

The Impact of Interactive Flat Panel Displays (IFPD) on Student Engagement and Learning Motivation

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ABSTRACT

This study examines the impact of Interactive Flat Panel Displays (IFPDs) on students' engagement and learning motivation in elementary education at SDN 1 Sempu. Student engagement and motivation are important aspects of the learning process, particularly at the elementary school level, where meaningful and interactive learning experiences can support students' active participation and deeper understanding. The integration of interactive technology such as IFPDs plays a strategic role in creating engaging and student-centered learning environments by combining multimedia content, touchscreen interaction, and collaborative activities. The objective of this study was to explore how the use of IFPDs influences students' behavioral and cognitive engagement as well as their learning motivation in classroom settings. This study employed a qualitative case study approach using classroom observations, semi-structured interviews, and documentation to collect data. The participants included elementary school teachers and students at SDN 1 Sempu who had experience using IFPDs in classroom instruction. The findings revealed that the use of IFPDs enhanced students' learning experiences through three main aspects: increased behavioral engagement during interactive activities, improved cognitive engagement through visual and interactive learning materials, and strengthened learning motivation characterized by enthusiasm and active participation. Students were more involved in touchscreen-based activities, group discussions, and interactive quizzes, which helped them focus on learning tasks and understand the material more effectively. However, the findings also indicated that the effectiveness of IFPDs depended on teacher facilitation and pedagogical integration. Teachers who designed interactive and student-centered activities were able to maximize the benefits of IFPDs, while limited technical skills and preparation time sometimes became challenges in implementation. Overall, the study concludes that the integration of IFPDs can significantly enhance student engagement and learning motivation when supported by effective teaching strategies and adequate teacher preparation. The findings contribute to the understanding of technology integration in elementary education and provide practical insights for teachers and schools in optimizing the use of interactive digital technologies in classroom learning.

Keywords: Interactive Flat Panel Display, Student Engagement, Learning Motivation, Elementary Education, Educational Technology.

I. Introduction

In recent years, education systems worldwide have undergone significant transformation due to the rapid integration of digital technologies into teaching and learning processes (Selwyn, 2016). Among these technologies, Interactive Flat Panel Displays (IFPDs) have emerged as a prominent instructional tool designed



to facilitate interactive and collaborative learning (Hwang et al., 2020; Johnson et al., 2017). IFPDs—large touchscreen displays with integrated software—support multimedia content, multi-user interaction, and immediate feedback, allowing teachers to implement learner-centered pedagogies more effectively than traditional whiteboards or projectors (Fisser & Phillips, 2017). In elementary classrooms, such technology has the potential to transform student engagement and motivation, which are critical determinants of academic success (Fredricks, Blumenfeld, & Paris, 2004). Student engagement refers to the behavioral, cognitive, and emotional involvement of learners in the educational process (Appleton, Christenson, & Furlong, 2008). Engaged students demonstrate sustained attention, persistence in challenging tasks, and enthusiasm for learning activities (Reeve, 2012). Behavioral engagement includes participation and collaboration; cognitive engagement involves deep thinking and self-regulation; while emotional engagement reflects interest and enjoyment (Skinner & Pitzer, 2012). Studies have shown that technology-enhanced environments can increase engagement by providing multisensory stimuli and interactive participation opportunities, which are especially appealing to young learners (Higgins, Beauchamp, & Miller, 2017). This is further supported by evidence that utilizing interactive digital tools and game-based learning platforms in elementary science education can significantly boost students' active participation and learning enthusiasm (MY, Hajar, & Arsyad, 2024).

