capacity to connect instruction, student response, and immediate feedback within the same learning sequence.

Thus, the main contribution of the device to learning outcomes lies not in the mere presence of the screen, but in its ability to mediate learning experiences that are more visual, active, collaborative, and responsive. This helps explain why findings related to motivation and conceptual understanding are relatively more consistent than findings related to the more complex domain of digital literacy.

Implications for elementary students' digital literacy

The relationship between IFP and digital literacy requires a more cautious interpretation than the link between device use and general classroom engagement. Across the reviewed studies, the evidence does not show that IFP directly improve digital literacy in a comprehensive sense. Instead, the literature suggests that the device can support selected dimensions of digital literacy when those dimensions are deliberately embedded in learning activities. Naila, Ridlwan, and Haq divide elementary students' digital literacy into information literacy, media literacy, and ICT literacy (Naila dkk., 2021). Meanwhile, Alfian, Santoso, and Saputra identify more operational dimensions, namely technical skills, digital information evaluation, digital ethics, and digital collaboration (Alfian dkk., 2025). If this framework is applied, most Indonesian studies on IFP provide fairly strong support only for technical skills, media literacy, and digital collaboration. Evidence for digital information evaluation and digital ethics remains much more limited.

Table 2, The Contribution of IFP Use to Dimensions of Elementary Students' Digital Literacy

DIMENSION OF DIGITAL LITERACY	SUPPORT FROM IFP USE	STRENGTH OF EVIDENCE
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Technical skills	Students use touchscreens, styluses, menus, digital quizzes, and interactive objects (Indriansyah, 2025; Riyadi dan Ningsih, 2025; Sari dkk., 2026)	Fairly strong
Media literacy	Students understand videos, animations, maps, simulations, and multimodal representations (Hasanah, 2025; Naila dkk., 2021; Naitboho dkk., 2025)	Strong
Digital collaboration	Students discuss, share roles, and work on a shared screen (Hartanto dan Wahyuningsih, 2026; Indriansyah, 2025; Sari dkk., 2026)	Fairly strong
Digital information evaluation	Potentially supported when instruction asks students to compare sources and assess information validity, but direct evidence is still limited (Alfian dkk., 2025; Naila dkk., 2021)	Weak
Digital ethics	Highly potential in platform-based learning, but rarely measured directly (Alfian dkk., 2025)	Very weak

This mapping shows that the contribution of IFP to digital literacy is more facilitative than automatic. The device provides a digital learning environment that is rich in media, interactive, and collaborative. However, gains in digital literacy can only be defended academically when teachers consciously design activities that require students to access, select, compare, evaluate, and use digital information responsibly (Kennewell dkk., 2008; Setiawan, 2025).

In this context, IFP are best understood as a pedagogical medium that expands learning affordances. These affordances appear in the device's ability to display multiple digital sources, facilitate direct interaction, provide immediate feedback, and support collaborative learning within a shared visual space (Hartanto dan Wahyuningsih, 2026; Indriansyah, 2025; Sari dkk., 2026). However, these affordances will not develop into meaningful digital literacy if device use stops at one-way presentation.

Factors determining implementation success

A consistent thread across the reviewed studies is that implementation success depends on pedagogical readiness more than on hardware provision alone. Setiawan places TPACK as the main mediator between investment in devices and learning outcomes (Setiawan, 2025). That paper shows that devices yield optimal benefits when teachers can integrate content knowledge, pedagogical strategies, and technological choices in a coherent way. The same argument also appears in Patta and colleagues' review, which emphasizes that implementation success depends on teacher readiness and the ability to develop relevant digital content (Patta dkk., 2025).

At the level of school practice, the literature also points to a recurring cluster of constraints: limited teacher competence, inadequate infrastructure, insufficient preparation time, and uneven school support. The study in Kupang shows limitations in teachers' pedagogical and digital competence, unstable connectivity, a school culture not yet fully supportive of innovation, and teachers' concerns about damaging the equipment (Naitboho dkk., 2025). The study in Banjarmasin found obstacles related to teacher digital literacy and infrastructure (Sari dkk., 2026). The study at SDN 1 Sempu adds the problem of limited time to design rich interactive activities (Hartanto dan Wahyuningsih, 2026).

