



TEACHERS' USE OF INTERACTIVE FLAT PANELS (IFP) TO ENHANCE CHILDREN'S LANGUAGE AND COGNITIVE SKILLS

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ABSTRACT

This study explores how teachers use Interactive Flat Panels (IFPs) to improve language and cognitive skills in children aged 4–8 and examines factors that support or hinder this use. A qualitative descriptive approach was applied, with data from observations, interviews, and documentation involving four teachers and twenty students at two schools in Semarang. Results show that strategies such as guided verbal interaction, digital storytelling, educational games, and cognitive scaffolding enhanced children's listening, speaking, literacy, problem-solving, and critical thinking skills. Supporting factors included technological resources, teacher competence, school policies, and parental involvement, while obstacles included limited digital skills, unsuitable content, technical problems, and low parental support. The study's limitations are its small sample and short observation period, suggesting future research should include more schools and longer studies. Overall, the findings inform effective digital learning strategies for early childhood development.

ABSTRAK

Penelitian ini bertujuan untuk menganalisis strategi guru dalam memanfaatkan Interactive Flat Panels (IFP) untuk meningkatkan kemampuan bahasa dan kognitif anak usia 4–8 tahun, serta mengidentifikasi faktor pendukung dan penghambat pelaksanaannya. Metode yang digunakan adalah deskriptif kualitatif dengan pengumpulan data melalui observasi kelas, wawancara mendalam, dan dokumentasi, melibatkan empat guru dan dua puluh siswa di dua sekolah di Semarang. Hasil penelitian menunjukkan bahwa strategi seperti interaksi verbal terpandu, digital storytelling, permainan edukatif berbasis logika dan angka, serta scaffolding kognitif mampu meningkatkan keterampilan mendengarkan, berbicara, literasi awal, pemecahan masalah, dan berpikir kritis anak. Faktor pendukung meliputi tersedianya sarana teknologi, kompetensi guru, kebijakan sekolah yang mendukung, dan keterlibatan orang tua, sedangkan faktor penghambat meliputi keterampilan digital guru yang terbatas, konten digital yang kurang relevan, gangguan teknis, dan dukungan orang tua yang minim. Penelitian ini terbatas pada dua sekolah dengan periode observasi yang singkat, sehingga penelitian lanjutan disarankan melibatkan lebih banyak sekolah dan durasi observasi lebih panjang. Secara keseluruhan, temuan ini berkontribusi pada pengembangan strategi pembelajaran digital yang efektif untuk mendukung perkembangan bahasa dan kognitif anak usia dini.

Keywords: Strategi guru, Interactive Flat Panels (IFP), Keterampilan bahasa, Keterampilan kognitif, Anak

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Introduction

Language and cognitive development are two key aspects that are inseparable from early childhood development, particularly during the ages of 4–8 years, which are widely recognized as a critical or “golden” period of development. At this stage, children experience rapid growth in language acquisition, including listening and speaking skills,

as well as in the development of logical reasoning and problem-solving abilities (Piaget, 2013). Vygotsky (1978) emphasized that language also functions as a tool for thinking; therefore, the quality of language development significantly influences children's cognitive processes. Accordingly, appropriate learning stimulation is essential to ensure balanced development across both domains.

The transformation of education through digital technology has led to the emergence of innovative instructional tools, such as Interactive Flat Panels (IFPs). IFPs function not only as presentation media but also as interactive learning platforms that integrate visual, auditory, and kinesthetic elements, thereby enhancing children's engagement in learning activities (Rosdiana, 2022). The integration of interactive digital media also aligns with the demands of 21st-century learning, which emphasizes creativity, communication, collaboration, and critical thinking from an early age (Munawaroh & Widiyaningrum, 2023).

At Barida Kindergarten in Demak and Nurul Qur'an Elementary School in Semarang, Interactive Flat Panels (IFPs) have been introduced as part of digital learning innovations. However, based on preliminary observations and interviews with teachers, the use of IFPs has not yet been optimized. Several teachers primarily utilize IFPs as display tools rather than as media that facilitate exploratory, interactive, and child-centered learning experiences. Ideally, effective use of IFPs should actively engage children through visual, kinesthetic, and problem-based learning activities (Salsabila, 2023).