Research has documented those interactive technologies, including IFPDs, can promote behavioral engagement by enabling students to interact directly with academic content (Sadera & Gunter, 2007; Smith et al., 2018). For example, students using IFPDs engage collaboratively in touch-based tasks, which lead to increased communication, peer support, and constructive learning behaviors (Liu et al., 2019). Moreover, the visual richness and interactive feedback provided by IFPDs support cognitive engagement, helping learners visualize abstract concepts and maintain focused attention (Hsieh, 2021). The integration of structured visual tools, such as mind mapping, within problem-based learning models has also been shown to effectively stimulate the critical thinking skills of elementary students (Nurfadila, Nurlina, & Ma'ruf, 2023; MY, Nurlina, & Ma'ruf, 2026). Closely connected to engagement, learning motivation—the internal drive to initiate and sustain learning behaviors—plays an essential role in academic achievement (Deci & Ryan, 2000; Wigfield & Cambria, 2010). According to Self-Determination Theory (SDT), motivation increases when learners experience autonomy, competence, and relatedness (Ryan & Deci, 2017). Digital tools that offer choice, challenge, and immediate feedback can satisfy these psychological needs, fostering intrinsic motivation (Ryan et al., 2018). Interactive displays like IFPDs can present content in meaningful and stimulating ways, increasing learners' curiosity and willingness to engage with instructional material (Chai et al., 2019).

In elementary education, where attention spans are variable and developmental needs are unique, interactive technologies can be pivotal. Young learners often benefit from hands-on and visually engaging tasks, which are difficult to achieve with static content (Yilmaz, 2016). IFPDs allow teachers to integrate multimedia elements—animation, video, games—into lessons, thereby creating dynamic experiences that appeal to diverse learning styles (Özdemir & Özdemir, 2020). Prior research in primary classrooms indicates that students exposed to IFPD-supported instruction report higher levels of interest, enjoyment, and participation compared with traditional instruction (Hsu & Ching, 2015; Rafi et al., 2020). Despite these promising outcomes, the effectiveness of IFPDs depends on pedagogical integration and teacher readiness. Teachers play a central role in mediating technology usage; when they lack confidence or pedagogical skills, IFPDs may simply serve as modern projectors rather than tools for dialogic and interactive learning (Tondeur et al., 2017; Ertmer et al., 2019). Research in Indonesian classrooms underscores this challenge, reporting that teacher professional development and curriculum alignment are crucial for maximizing the benefits of digital tools (Pamungkas et al., 2020; Setianingsih, 2021). Therefore, a robust analysis of teacher competency development programs is necessary to ensure successful digital transformation in schools (Suarlin, MY, & Arsyad, 2025).

Within the Indonesian context, the Ministry of Education emphasizes digital literacy and the integration of information and communication technologies (ICT) in the 21st-century learning framework (Kemendikbud, 2018). National studies suggest that schools adopting interactive display technologies

observe improvements in student participation and collaboration (Nurhayati, 2022; Rahmawati & Suhendi, 2023). However, empirical research specifically examining the impact of IFPDs on elementary students' engagement and motivation remains limited, particularly within localized case contexts such as SDN 1 Sempu. International research supports these observations. A study in Singapore found that IFPD-enhanced lessons increased student enthusiasm and participation compared with traditional instruction (Ong & Lai, 2016). In Europe, research in primary schools demonstrated that IFPDs positively influenced learning attitudes and collaborative skills, though the effect size varied according to teacher competence (Pérez-Sanagustín et al., 2019). Despite positive trends, some studies highlight challenges related to classroom management, unequal access, and technical disruptions, which can mitigate potential motivational gains (Li & Ma, 2019).

Moreover, meta-analyses suggest that digital technology alone does not guarantee improved learning outcomes; rather, effectiveness depends on contextual factors, such as instructional design, teacher digital literacy, and learner characteristics (Hattie, 2017; Tamim et al., 2015). For instance, technologies that align with constructivist pedagogies—where students collaborate, explore, and reflect—are more likely to enhance engagement and motivation than those used primarily for presentation (Luckin et al., 2018). Furthermore, addressing digital inequality remains a critical policy challenge in ensuring that disadvantaged regions can also benefit from these advancements (Suarlin, Elpisah, & MY, 2026). In this respect, case studies offer an in-depth understanding of educational phenomena within real-world contexts (Yin, 2018). By focusing on SDN 1 Sempu—a primary school implementing IFPDs—this research aims to examine not only whether IFPDs influence engagement and motivation, but also how students experience interactive learning and how teachers facilitate technology use. Such insights can contribute to national and international discourse on effective digital learning environments, informing practitioners, policymakers, and researchers. In summary, although interactive technologies like IFPDs hold promise for increasing student engagement and learning motivation in elementary classrooms, their impact is shaped by pedagogical practices and contextual conditions. Indonesian classrooms, including SDN 1 Sempu, present meaningful contexts for exploring these dynamics. By investigating the relationship between IFPD use, student engagement, and motivation, this study seeks to fill a gap in the literature and offer evidence-based recommendations for enhancing technology-supported teaching and learning.

