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Implementation of the Interactive Digital Board as a Learning Medium to Enhance Educational Quality in Primary Schools

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ABSTRACT

The development of digital technology has encouraged the use of interactive learning media in primary education, including Interactive Digital Boards (IDB). This study aims to describe the utilization of IDB as an interactive learning medium at SD Negeri 2 Kalak. This study employed a descriptive qualitative approach involving the principal, a fifth-grade teacher, and fifth-grade students selected through purposive sampling. Data were collected through in-depth interviews and direct classroom observations. Data analysis consisted of data reduction, data display, and conclusion drawing, while data trustworthiness was established through source and technique triangulation. The findings indicate that IDB utilization was supported by school management through the provision of facilities and supervision. In classroom activities, teachers integrated the Technological Pedagogical Content Knowledge (TPACK) framework by using annotation features to highlight learning materials, screen-splitting features to display learning content, and digital quizzes to provide interactive learning activities. Students were observed participating by responding to questions, engaging in discussions, and taking part in interactive quiz activities. These activities reflected students' active involvement during the learning process. However, IDB utilization still faced challenges, particularly unstable internet connections and limited teacher preparation time. These findings suggest that IDB can support more varied and interactive learning activities when accompanied by adequate school support and teachers' ability to integrate technology into instruction.

1. INTRODUCTION

The development of digital technology has driven changes in the delivery of education, including at the elementary school level. Learning no longer relies solely on conventional textbooks and blackboards, but has begun to utilize various digital technologies that enable more visual, interactive, and varied presentations of material. Technology can support improved learning quality if its use is positioned according to student needs and continues to strengthen human interaction in the educational process (UNESCO, 2023). At the elementary school level, the use of appropriate learning media plays a crucial role because students still require concrete, visual, and engaging learning experiences to understand various concepts. Digital media allows teachers to integrate text, images, animation, video, audio, and interactive activities within a single learning process. Learning through multimedia can help students build understanding by integrating verbal and visual information more meaningfully if the multimedia is designed according to learning principles (Mayer, 2021). Technology and media, as part of the learning design, need to be selected based on student characteristics, learning objectives, materials, and learning conditions, not simply because of the presence of technological devices in the classroom (Smaldino et al., 2019).

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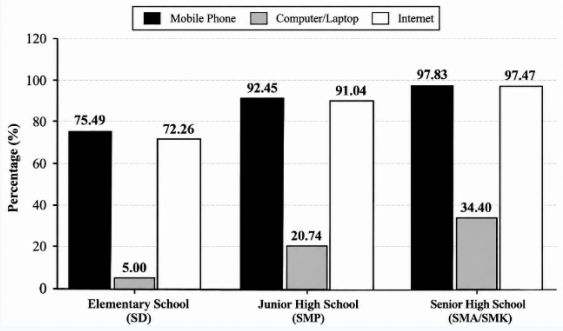


Figure 1. Distribution of Digital Technology Use among Students
Source: Badan Pusat Statistik (2025)

The use of digital technology in education can also be seen from students' access to various digital devices. Based on data from the Central Statistics Agency (BPS) through the March 2025 National Socioeconomic Survey (Susenas) presented in the *2025 Education Statistics publication*, mobile phone use among students reached 75.49% at the elementary school level, 92.45% at the junior high school level, 97.83% at the senior high school level, and 99.51% at the tertiary level. Meanwhile, computer or laptop use was 5.00%, 20.74%, 34.40%, and 64.24%, respectively. Meanwhile, internet use reached 72.26% at the elementary school level, 91.04% at the junior high school level, 97.47% at the senior high school level, and 99.29% at the tertiary level (Syidah, 2025). These data indicate that elementary school students' access to digital technology has increased, although computer or laptop use remains relatively limited compared to mobile phone and internet use. However, these data describe the use of digital devices in general and do not specifically reflect the use of Digital Interactive Boards (DIBs) in learning. Therefore, these data are used to illustrate the context of students' digital technology access, not as an indicator of DIB use in schools. One technology that has the potential to support interactive learning in elementary schools is the Interactive Digital Board (IBD). This device allows teachers to present material through text, images, videos, animations, and interactive exercises, as well as annotate directly on the screen. Students can also interact with the material through touch and teacher-designed learning activities. The Indonesian government is also encouraging the digitalization of learning by providing IBD devices in educational units. This program is aimed at expanding the use of technology in the learning process so that students in various regions have the opportunity to access digital learning resources and content (Rayhan, 2026). Ideally, the use of technology in learning not only functions as a tool for displaying material, but is able to create an active, interactive, collaborative, and student-centered learning process. The IBD has characteristics that support this condition because it allows teachers to display text, images, videos, animations, and interactive exercises, as well as annotate directly on the screen (Khoirunnisa et al., 2026). Students can also interact with the material through touch and teacher-designed learning activities. Interactive digital learning media is aimed at improving students' understanding of historical material, especially because conventional learning tends to face problems in the form of low student interest and involvement (Asbah et al., 2025).