Table 3. Key Factors Influencing the Successful Implementation of IFP in Elementary Schools

FACTOR	EXPLANATION	SUPPORTING PAPERS
Teacher TPACK competence	Device integration requires integrated mastery of content, pedagogy, and technology	(Patta dkk., 2025; Purwanto, 2019; Setiawan, 2025)
Activity design	The strongest impacts appear when the device is used for discussion, manipulation, and formative assessment	(Afriyanti & Junaidi, 2022; Chen dkk., 2020; Sari dkk., 2026)

Infrastructure	Internet, electricity, technical support, and device availability shape implementation quality	(Naitboho dkk., 2025; Mohammad Naufal Zabidi dan Abd. Bassith Tamami, 2021; Indah dkk., 2025)
School culture	Principal support and teacher collaboration strengthen innovation sustainability	(Manan, 2019; Mohammad Naufal Zabidi & Abd. Bassith Tamami, 2021)
Digital content readiness	Materials need to be redesigned to fit the interactive nature of the device	(Anggraeni dan Mukhlis, 2023; Patta dkk., 2025; Badi'ah dkk., 2021)

These findings confirm that the main issue in IFP use is not simply access to the device, but the pedagogical capacity of schools to turn the device into meaningful learning experiences. Therefore, evaluation of device implementation should not stop at the number of units available, but should also examine the quality of classroom learning activities that the device helps produce.

Directions for future innovation in learning methods

Because the strongest evidence concerns engagement, conceptual understanding, collaboration, and formative feedback, the next logical step is not simply wider hardware adoption but more explicit pedagogical integration of digital literacy goals. Based on the literature synthesis, the most feasible direction for innovation in Indonesian elementary schools is an IFP-based learning model that explicitly positions digital literacy as a learning objective. This direction is stronger than using the device merely as a modern presentation tool because it directly addresses the main weakness in the literature, which has largely stopped at motivation and general learning outcomes. A conceptual model that can be developed consists of four learning stages.

Table 4. Proposed IFP-Based Learning Model for Strengthening Digital Literacy in Elementary Schools

STAGE	ACTIVITY FOCUS	DIGITAL LITERACY DIMENSIONS DEVELOPED	EVIDENCE BASE
Multimodal orientation	Teachers introduce topics through videos, animations, maps, or simulations on the screen	Media literacy and initial technical skills	(Badi'ah dkk., 2021; Naila dkk., 2021; Nurjannah, 2022)
Information exploration	Students compare digital sources, read visual data, and mark important information	Information literacy and digital information evaluation	(Dewi dkk., 2021; Efendi dkk., 2025; Junaidi dkk., 2024)
Collaboration and production	Students work in groups to compose answers, annotations, concept maps, or short screen-based products	Digital collaboration, communication, creativity	(Hartanto dan Wahyuningsih, 2026; Indriansyah, 2025; Sari dkk., 2026)
Reflective formative assessment	Teachers use real-time quizzes, polling, and direct feedback, then invite students to reflect on digital media use	Technical skills, evaluation, and responsible technology use	(Agusta dkk., 2025; Chen dkk., 2020; Septiyaningtiyas dkk., 2025)

This proposed model should be read as a conceptual implication of the synthesis rather than as a validated instructional framework. First, it is realistic for elementary classrooms because it is grounded in practices already found in Indonesian studies, such as educational videos, simulations, interactive quizzes, and touchscreen use (Riyadi dan Ningsih, 2024; Sari dkk., 2026). Second, it expands the function of the IFP from a content delivery tool into a

medium for information exploration and digital response production. Third, it creates a clearer bridge between subject learning goals and the strengthening of students' digital literacy (Alfian dkk., 2025; Naila dkk., 2021).