. Furthermore, children's language and cognitive abilities appear to develop unevenly across these educational settings. This imbalance may be influenced by limited exposure to diverse learning stimuli, including the suboptimal use of digital media that does not adequately support differentiated learning tailored to individual children's needs (Musthafa, 2021; Ministry of Education and Culture Regulation No. 137 of 2014 on Early Childhood Education Standards).

Another identified issue concerns the limited availability of developmentally appropriate digital learning content, as well as teachers' insufficient capacity to design technology-based instructional strategies that simultaneously stimulate listening, speaking, numeracy, memory, and logical reasoning skills in an integrated manner (Hapsari & Putra, 2021; Setyawan, 2022). Previous studies have also indicated that many early-grade teachers continue to struggle with aligning digital media use with pedagogical principles required for holistic child development (Maryani, 2020). Therefore, mapping effective teacher strategies for utilizing IFPs to optimize children's language and cognitive development is of critical importance (Rahmawati & Arifin, 2023).

Global studies suggest that the integration of digital media in early childhood education can enhance a range of developmental skills, including language literacy and cognitive reasoning (Smith & Anderson, 2020; Lee, 2021). International research further highlights that teachers' digital pedagogical competence is a key determinant of successful technology-supported learning (Ng & Nicholas, 2022). At the national level, studies in Indonesia have reported that digital media strengthens early language development (Rahmawati, 2021) and supports cognitive abilities such as basic numeracy and logical thinking (Setyawan, 2022), while teachers' mastery of digital pedagogy contributes significantly to instructional effectiveness (Hasan, 2023). However, these national studies tend to focus on a single developmental domain at a time and rarely integrate language and cognitive skills simultaneously. Moreover, research in the Indonesian context has not specifically examined how Interactive Flat Panels (IFPs) can support both domains through an integrated approach, particularly in early childhood and lower elementary education settings. A further research gap is evident in the limited attention given to supporting and inhibiting factors influencing IFP implementation, despite evidence that successful technology integration is shaped by infrastructure availability, teacher readiness, parental digital literacy, and internet connectivity in schools (Salsabila, 2022). Comprehensive studies are therefore required to produce more applicable and context-sensitive recommendations.

Based on the above considerations, this study aims to: (1) describe teachers' strategies in utilizing IFPs to enhance the language skills of children aged 4–8 years; (2) identify teacher strategies for improving children's cognitive abilities through IFPs; and (3) analyze the supporting and inhibiting factors influencing IFP implementation at Barida Kindergarten and Nurul Qur'an Elementary School in Semarang. The findings of this study are expected to enrich scholarly discourse on interactive digital media in early childhood education and to provide practical recommendations for educational institutions seeking to improve learning quality through technological innovation.

Theoretically, this research contributes to the expansion of the literature on IFP integration in stimulating children's language and cognitive development. Practically, the findings may guide teachers in designing more effective digital learning experiences, enhance educators' digital literacy competencies, and encourage schools to provide adequate supporting facilities to optimize the use of IFPs in classroom instruction.

Theoretical Studies

A. Language Development of Children Aged 4–8 Years

Language development in children aged 4–8 years represents a critical phase in acquiring more complex linguistic skills. During this period, children's vocabulary expands rapidly as a result of stimulation from both home and school environments (Santrock, 2018). Children begin to construct longer and more meaningful sentences, reflecting advancements in syntactic and semantic abilities.

Receptive language skills, such as listening and understanding instructions, develop concurrently with expressive skills, particularly speaking. Social interaction with teachers and peers serves as a primary driver of language development (Vygotsky, 1978). Teachers play a pivotal role in modeling language use and reinforcing linguistic structures within meaningful contexts. Furthermore, phonological development becomes increasingly evident through children's improved ability to articulate sounds, letters, and words clearly. Early literacy skills, including letter recognition, picture reading, and comprehension of simple narratives, are also introduced during this stage (Mayer, 2020).