This potential is supported by the results of previous research. Deni & Suratmi (2024) explained that the use of media plays a crucial role in achieving learning objectives, while digital technology can be a solution when the use of learning media is not optimal. The research produced interactive multimedia based on *problem-based learning* that was considered very feasible and practical for use in learning for fifth-grade elementary school students. Research by Putra & Afrina (2023) also developed interactive learning multimedia based on Genially for elementary school students, which shows attention to the use of interactive technology as part of learning media innovation. Furthermore, research on interactive boards more specifically shows positive potential for the learning process. Lestari et al. (2026) stated that Digital Interactive Boards can play a role in increasing learning motivation for elementary school students. Hermayanti & Nisa (2026) also

studied PID as an innovation in mathematics learning in elementary schools, which showed an increase in learning outcomes, while research by Herza et al. (2024) regarding *interactive whiteboards* in Fiqh learning in elementary schools showed that interactive board technology can be used to support more interesting and interactive learning. Kühl & Wohninsland (2022) found that the use of *interactive whiteboards* in learning is related to vocabulary acquisition and student learning motivation. Research by Nguyen-Bich-Thy (2023) on elementary school students in Vietnam also showed that learning using *interactive whiteboards* yielded better results than traditional learning in terms of learning achievement, classroom interaction, and student attitudes. Meanwhile, Zhou et al. (2022) found that supportive conditions and teachers' intentions to use them positively influenced *interactive whiteboard usage behavior*. Therefore, the success of technology depends not only on the availability of devices but also on the readiness and supporting conditions for their use. However, the reality of educational technology utilization does not always align with these ideal conditions. The availability of digital devices does not automatically guarantee interactive learning. Available devices may only be used to display materials or videos, while interactive features such as direct writing, annotations, quizzes, educational games, and student engagement are not optimally utilized (Masria & Ilyas, 2026) . This shows that the issue of digitalization of learning is not only about the availability of devices, but also about how these devices are planned, used, monitored, and developed in learning practices.

UNESCO also reports that evidence regarding the added value of digital technology for learning remains uneven, and that the effectiveness of technology depends heavily on the suitability of the technology to learning objectives, teacher readiness, the school context, and how the technology is used (UNESCO, 2023) . Research by Yunhang & Hidayati (2023) on the implementation of *blended learning* in elementary schools shows that the success of technology-based learning is supported by human resource capacity, support from principals and supervisors, and teachers' ability to utilize various learning media. The study used observation, interviews, and documentation, and analyzed data qualitatively through data reduction, data presentation, and drawing conclusions. If the use of blended learning (PID) is not supported by good planning, teacher skills, supporting facilities, and school monitoring, the technology risks becoming merely an additional facility without providing significant changes to the quality of learning (Andhiny et al., 2026) . Conversely, if blended learning is utilized appropriately, teachers can integrate various learning resources and interactive activities into learning. Students also have greater opportunities to ask questions, discuss, experiment, and interact directly with the material. Therefore, the successful use of PID needs to be seen as a process that involves aspects of school policy, teacher readiness, learning implementation, student response, availability of facilities, as well as evaluation and resolution of obstacles. Based on previous research, there is a research gap *that* needs to be addressed. Previous research on digital learning media has tended to focus on product development, testing media feasibility, measuring motivation or learning outcomes, and analyzing teacher acceptance of the technology. Research on PID specifically has demonstrated the benefits of the device for certain aspects of learning, but has not simultaneously explained how school policies and support are translated into lesson planning, how teachers utilize PID features in teaching practice, how students are involved in its use, and how schools and teachers address emerging obstacles. Furthermore, previous research explored has used different subject contexts, levels, and locations, and therefore has not been able to directly explain the implementation of PID at SD Negeri 2 Kalak. This gap indicates the need for research that not only assesses the benefits of PID based on learning outcomes or motivation, but also understands the actual process of its use in elementary school settings. This gap serves as an important basis for conducting research at SD Negeri 2 Kalak. This research's specific contribution lies in examining the comprehensive implementation of PID within the context of an educational unit, not just measuring the influence of devices on a single learning outcome