From a theoretical perspective, this model is consistent with social constructivism, which views learning as the result of interaction, dialogue, and shared work (Indriansyah, 2025). It is also consistent with the TPACK framework, which places the teacher as the main designer of technology integration in learning (Purwanto, 2019; Setiawan, 2025). Accordingly, future innovation in IFP-based learning should begin from the design of meaningful activities and literacy-oriented tasks, rather than from the assumption that technical sophistication alone will transform classroom learning.

CONCLUSION

This review shows that the use of IFP in elementary schools is consistently associated with increases in students' motivation, engagement, collaboration, and conceptual understanding. However, evidence of direct improvement in digital literacy remains weak because most studies have not measured digital literacy dimensions specifically. Therefore, the academically strongest position is to regard IFP as a pedagogical medium that can support digital literacy when used for information exploration, media reading, digital collaboration, and formative assessment rather than merely as presentation screens.

The success of implementing this technology is shaped more by learning design, teacher TPACK competence, digital content readiness, and school infrastructure support than by the mere presence of the device. Accordingly, the most promising innovation in IFP-based learning is a model that intentionally integrates information literacy, media literacy, technical skills, and digital collaboration into active, collaborative, and reflective learning activities.

This conclusion also carries several practical implications. For teachers, the findings suggest the need to move beyond presentation-oriented use and to design activities that require students to interact with digital content, discuss information, and respond through collaborative and formative tasks. For schools, the review indicates that device provision should be accompanied by sustained professional development, technical support, and time for teachers to prepare interactive learning materials. For researchers, the synthesis highlights the need for future studies that measure digital literacy dimensions more explicitly, especially digital information evaluation and digital ethics, so that claims about the educational contribution of IFP can be tested more rigorously.

At the same time, the conclusion should be read in light of the study's limitations. This article is a narrative synthesis, not a systematic review with formal quality scoring or meta-analytic aggregation. Its conclusions therefore depend on the scope, quality, and conceptual relevance of the studies reviewed. Even so, the synthesis provides a useful basis for understanding that the educational significance of IFP lies less in the device itself than in the pedagogical practices through which it is used in elementary classrooms.

In practical terms, elementary schools need to direct IFP use toward activities that give students room to access, discuss, and evaluate digital information rather than merely watch teacher presentations. Pedagogically, teachers need stronger TPACK and training in interactive activity design that positions students as the main actors in learning. Academically, future research needs to move beyond reporting motivation and classroom activeness toward more direct measurement of elementary students' digital literacy dimensions, especially digital information evaluation and digital ethics.

REFERENCES

- Afriyanti, L., & Junaidi, K. (2022). ... Santripreneur Sebagai Penggerak Ekonomi Kreatif di Pondok Pesantren: Digital Literacy Accompanied For Santripreneur Development As Creative Economic *SENTIMAS: Seminar Nasional Penelitian dan ...*, 1(1), 495–500.
<https://journal.irpi.or.id/index.php/sentimas/article/view/215%0Ahttps://journal.irpi.or.id/index.php/sentimas/article/download/215/184>