Pragmatic language skills begin to mature as children learn communication rules such as turn-taking, maintaining eye contact, using appropriate intonation, and adapting language according to their conversational partners (Bee & Boyd, 2012). Facial expressions, gestures, and vocal modulation are increasingly employed to convey meaning and emotion, indicating growing competence in social communication. Appropriate educational stimulation during the ages of 4–8 years is therefore essential in fostering foundational language skills that support future academic success.

With advancements in technology, children are now exposed to a wide range of digital media, which can serve as an effective source of language stimulation when used appropriately. Interactive media such as Interactive Flat Panels (IFPs) enable children to learn language through visual storytelling, phonetic quizzes, and vocabulary games that integrate sensory and verbal communication. Proper stimulation during this critical period of language development can enhance children's interest in literacy and prepare them for subsequent stages of formal education.

B. Cognitive Development of Children Aged 4–8 Years

From a cognitive perspective, children aged 4–8 years are transitioning from the preoperational stage toward the concrete operational stage of development. According to Piaget, this is a period during which children begin to think logically about concrete objects and develop a basic understanding of cause-and-effect relationships (Piaget, 2013). At this age, children still rely heavily on direct and hands-on experiences to process information; therefore, educators must provide concrete, exploration-based learning activities.

Memory development also accelerates significantly during this phase. Children become increasingly capable of recalling symbols, numbers, letters, and simple patterns frequently encountered in visual learning contexts (Santrock, 2018). These abilities support the acquisition of early numeracy and literacy concepts. Repeated exposure to information through engaging and visually stimulating media strengthens memory retention and concentration.

Moreover, children's classification and categorization skills continue to develop. They are able to group objects based on attributes such as color, size, and shape, as well as to understand basic sequential concepts such as beginning, middle, and end. These cognitive processes form the foundation for logical and analytical thinking in later stages of development. Learning activities that stimulate categorization skills are essential for building an understanding of fundamental mathematical and scientific concepts.

In terms of problem-solving, children begin to experiment with various strategies to reach solutions in both learning and play contexts. Teachers are therefore encouraged to provide cognitive challenges through educational games, simple experiments, and creative thinking activities that promote independent decision-making (Setyawan, 2022). Consequently, experiential and hands-on learning approaches play a crucial role in fostering optimal cognitive development.

C. Concept and Function of Interactive Flat Panels (IFPs) in Learning

Interactive Flat Panels (IFPs) are modern digital devices equipped with touch-screen technology and high-quality visual and audio systems, allowing users to interact directly with the display surface (Ali, 2023). IFPs are designed as interactive instructional media that integrate technological features with pedagogical practices, enabling teachers to deliver content in more creative and varied ways. Features such as dynamic presentations, real-time on-screen annotation, access to educational applications, and connectivity with other devices (e.g., laptops and tablets) provide teachers with flexibility in designing engaging and effective learning experiences.

In early childhood and elementary education, IFPs facilitate multisensory learning through the integration of images, sounds, videos, animations, and developmentally appropriate educational games (Hsin & Tsai, 2019). Through these media, children can explore abstract concepts via concrete experiences, enhance memory retention, and develop imagination. Additionally, IFPs promote two-way interaction between teachers and students, making learning more communicative, participatory, and collaborative compared to conventional lecture-based approaches.

Functionally, IFPs serve not only as tools for content presentation but also as platforms for concept exploration, reinforcement of literacy and numeracy skills, and development of critical, logical, and creative thinking abilities aligned with 21st-century learning demands. The integration of diverse digital learning resources, interactive simulations, and collaborative projects through IFPs enables children to learn actively, independently, and contextually. Therefore, IFPs represent an innovative solution for creating enjoyable and meaningful learning experiences while supporting children's holistic development.

D. Teachers' Strategies in Utilizing IFPs for Language and Cognitive Development

Teachers' instructional strategies are central to the successful implementation of IFPs in the classroom. Teachers can design lessons that stimulate language development through guided verbal interaction, digital storytelling, and conversational scaffolding (Vygotsky, 1978). To support cognitive development, teachers may employ problem-solving-based gamification, interactive visual-motor activities, and memory exercises that challenge children's thinking skills (Hasan, 2023).