variable. This research examines the relationship between school support and policies, teacher learning planning, PID implementation in teaching and learning activities, the use of interactive features, student engagement, as well as obstacles and efforts to optimize its use. The principal, teachers, and students were involved as sources of information to gain understanding from the perspectives of school management, learning implementation, and student experiences. Through this approach, this research is expected to provide an empirical picture of how PID is utilized in learning activities, the factors that influence its implementation, and aspects that still need to be improved so that its use is in accordance with learning objectives. Thus, this research is important to conduct because the presence of digital devices in schools needs to be followed by planned, appropriate, and appropriate utilization of learning needs. PID should not only function as a replacement for a blackboard or a tool for displaying material, but needs to be integrated with learning strategies that encourage student activity, interaction, and involvement. This study aims to describe the implementation of the use of Digital Interactive Boards as an interactive learning medium at SD Negeri 2 Kalak, including school support, learning planning and implementation, student involvement, as well as obstacles and efforts to optimize its use in supporting the improvement of learning quality.

2. METHODS

This study uses a descriptive qualitative approach to describe the implementation of the use of Digital Interactive Boards (DIBs) as an interactive learning medium at SD Negeri 2 Kalak. The study was conducted on October 5–11, 2026. Informants were selected using a purposive sampling technique, with a six-informant design consisting of one principal, one fifth-grade teacher, and four fifth-grade students. The selection of informants was based on their involvement and experience in utilizing DIBs during learning (Sugiyono, 2022) . Data collection was conducted through semi-structured interviews and direct observation. Interviews with the principal focused on policies, facilities, training, monitoring, and obstacles to the use of DIBs. Teacher interviews covered lesson planning, TPACK integration, utilization of DIBs features, student responses, and obstacles and solutions. Meanwhile, student interviews explored experiences, interest, understanding, and activeness during learning. Observations were conducted in fifth-grade learning by paying attention to teacher preparation, use of DIBs features, material delivery, interactions, student activities, and obstacles that emerged. The subjects observed were adjusted to the actual learning schedule that uses DIBs, namely Indonesian. The research instruments were developed based on the study's focus on school management, TPACK integration, PID feature utilization, student responses, and constraints and optimization efforts. Details of the data collection techniques and research instruments are presented in Table 1.

Table 1. Data Collection Techniques and Research Instruments

Informants/Data Sources	Technique	Focus of Observation or Questions
Headmaster	Interview	PID policies, facilities, training, monitoring, and constraints
Fifth grade teacher	Interview	Planning, TPACK integration, PID features, student responses, and solutions
Fifth grade students	Interview	Interest, understanding, activeness, and learning experience
Class V learning	Observation	Preparation, use of PID features, interactions, student activities, and constraints

The research instruments consisted of interview guidelines and observation sheets, compiled based on the research focus. Data were analyzed using the Miles & Huberman (1984) model , including data condensation, data presentation, and conclusion drawing and verification. Condensation was carried out by sorting the interview and observation results based on the research

theme. Next, the data were presented in descriptive and tabular form, and conclusions were drawn by checking their conformity with field evidence. Data validity was tested through source triangulation by comparing information from the principal, teachers, and students, and technical triangulation by matching interview and observation results. The researcher also conducted *member checking* to confirm the conformity of the information with the informants (Sugiyono, 2022) . The study adhered to ethical data collection by requesting permission from the school and the consent of parents or guardians before involving students. Students were given a simple explanation of the research objectives and the freedom to refuse to answer or stop the interview. The identities of all informants were kept confidential.