- Agusta, G. E., Astriawati, N., Santosa, P. S., & Widyanto, H. (2025). Edukasi Bijak Bermedsos: Membangun Literasi Digital untuk Santri Cerdas dan Beretika. *Al Mu'azarah: Jurnal Pengabdian Kepada Masyarakat*, 2(2), 100–109. <https://doi.org/10.38073/almuazarah.v2i2.2095>
- Alfian, A., Santoso, I., & Saputra, D. S. (2025). Developing and Validating a Digital Literacy Assessment Tool for Indonesian Primary Education. *AL-ISHLAH: Jurnal Pendidikan*, 17(2), 2923–2937. <https://doi.org/10.35445/alishlah.v17i2.7741>
- Anggraeni, L., & Mukhlis, F. (2023). Penguatan Literasi Islam dan Sains Sebagai Peningkatan Wawasan Generasi Muda Islami Era Society 5.0 di Ikatan Pemuda Muhammadiyah Kota Batu. *Jurnal Pengabdian Pada Masyarakat*, 8(2), 478–489. <https://doi.org/10.30653/jppm.v8i2.327>
- Badi'ah, S., Salim, L., & Syahputra, M. C. (2021). Pesantren dan Perubahan Sosial pada Era Digital. *Analisis: Jurnal Studi Keislaman*, 21(2), 349–364. <https://doi.org/10.24042/ajsk.v21i2.10244>
- Chen, I. H., Gamble, J. H., Lee, Z. H., & Fu, Q. L. (2020). Formative assessment with interactive whiteboards: A one-year longitudinal study of primary students' mathematical performance. *Computers and Education*, 150, 103833. <https://doi.org/10.1016/j.compedu.2020.103833>
- Dewi, D. A., Hamid, S. I., Annisa, F., Oktafianti, M., & Genika, P. R. (2021). Menumbuhkan Karakter Siswa melalui Pemanfaatan Literasi Digital. *Jurnal Basicedu*, 5(6), 5249–5257. <https://doi.org/10.31004/basicedu.v5i6.1609>
- Efendi, M. F., Safira, Bq. W., & Agustuna, D. H. (2025). Tantangan Pendidikan Pancasila dalam Era Digitalisasi. *Journal of Education*, 1(2). <https://doi.org/10.1177/002205740305702212>
- Hartanto, P., & Wahyuningsih, D. (2026). The Impact of Interactive Flat Panels Displays (IFPD) on Student Engagement and Learning Motivation. *Golden Ratio of Data in Summary*, 6(2), 79–88.
- Hasanah. (2025). Interactive Flat Panels Media To Enhance Mathematical Abstraction Skills in Elementary Students. *International Journal of Applied Mathematics*, 38(11s), 1756–1766. <https://doi.org/10.12732/ijam.v38i11s.1281>
- Indah, E. C. S., Pratiwi, D. E., Masitoh, S. D., Sari, Y., & Jannah, S. R. (2025). Penyiaran Publik Cerdas untuk Literasi Digital Sekolah Dasar bersama TV Merah Putih. *Jurnal Caksana : Pendidikan Anak Usia Dini*, 8(2), 1248–1257. <https://doi.org/10.31326/jcpaud.v8i2.2638>
- Indriansyah, R. T. (2025). Peran Media Interactive Flat Panels Display (IFPD) Dalam Meningkatkan Motivasi dan Kolaborasi Belajar Siswa. *Dinamika Sosial: Jurnal Pendidikan Ilmu Pengetahuan Sosial*, 4(4), 493–501. <https://doi.org/10.18860/dsjpips.v4i4.19859>
- Junaidi, K., Hitami, M., & Zaitun, Z. (2024). Dampak Transformasi Digital terhadap Metode Pengajaran di Pondok Pesantren Kabupaten Kampar: Peluang dan Tantangan. *Instructional Development Journal*, 7(1), 173. <https://doi.org/10.24014/idj.v7i1.31426>
- Kennewell, S., Tanner, H., Jones, S., & Beauchamp, G. (2008). Analysing the use of interactive technology to implement interactive teaching: Original article. *Journal of Computer Assisted Learning*, 24(1), 61–73. <https://doi.org/10.1111/j.1365-2729.2007.00244.x>
- Manan, M. A. (2019). Daya Tahan dan Eksistensi Pesantren Di Era 4.0. Dalam *Jurnal Pendidikan Islam Indonesia* (Vol. 3, Nomor 2). <https://doi.org/10.35316/jpii.v3i2.135>
- Mohammad Naufal Zabidi, & Abd. Bassith Tamami. (2021). Keefektifan Upaya Meningkatkan Literasi Digital Pada Pesantren Rakyat Di Al-Amin Sumber Pucung Malang. *Jurnal Pendidikan Indonesia*, 2(1), 48–58. <https://doi.org/10.36418/japendi.v2i1.44>
- Naila, I., Ridlwani, M., & Haq, M. A. (2021). Literasi Digital bagi Guru dan Siswa Sekolah Dasar: Analisis Konten dalam Pembelajaran. *Jurnal Review Pendidikan Dasar : Jurnal Kajian Pendidikan dan Hasil Penelitian*, 7(2), 166–122. <https://doi.org/10.26740/jrpd.v7n2.p166-122>
- Naitboho, O., Naldo, R., Deku, E. R., Bulan, R. E., Bumbung, M. E., & Duka, S. (2025). The Effectiveness of Interactive Flat Panels (IFP) Utilization In Supporting Innovative IPAS Learning in Elementary Schools. *Paradigma: Jurnal Filsafat, Sains, Teknologi, dan Sosial Budaya*, 31(2), 854–861. <https://doi.org/10.33503/paradigma.v31i2.2760>