II. Literature Review

The integration of digital technologies in education has reshaped pedagogical practices and student learning experiences. Among these technologies, Interactive Flat Panel Displays (IFPDs) have gained attention for their potential to enhance engagement and motivation in classrooms (Hwang et al., 2020; Johnson et al., 2017). IFPDs combine the functionalities of touchscreens, multimedia, and collaborative tools, allowing for more interactive and student-centered learning experiences compared with traditional whiteboards or projectors (Fisser & Phillips, 2017). Student engagement is a multidimensional construct encompassing behavioral, cognitive, and emotional components (Fredricks, Blumenfeld, & Paris, 2004). Behavioral engagement refers to participation and effort in learning tasks, cognitive engagement relates to investment in understanding and self-regulation, and emotional engagement reflects interest and positive attitudes toward learning. Studies indicate that interactive technologies, particularly IFPDs, facilitate these dimensions by enabling active participation, visualization of abstract concepts, and collaborative learning (Liu et al., 2019; Hsieh, 2021). For example, touch-based activities on IFPDs allow students to manipulate content, discuss problem-solving strategies with peers, and receive immediate feedback, thereby promoting deeper engagement (Sadera & Gunter, 2007; Smith et al., 2018).

Closely linked to engagement, learning motivation is influenced by both intrinsic factors (e.g., curiosity, interest) and extrinsic factors (e.g., grades, rewards) (Deci & Ryan, 2000; Wigfield & Cambria, 2010). The Self-Determination Theory posits that environments supporting autonomy, competence, and relatedness enhance intrinsic motivation (Ryan & Deci, 2017). IFPDs contribute to this process by offering dynamic and

interactive content, fostering learner autonomy through exploratory tasks, and enabling collaborative problem-solving that enhances relatedness (Chai et al., 2019; Ryan et al., 2018). Research in primary education has shown that IFPDs positively influence both engagement and motivation. Yilmaz (2016) and Özdemir & Özdemir (2020) note that young learners benefit from visual and tactile interaction, which maintains attention and stimulates curiosity. Hsu & Ching (2015) further report that multimedia-supported lessons using interactive displays improve students' participation and willingness to engage in learning activities. National studies in Indonesia also highlight the potential of IFPDs to enhance classroom interactivity, though challenges remain in teacher readiness and integration strategies (Nurhayati, 2022; Pamungkas et al., 2020; Setianingsih, 2021).

Despite promising outcomes, scholars caution that the effectiveness of IFPDs depends on pedagogical integration and contextual factors. Simply providing technology is insufficient; teachers must align interactive tools with lesson objectives and facilitate meaningful student-centered activities (Ertmer et al., 2019; Tondeur et al., 2017). Furthermore, issues such as uneven access, technical disruptions, and limited teacher competence can diminish the positive effects on motivation and engagement (Li & Ma, 2019). Overall, the literature emphasizes that IFPDs serve as a powerful medium to support active, interactive, and motivating learning experiences, particularly in elementary classrooms where engagement is often fragile and attention spans are short. However, optimal outcomes are contingent upon teacher facilitation, curriculum alignment, and integration strategies. This underscores the need for context-specific studies, such as investigating the implementation of IFPDs at SDN 1 Sempu, to provide practical insights into enhancing student engagement and motivation in Indonesian primary education contexts.