3. RESULTS AND DISCUSSION

The results of research on the management of the use of Information and Communication Technology (ICT) as an interactive learning medium at SD Negeri 2 Kalak indicate that the use of Digital Interactive Boards (DIBs) involves various aspects, ranging from school policies and support, learning planning, the use of interactive features, to student responses during the learning process. Furthermore, this study also identified several obstacles in the implementation of IBs and efforts made by schools and teachers to optimize their use. Overall, the research findings are summarized in the following chart.

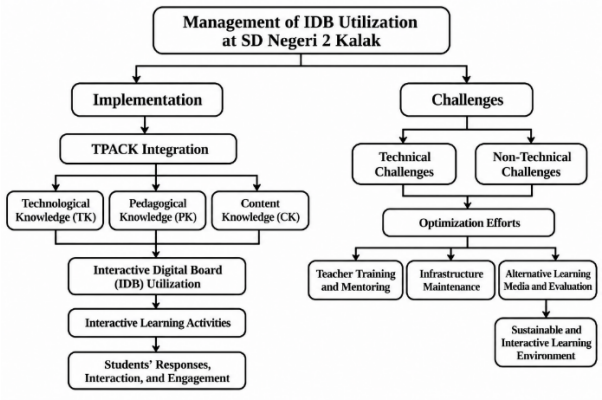


Figure 2. Research Findings on the Management of Interactive Digital Board (IDB) Utilization at SD Negeri 2 Kalak

Based on Figure 2, research findings indicate that the use of Digital Interactive Boards (DIBs) in learning depends not only on the availability of technology, but also on the support of school management and the ability of teachers to integrate aspects of technology, pedagogy, and learning materials through the Technological Pedagogical Content Knowledge (TPACK) approach. The use of interactive DIBs supports the creation of more engaging learning and encourages student engagement. However, its implementation still faces technical and non-technical obstacles, requiring optimization efforts through teacher training, mentoring, infrastructure maintenance, and ongoing evaluation.

3.1 School Policies, Planning, and Support for IDB Utilization

In an effort to transform conventional learning into a more interactive and student-centered environment, Kalak 2 Elementary School has begun utilizing Digital Interactive Boards (DIBs) as a supporting medium for learning activities. The use of these devices is part of the school's efforts to adapt the educational process to developments in information and communication technology. The presence of DIBs provides teachers with the opportunity to develop more varied delivery methods through a combination of text, images, videos, animations, and various interactive learning

applications. Based on interviews with the principal, the policy for utilizing DIBs is aimed at supporting teachers in creating more engaging learning that aligns with developments in educational technology. The principal explained that the use of digital devices is expected to be an alternative in developing the learning process so that it does not solely rely on lecture methods and the use of textbooks. The principal said:*"We hope this digital interactive board will help teachers deliver learni ng materials. We encourage teachers to utilize this facility so that learning doesn't rely solely on lectures or textbooks, but also utilizes technology that's more engaging for students."*This statement demonstrates that the principal's support is a crucial element in encouraging the use of learning technology. This policy not only addresses the availability of devices but also encourages teachers to develop their skills in integrating technology into teaching and learning activities. Furthermore, the principal explained that the use of PID needs to be tailored to teacher readiness and student needs. This is evident in the school's efforts to provide teachers with opportunities to learn how to use the devices and to support each other when they encounter difficulties operating certain features. The principal stated: *"We provide teachers with the opportunity to learn how to use the device. Teachers also help each other if someone doesn't understand how to operate a particular feature. We hope that all teachers can utilize the PID according to their learning needs."*