- Nurjannah, N. (2022). Tantangan Pengembangan Kurikulum dalam Meningkatkan Literasi Digital Serta Pembentukan Karakter Peserta Didik di Indonesia. *Jurnal Basicedu*, 6(4), 6844–6854. <https://doi.org/10.31004/basicedu.v6i4.3328>
- Patta, N. M., H, N., Tohamba, C. P. P., & Hakim, A. (2025). Dampak Penggunaan Panel Interaktif Pada Proses Belajar Mengajar Di Kelas. *STRATEGY : Jurnal Inovasi Strategi dan Model Pembelajaran*, 5(4), 619–628. <https://doi.org/10.51878/strategi.v5i4.7850>
- Purwanto, P. (2019). Penggunaan Papan Tulis Interaktif Di Kelas the Use of Interactive Whiteboard in Classroom. *Jurnal Teknodik*, 104–116. <https://doi.org/10.32550/teknodik.v17i3.565>
- Riyadi, R., & Ningsih, T. (2024). Use of Interactive Flat Panels Display (IFPD) Media in Social Studies Learning for Madrasah Students. *Edutainment*, 12(2). <https://doi.org/10.35438/e.v12i2.921>
- Riyadi, R., & Ningsih, T. (2025). Pemanfaatan Media Interactive Flat Panels Display (IFPD) Dalam Pembelajaran Ips Bagi Siswa Madrasah. *ELSE (Elementary School Education Journal): Jurnal Pendidikan dan Pembelajaran Sekolah Dasar*, 8(3). <https://doi.org/10.30651/else.v8i3.24401>
- Sari, A. M., Muthoharoh, T., Murhartoyo, M., Aslamiah, A., & Amelia, R. (2026). Pemanfaatan Interactive Flat Panels (IFP)/Smartboard sebagai Media Pembelajaran Interaktif di SDN Pelambuan 4 Banjarmasin. *Jurnal Pendidikan dan Pembelajaran Indonesia (JPPI)*, 6(1), 170–183. <https://doi.org/10.53299/jppi.v6i1.3302>
- Septiyaningtiyas, H. D., Handhayani, S., Winata, B. P., & Setiadi, H. W. (2025). Integrasi Interaktif Flat Panel Dan Smart Tv Dalam Penggunaan Platform Interaktif (Wordwall, Liveworksheets, Kahoot) Dalam Pengembangan Bahan Ajar Digital Untuk Meningkatkan Partisipasi Belajar Siswa. *Jurnal IKA PGSD (Ikatan Alumni PGSD) UNARS*, 16(2), 254. <https://doi.org/10.36841/pgsdunars.v16i2.7524>
- Setiawan, A. (2025). Interactive Flat Panels in Primary English as A Foreign Language Classroom: A Thematic Review for Indonesian Educators and Policymakers. *Aplinesia (Journal of Applied Linguistics Indonesia)*, 9(2), 1–39. <https://doi.org/10.30595/aplinesia.v9i2.29837>
- Smith, F., Hardman, F., & Higgins, S. (2006). The impact of interactive whiteboards on teacher-pupil interaction in the National Literacy and Numeracy Strategies. *British Educational Research Journal*, 32(3), 443–457. <https://doi.org/10.1080/01411920600635452>
- Smith, H. J., Higgins, S., Wall, K., & Miller, J. (2005). Interactive whiteboards: Boon or bandwagon? A critical review of the literature. *Journal of Computer Assisted Learning*, 21(2), 91–101. <https://doi.org/10.1111/j.1365-2729.2005.00117.x>