III. Research Method

This study employed a qualitative case study design to investigate the impact of Interactive Flat Panel Displays (IFPDs) on student engagement and learning motivation at SDN 1 Sempu. A case study approach was selected because it allows for an in-depth exploration of complex educational phenomena within real-life classroom contexts, particularly how technology interacts with teaching practices and student experiences (Yin, 2018; Rafi et al., 2022). The participants consisted of 30 elementary students from grades 4 and 5 who had at least three months of exposure to IFPD-supported lessons, as well as two classroom teachers who regularly integrated IFPDs into their instruction. Participants were chosen using purposive sampling to ensure that they had sufficient experience to provide meaningful insights into engagement and motivation (Pamungkas et al., 2021; Setianingsih & Idris, 2022). Multiple data sources were employed to enhance credibility. Classroom observations were conducted over four weeks to document students' behavioral, cognitive, and emotional engagement during IFPD-mediated activities (Yilmaz & Yilmaz, 2021). Semi-structured interviews with students and teachers captured perceptions, experiences, and challenges related to IFPD use, while lesson plans and student work artifacts were analyzed to provide contextual understanding of instructional strategies and content design (Hsieh, 2021; Sharma & Sharma, 2023). The collected data were analyzed using thematic analysis, following Braun and Clarke's (2006) six-step procedure, including familiarization, coding, theme development, theme review, and reporting (Nguyen et al., 2021). Triangulation of observation, interview, and document data ensured trustworthiness and minimized researcher bias (Smith et al., 2018). Ethical considerations were carefully observed: permission was obtained from school authorities, informed consent was secured from teachers and parents, and students' anonymity and confidentiality were strictly maintained. Participants were informed of the voluntary nature of their involvement and their right to withdraw at any stage (Ryan & Deci, 2020). This methodological framework provided a comprehensive examination of how IFPDs influence student engagement and learning motivation, capturing both observable behaviors and subjective experiences within the primary classroom context.

IV. Result and Discussion

4.1. Overview of Findings

This study examined how the integration of Interactive Flat Panel Displays (IFPDs) in elementary classroom instruction influenced students' engagement and learning motivation at SDN 1 Sempu. Data were collected through classroom observations, interviews with students and teachers, and document analysis of lesson artifacts. The findings indicate substantial positive impacts on multiple dimensions of engagement and motivation when IFPDs were used with student-centered, interactive instructional strategies. These findings are consistent with recent studies showing that Interactive Flat Panels and smartboard technologies can enhance classroom interaction and student motivation through interactive and collaborative learning environments (Indriansyah, 2025; Suryandari et al., 2025; Ainurrohmah et al., 2026). Three broad themes emerged from the data: enhanced behavioral engagement, reflected in students' active participation during lessons and their interactions with peers and learning content; heightened cognitive engagement, observed through deeper processing of instructional material and improved problem-solving abilities; and increased learning motivation, marked by sustained interest, enthusiasm, and a willingness to participate in learning activities. These three dimensions of engagement are commonly reported in studies on interactive learning technologies, particularly those involving touchscreen-based instructional media (Julaeha et al., 2025; Nugraha et al., 2023).

4.2. Behavioral Engagement

Behavioral engagement, defined as students' active involvement and participation during learning activities, significantly increased after the introduction of IFPDs. Observations revealed that students were more inclined to raise questions, interact with multimedia content, and participate in group tasks facilitated through touchscreen activities. For example, in science and thematic lessons, students frequently engaged with drag-and-drop exercises and interactive quizzes displayed on the panel, which sustained attention and reduced off-task behavior. Similar findings were reported in studies showing that IFP technology supports active learning environments and encourages students to participate more actively in classroom activities (Suryandari et al., 2025; Nugrahani et al., 2025). These findings align with national studies indicating that interactive, technology-enhanced learning environments positively influence participation and behavioral engagement. In the case of SDN Menteng Atas 01, researchers reported that the use of IFP in IPAS lessons created a more dynamic learning environment where students were more actively involved in asking questions, discussing content, and responding to interactive tasks than in traditional instruction without IFPs (Suryandari et al., 2025).

Similarly, research on IFP implementation in elementary Religious Education (PAI) classes found increased student participation in discussions and digital engagement with instructional material (Indriansyah, 2025; Hidayat & Musnandar, 2025). International research supports these qualitative findings, showing that interactive display technologies promote active learning behaviors. Studies on technology-enhanced learning environments suggest that multimodal content, immediate feedback, and collaborative tasks facilitated through digital panels result in greater student interaction and classroom involvement compared to static media. These findings are also supported by research on SmartBoard technology which emphasizes its ability to facilitate direct interaction with learning content (Rahayu & Makmur, 2024).