In addition to the principal's support, lesson planning is a crucial aspect in determining the success of PID utilization. Teachers need to develop lesson plans that take into account student characteristics, learning objectives, the material presented, and the appropriateness of the digital media used. Elementary school-aged children tend to require concrete and visual learning experiences, so presenting material through images, videos, animations, and simulations can help provide a clearer picture of the learning material (Mayer, 2021) . Based on interviews with teachers, the use of PID requires preparation before the teaching and learning activities begin. Teachers first determine the material to be delivered, prepare digital teaching materials, and select applications that align with the learning objectives. The teacher stated: *"Before teaching, I usually prepare the material first, then determine which parts are suitable for display using PID. I also prepare images, videos, or practice questions that are relevant to the material. So, not all materials need to use interactive features, but they should be tailored to the learning needs."* The interview results indicate that PID-based learning planning is not only related to the preparation of materials, but also includes the selection of technology that is appropriate to pedagogical needs. In this case, the application of the Technological Pedagogical Content Knowledge (TPACK) concept is relevant because it integrates knowledge of technology, pedagogy, and learning materials. Thus, the use of PID is not limited to replacing a projector to display slides, but is directed to support the achievement of learning objectives (Smaldino et al., 2019) . Based on these findings, it can be seen that school policies and teacher planning are related in supporting the use of PID. The principal plays a role in providing institutional support, while teachers are responsible for translating this support into learning planning and implementation.

3.2 Teacher Planning and Implementation of IDB-Based Learning

The Digital Interactive Board (DIB)-based learning process at SD Negeri 2 Kalak was developed to shift conventional learning patterns toward a more dynamic and student-centered learning experience. In its implementation, teachers integrate the use of DIB into learning activities by utilizing various digital media tailored to the material and learning objectives. Based on interviews with teachers, DIB is used as a medium to help explain material that requires visual support. Teachers can display material through digital screens so that students gain a clearer picture of the object or concept being studied. The teacher explained: *"I usually explain the material by displaying the teaching materials on the screen. If there's material that requires images or videos, I show them so the students can easily see the examples. After that, I give questions or exercises, and some students*

come forward to try to answer them directly on the screen." This statement demonstrates that the use of PID is not only used as a presentation medium, but also utilized to engage students in learning activities. The teacher begins the activity by explaining the material through a visual display, then asks questions to determine students' understanding. Next, students are given the opportunity to interact directly with the material displayed. For example, when the teacher is delivering material that requires visual observation, the teacher can display images or learning videos through PID. Students are then asked to observe the display, identify the information displayed, and share their observations. The teacher provides reinforcement for students' answers and connects the observations to the concepts of the material being studied. In the next activity, the teacher provided practice questions via the PID screen. Students took turns coming to the front of the class to choose answers, match images to captions, or complete interactive quizzes. This activity provided an opportunity for students to participate directly, while the teacher acted as a facilitator, providing direction and reinforcement for student answers. Based on learning observations, this activity demonstrated that the use of PID can provide greater engagement for students. They not only received explanations from the teacher but also had the opportunity to try, answer questions, and interact with the learning materials. The use of PID in learning activities is also related to the change in learning approach from teacher-centered to more student-centered learning. Teachers continue to play the role of director and facilitator, while students have wider opportunities to observe, try, answer questions, and discuss. This is in line with research by Judijanto et al. (2025) and Khoirunnisa et al. (2026) which emphasizes the importance of using interactive digital media in supporting student engagement during learning. Thus, the implementation of PID-based learning at SD Negeri 2 Kalak is not only related to the use of digital devices, but also involves adjusting learning strategies so that technology can be utilized according to student needs and learning objectives.