4.3. Cognitive Engagement and Higher-Order Thinking

The use of IFPDs also appeared to bolster cognitive engagement among students that is, deeper thinking, conceptual understanding, and meta-cognitive processing. During observed lessons, students were not only participating physically but were also cognitively processing complex content through interactive simulations and scaffolded tasks. For instance, in thematic science lessons, students used the touch features

to manipulate diagrams and explore cause-effect relationships, which helped them articulate their understanding through peer discussion and reflection. Similar outcomes were reported in studies demonstrating that interactive digital media help students process information more deeply through visual and kinesthetic interaction (Salsyabila & Zulherman, 2024).

Findings from other Indonesian research echo this effect of interactive digital media on cognitive engagement. A study on combined IFP and interactive learning environments found improved student engagement scores and greater participation in group problem-solving tasks (Indriansyah, 2025). Likewise, research in elementary classrooms with IFPs showed that interactive features such as drag-and-drop, concept mapping, and interactive quizzes encouraged students to articulate reasoning, represent ideas, and solve problems collaboratively (Suryandari et al., 2025; Nugrahani et al., 2025). This evidence resonates with broader research on technology-enhanced classrooms, where interactive digital tools by supporting multimodal representation of content help students engage more deeply with academic material (Julaeha et al., 2025). Such tools can scaffold learning in ways that promote strategic thinking and self-regulated learning (e.g., setting goals, monitoring progress, and evaluating results), particularly when interactive features are used consistently across lessons (Nugraha et al., 2023).

4.4. Learning Motivation

One of the most prominent effects observed in this study was on learning motivation. Motivation was measured through student self-reports and teacher observations focusing on interest, persistence, and enthusiasm. After integrating IFPDs into classroom instruction, students exhibited increased curiosity, greater willingness to participate, and a more positive attitude toward learning tasks. These findings are consistent with research showing that interactive digital displays enhance intrinsic motivation by creating visually engaging and participatory learning environments (Ainurrohmah et al., 2026; Indriansyah, 2025). This increase is consistent with multiple recent national studies reporting that interactive digital media and technology can enhance intrinsic motivation among elementary students by making learning more enjoyable and personally relevant (Jandri et al., 2025; Salsyabila & Zulherman, 2024). For example, research at SD Islam Sabillillah 1 Malang found that IFPD use enhanced students' motivation by presenting engaging visuals, interactive touch activities, and stylus-based tasks that made learning more dynamic and enjoyable (Indriansyah, 2025). Another study focusing on smartboard use in elementary classrooms reported increased intrinsic motivation, heightened confidence, and a more collaborative and enjoyable learning atmosphere (Ainurrohmah et al., 2026).

Studies on interactive media more generally have also found significant increases in motivation when digital tools are used to create interactive, student-centered activities that appeal to diverse learning preferences (Julaeha et al., 2025; Nugraha et al., 2023). Furthermore, experimental research indicated that interactive digital media including quizzes and simulations can increase learners' attention, relevance perception, confidence, and satisfaction, leading to enhanced motivation (Fitriyah & Mutammiroh, 2024).

4.5. Teacher Facilitation and Pedagogical Integration

While technology was a strong catalyst for engagement and motivation, its impact was closely mediated by teacher facilitation and pedagogical integration. In classrooms where teachers actively designed IFP-supported activities (e.g., interactive quizzes, collaborative annotation tasks, guided multimedia exploration), students showed higher levels of sustained engagement and cognitive effort than in classes where the IFP was used primarily for direct instruction or presentation. These findings align with research indicating that pedagogical strategies play a crucial role in determining the effectiveness of interactive technology integration (Indriansyah, 2025; Nugrahani et al., 2025).

This observation aligns with research emphasizing the critical role of pedagogical design in technology integration. National studies on IFP utilization management indicate that systematic planning, teacher coordination, and proactive implementation strategies are essential for realizing the full benefits of

technology (IndraSari & Inganah, 2025). Similar findings are reported in thematic reviews showing that interactive flat panels only enhance learning engagement and outcomes when teachers integrate them using well-structured lessons that leverage interactivity for active learning (Rahayu & Makmur, 2024).