3.3 Utilization of Interactive IDB Features in the Learning Process

The use of the Digital Interactive Board (DIB) at SD Negeri 2 Kalak provides teachers with the opportunity to utilize various features that support the delivery of materials and student learning activities. These features enable teachers to develop more varied learning experiences compared to using conventional whiteboards. Based on research results, the DIB features utilized in learning include writing and drawing directly on the screen (annotation), emphasizing certain parts of the material (highlighting), and splitting the screen display (screen splitter). In addition, teachers also integrate learning applications such as Wordwall and Genially to present practice questions in the form of educational games. Based on interviews with teachers, the use of the DIB features helps teachers in delivering materials while providing variety in learning activities. Teachers said: *"The features I use most often are writing or marking up material, displaying images and videos, and sharing the screen. I also use Wordwall or Genially to provide practice questions so that the children don't just work on problems in the textbook."* The interview results indicate that the use of PID features is tailored to the needs of the material delivery. The annotation feature, for example, can be used when teachers provide additional explanations by writing keywords, making marks, or drawing specific sections of the material being displayed. Meanwhile, the highlighting feature helps teachers emphasize important information so that it is easier for students to pay attention. The screen splitter feature can be used to display two materials simultaneously so that students can compare images, information, or learning concepts. The use of these features provides variety in material presentation and helps teachers direct students' attention to the information being discussed.

In addition to the built-in features of PID, the integration of the Wordwall and Genially applications provides alternative, more interactive learning activities. For example, teachers can display a picture-matching game, a multiple-choice quiz, or an answer grouping exercise. Students are then given the opportunity to choose answers directly through the PID screen. In this activity,

teachers not only provide questions but also encourage students to understand the reasons for their chosen answers. When students provide an incorrect answer, teachers can provide an explanation and guide them to find the correct answer. The use of these interactive features demonstrates that PID can function as a medium for conveying information and as a learning activity tool. This aligns with research by Masria & Ilyas (2026) which describes the use of interactive learning applications to support learning activities, as well as research by Herza et al. (2024) regarding the contribution of digital boards to student engagement and conceptual understanding. Thus, the presence of PID's interactive features provides opportunities for teachers to develop more active, visual, and participatory learning. However, the effectiveness of its use still depends on the teacher's ability to select and integrate features according to learning objectives.

3.4 Student Responses, Interaction, and Participation

The use of the Digital Interactive Board (DIB) at SD Negeri 2 Kalak provides a more varied learning experience for students. The presentation of material through images, videos, animations, and educational games provides visual stimuli that can attract students' attention during learning activities. In addition, the opportunity to interact directly with the DIB screen provides a different experience compared to learning that only relies on verbal explanations and textbooks. Based on observations, student engagement can be seen through their attention to the material displayed, responses when the teacher asks questions, and participation when given the opportunity to use the DIB interactive features. Students also have the opportunity to come to the front of the class and try to complete exercises displayed on the digital screen. The results of interviews with students (S1) indicate that the use of the DIB provides an interesting learning experience, especially when the teacher presents material through videos or educational games. Students (S1) said: *"I'm happy because when I use the board, there are pictures and videos. So learning isn't just about reading books or listening to the teacher's explanation."* The student also revealed that the activity he liked most was when he was given the opportunity to try games or quizzes via the PID screen. *"I like it best when there are games or quizzes. Because you can come to the front and answer questions directly on the screen."* Meanwhile, students (S2) provided feedback regarding the opportunity to participate directly during learning. Students (S2) stated: *"I'm happy and more enthusiastic. Usually, when the teacher shows a video or a game, I want to try it too."* When asked about his participation in learning activities, student (S2) explained: *"Yes, because you can try it right in front of you. If there are games, it's even more fun."*

Based on the student's statement, the use of PID can provide opportunities for students to gain a more active learning experience. Students not only pay attention to the material presented, but can also try to complete assignments and interact with the learning content. Interactions that arise during learning can also take place between teachers and students or between students. The teacher poses questions or challenges through PID, then students try to answer and provide responses. In certain activities, students can also discuss with friends to determine the correct answer. In addition to increasing engagement, the use of PID is also felt to help students understand the material through visual presentation. One student (S1) said: *"Yes, because if there are pictures or videos, it's easier for me to understand. If I just explain it, sometimes I'm still confused, but if I'm shown examples, I understand better."* This information demonstrates that visual presentation of material can help students gain a more concrete understanding of the learning material. However, student understanding still needs to be supported by teacher explanations and learning evaluations. This finding aligns with research by Ariyani et al. (2026) , which explains that the use of digital interactive boards can support student learning motivation. Furthermore, Asbah et al. (2025) demonstrated that the use of interactive digital media can help create a more dynamic learning environment and support material understanding. Thus, student responses to the use of PID can be seen through interest,

involvement, courage to try, and interaction during learning. This indicates that the use of digital technology provides an alternative learning approach that is more suited to students' developmental needs.