4.6. Challenges in Implementation

Despite clear benefits, several challenges emerged in both observed classrooms and supporting literature. Teachers continued to face technical constraints, such as limited mastery of advanced IFP features, occasional software glitches, and insufficient time to design rich interactive activities. Some students also experienced difficulty transitioning from passive observation to active interaction with digital content without guided scaffolding. Similar challenges have been identified in studies examining the integration of interactive technology in classroom settings (IndraSari & Inganah, 2025). These challenges are consistent with findings from other studies, which highlight that technology access alone is insufficient; teacher professional development and technical support are essential for impactful integration (Suryandari et al., 2025; Indriansyah, 2025). National research on IFP in teaching highlighted that although students become more actively involved, teachers often need additional training to optimize use beyond basic functionalities (Nugrahani et al., 2025). Similarly, studies on interactive digital tools emphasize that when teachers lack confidence or support, the technology may remain under-utilized or used as a static display rather than for interactive learning (Rahayu & Makmur, 2024). Another challenge relates to time constraints during lessons. Some teachers reported difficulty balancing curriculum coverage with interactive activities, especially when IFP tasks require additional setup or transitions between digital tools and traditional instruction. Such workload issues have been documented in other contexts as barriers to sustained technology use (IndraSari & Inganah, 2025).

The findings of this study have significant pedagogical and policy implications. First, IFPDs when thoughtfully integrated can serve as powerful tools for fostering engagement and motivation among young learners. Schools aiming to enhance 21st-century learning competencies may benefit from investing in interactive display technologies supported by professional development for teachers (Indriansyah, 2025; IndraSari & Inganah, 2025). Second, the study underscores the importance of teacher training and instructional design support. Professional learning communities, technology coaching, and collaboration time can help teachers design more effective IFP-enabled activities that emphasize inquiry, interactivity, and student autonomy (Suryandari et al., 2025). Third, educational policymakers should consider infrastructure and maintenance planning as part of technology implementation strategies. Ensuring reliable connectivity, technical support, and accessible content repositories will help schools sustain the use of interactive technologies beyond initial deployment (Rahayu & Makmur, 2024). In summary, the integration of IFPDs at SDN 1 Sempu significantly enhanced students' behavioral and cognitive engagement as well as intrinsic motivation. The positive effects were most pronounced in classrooms where teachers employed interactive and student-centered lessons. These results corroborate multiple national studies demonstrating similar outcomes in primary education contexts (Ainurrohmah et al., 2026; Indriansyah, 2025; Suryandari et al., 2025). However, effective pedagogical integration and teacher readiness remain critical factors for maximizing the educational value of IFP technology.

V. Conclusion

This study investigated the impact of Interactive Flat Panel Displays (IFPDs) on students' engagement and learning motivation in elementary education at SDN 1 Sempu. The findings demonstrate that the integration of IFPDs in classroom instruction contributed positively to multiple dimensions of student engagement, including behavioral, cognitive, and motivational aspects. Students showed higher levels of participation during lessons, more active interaction with instructional content, and greater enthusiasm for learning activities when IFPDs were integrated into student-centered teaching practices. The interactive

features of IFPDs, such as touchscreen manipulation, multimedia presentations, and digital quizzes, created a more dynamic and engaging learning environment compared to traditional instructional methods. In terms of behavioral engagement, students became more attentive and actively involved in classroom activities, particularly during collaborative and interactive tasks. Cognitive engagement also improved as students were encouraged to explore concepts through visual and interactive representations, which supported deeper understanding and problem-solving skills. Furthermore, learning motivation increased as students expressed greater curiosity and willingness to participate in classroom activities. The use of interactive digital media appeared to make learning more enjoyable and meaningful, which contributed to students' sustained interest in academic tasks.

However, the study also identified several challenges in implementing IFPDs effectively. Teachers faced limitations related to technical skills, time constraints in preparing interactive materials, and occasional technical issues during lessons. These findings suggest that the successful integration of IFPDs depends not only on the availability of technology but also on teachers' readiness and pedagogical competence in utilizing interactive tools effectively. Overall, this study concludes that IFPDs have significant potential to enhance student engagement and motivation in elementary education when supported by appropriate instructional strategies and teacher training. Therefore, schools and educational policymakers should consider providing continuous professional development and technical support to ensure the optimal use of interactive display technologies in classroom learning.

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