3.5 Implementation Challenges and Optimization Efforts

Although the use of Digital Interactive Boards (DIBs) provides opportunities for developing more interactive learning, their implementation at SD Negeri 2 Kalak still faces several obstacles, both technical and non-technical. These obstacles relate to internet network stability, device condition, differences in teacher ability in operating technology, and the time required to prepare digital teaching materials. This condition indicates that the success of technology utilization in learning is determined not only by the availability of devices, but also by the readiness of the infrastructure and the ability of teachers to integrate it with learning strategies. Based on the results of interviews with the principal (KS), obstacles to PID utilization are related to internet network stability and differences in teacher ability in operating learning technology. The principal stated: *"There are several obstacles, particularly related to internet connectivity and teachers' ability to use technology. Not all teachers have the same capabilities. Furthermore, devices or applications sometimes experience glitches, requiring adjustments during learning."* This information demonstrates that infrastructure and human resource readiness are interrelated aspects of PID implementation. Internet network disruptions can limit the use of learning applications that require a direct connection, such as Wordwall and Genially. As a result, teachers cannot always carry out interactive activities according to the plans. Meanwhile, differences in teachers' digital skills influence the extent to which PID features can be optimally utilized. Teachers who are not yet proficient in device features tend to use them primarily for displaying material, rather than developing activities that involve direct student interaction. In addition to technical challenges, interviews with teachers indicate that preparing interactive teaching materials also requires time and adequate technological expertise. A teacher explained: *"The problem is sometimes the internet connection is unstable, and some applications won't open immediately. Furthermore, preparing interactive teaching materials takes time. If you're not used to using certain features, you sometimes have to learn them first."*

The interview results show that the obstacles to PID utilization lie not only in the ability to operate the device, but also in the teacher's ability to integrate technology with learning materials and strategies. From a Technological Pedagogical Content Knowledge (TPACK) perspective, mastery of technology needs to be supported by pedagogical understanding and mastery of the material so that its use contributes to the learning process. This means that teachers are not only able to operate PID, but also need to understand the appropriate features to convey the material and encourage student engagement. For example, the use of the annotation feature is not only intended to write on a digital screen, but can be directed to encourage students to identify important parts of the material, mark certain objects, or solve problems directly. Similarly, the use of Wordwall and Genially is not merely intended to introduce games in learning, but needs to be accompanied by teacher strategies in connecting game activities with the competencies to be achieved. If the choice of technology is not adapted to the characteristics of the material and learning objectives, the use of PID risks merely being a variety of displays without providing a meaningful learning experience. From a pedagogical perspective, the teacher's role is crucial in determining how technology is used to build learning interactions. Teachers need to manage students' opportunities to use the screen, ask provocative questions, guide discussions, and provide feedback on answers. Therefore, the success of PID implementation is determined not only by the sophistication of the features but also by the teacher's ability to design activities that enable active student participation. This demonstrates the interrelationship between Technological Knowledge (TK), Pedagogical Knowledge (PK), and

Content Knowledge (CK) within the TPACK framework. In addressing these challenges, school management support is crucial in creating conditions that enable the sustainable use of PID. Interviews revealed that the principal strives to encourage teachers to improve their ability to utilize learning technology through coordination and sharing experiences among teachers. The principal (KS) explained: *"We are working to overcome these challenges by coordinating with teachers, monitoring the condition of the equipment, and encouraging them to continue learning. If there are technical difficulties, we adapt our use to the current situation to ensure learning activities continue."*

This statement demonstrates the principal's role in directing and supporting the use of technology in the school environment. Management support is demonstrated not only through the provision of facilities, but also through monitoring device use, maintaining infrastructure, and providing opportunities for teachers to develop their competencies. This support influences teacher readiness to utilize PID because teachers need a work environment that supports the learning process and adapts to the use of new technologies. Meanwhile, the teacher explained the efforts made when facing disruptions during learning: *"I usually prepare the materials before class. If the internet is problematic, I use saved materials or other media. For features I don't understand, I study on my own or ask other teachers."* The efforts made by these teachers demonstrate adjustments in integrating technology with learning strategies. Offline material preparation anticipates limitations in internet connectivity, while communication and peer learning provide alternatives to improve technology mastery. From a TPACK perspective, these efforts demonstrate that teachers' technological competence develops through experience using devices and the ability to adapt technology to learning needs. Teachers are not only required to master PID features but also need to be able to identify alternative media when the planned technology cannot be used. From a school management perspective, improving teacher competency needs to be supported through training, workshops, and peer mentoring. These activities can be directed at hands-on practice using PID features, developing digital teaching materials, and selecting applications appropriate to the characteristics of the learning material. Practice-oriented training is more relevant because teachers not only gain an understanding of device functions but also learn to apply them in real-life learning situations. In addition to improving teacher competency, schools need to pay attention to the readiness of facilities and infrastructure by checking device conditions, power availability, internet network stability, and regular maintenance. This support is necessary to ensure that teacher-prepared lesson plans can be implemented without too many technical obstacles. Therefore, school management plays a strategic role in linking technology availability with teacher readiness and classroom learning needs.

These findings align with research by Yunhang & Hidayati (2023) , which emphasized the importance of facility readiness, school management, and human resource capacity building in supporting the use of educational technology. However, in the context of SD Negeri 2 Kalak, these findings demonstrate that management support needs to be translated into operational steps, such as mentoring the use of PID, device maintenance, and providing alternatives in the event of technical disruptions. Therefore, school support does not stop at providing facilities but also includes efforts to ensure that devices can be utilized pedagogically by teachers. Based on these overall findings, the obstacles to PID utilization at SD Negeri 2 Kalak indicate a link between technology readiness, teacher pedagogical competence, material mastery, and school management support. The TPACK framework explains that technology utilization will be more meaningful when the three aspects of technological knowledge, pedagogy, and learning materials are integrated into teaching and learning activities. Therefore, PID optimization cannot be achieved solely through device procurement; it needs to be accompanied by continuous improvement of teacher competence and support from school management so that technology truly functions as an interactive learning medium that supports student engagement.

4. CONCLUSION

Overall, the research results based on interviews and observations indicate that the use of Digital Interactive Boards (DIBs) at SD Negeri 2 Kalak has the potential to support more interactive learning, increase student engagement, and enrich learning activities. The use of annotation features, screen splitting, and digital games and quizzes provides variety in material delivery and encourages students to be more active in interacting during learning. The implementation of DIBs is supported by school policies and support, teacher learning plans based on the Technological Pedagogical Content Knowledge (TPACK) framework, and positive student responses. However, its implementation still faces obstacles such as unstable internet connections, limited preparation time, and differences in teachers' digital literacy skills. Therefore, optimizing the use of DIBs requires human resource readiness, adequate technical facilities, and continuous evaluation. This study has limitations because it was only conducted in one school, SD Negeri 2 Kalak. Therefore, the results are contextual and cannot be directly generalized to all elementary schools. Furthermore, this study used a descriptive qualitative approach, so the findings emphasize the experiences, perspectives of informants, and learning conditions based on interviews and observations, rather than quantitative measurements of the influence or effectiveness of PID. Based on the research results, teachers are expected to continue improving their digital competencies by utilizing various PID features creatively and according to learning needs. The development of interactive teaching materials can also be done collaboratively between teachers to reduce preparation time. The school is expected to improve the maintenance of technical facilities, maintain a stable internet connection, and provide ongoing training and mentoring to improve teachers' digital skills. Furthermore, future researchers are advised to conduct research in several schools with different characteristics and infrastructure conditions to obtain a broader picture. Future research can also use a quantitative approach to measure the relationship or influence of PID utilization on student learning outcomes and critical thinking skills.

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