Teachers must carefully select digital content that is not only engaging but also developmentally appropriate and aligned with language and cognitive learning objectives.

Teacher guidance during IFP-based activities is essential to ensure that media use remains focused on meaningful learning rather than mere digital entertainment. When implemented strategically, IFPs can function as effective tools for integrating language and cognitive skill development.

Effective use of interactive digital media requires careful instructional planning to ensure meaningful learning outcomes. This planning includes selecting applications or software aligned with both linguistic and cognitive learning goals, as well as designing interaction scenarios that foster creativity and critical thinking (Miller & Almon, 2009). Furthermore, teachers should adjust the level of difficulty of digital activities to match students' developmental capacities, ensuring inclusive participation and optimal learning experiences. Systematic planning also involves establishing clear learning indicators to support objective evaluation of learning processes and outcomes.

Integrating digital media with traditional learning activities is another important strategy. The use of IFPs and other digital tools should complement, rather than replace, face-to-face interaction and physical activities, which are essential for children's motor, social, and emotional development. By combining digital and traditional learning experiences, children can benefit from balanced and comprehensive instruction while developing adaptability across diverse learning contexts (Hsin, Li, & Tsai, 2014). In this framework, teachers act as facilitators who create meaningful interactions, guide contextual learning experiences, and encourage collaboration and reflection, ensuring that digital media serves as a pedagogical tool to deepen conceptual understanding rather than merely functioning as entertainment.

E. Supporting and Inhibiting Factors in IFP Implementation

Teachers' instructional strategies are a central determinant of successful IFP implementation. Teachers are required to design lessons that stimulate language development through guided verbal interaction, digital storytelling, and conversational support (Vygotsky, 1978). To foster cognitive development, teachers may employ problem-solving-based approaches, gamification, interactive visual-motor activities, and memory exercises that challenge children's thinking abilities (Hasan, 2023).

Teachers must select digital content that is developmentally appropriate rather than merely visually appealing. The selection of applications should be aligned with specific language and cognitive learning objectives. Teacher guidance in exploring IFP-based activities is essential to ensure that media use remains focused on learning outcomes rather than serving solely as digital entertainment. When supported by appropriate instructional strategies, IFPs can function as effective tools for the integrated development of children's language and cognitive skills.

The use of interactive digital media requires careful instructional planning to ensure effective and meaningful learning. Such planning involves selecting applications or software that align with both linguistic and cognitive goals, as well as designing interaction scenarios that stimulate children's creativity and critical thinking skills (Miller & Almon, 2009). Teachers must also adjust the level of difficulty of digital activities to match children's developmental capacities, ensuring active engagement and optimal learning experiences for all learners. Systematic planning further includes the establishment of clear learning indicators to enable objective evaluation of learning processes and outcomes.

Beyond planning, teachers' roles as active facilitators during digital interactions are crucial to learning success. Teachers are expected to provide guidance, motivation, and timely feedback so that children do not merely consume information passively but actively process, understand, and apply newly acquired concepts. Scaffolding strategies are implemented through gradual support, ranging from full assistance to encouraging independent learning, thereby enabling children's cognitive and language skills to develop progressively within their zone of proximal development (Wood, Bruner, & Ross, 1976). Continuous observation of children's learning behaviors allows teachers to adapt instructional interventions, such as

posing thought-provoking questions or adjusting learning challenges to maintain relevance and engagement.

Integrating digital media with traditional learning approaches is another essential strategy. The use of IFPs or other digital tools should complement rather than replace face-to-face interaction and physical activities, which are critical for children's motor, social, and emotional development. By combining digital and conventional learning experiences, children can benefit from balanced and comprehensive instruction while developing adaptability across diverse learning contexts (Hsin, Li, & Tsai, 2014). In this context, teachers act as facilitators who create meaningful interactions, guide contextual learning experiences, and encourage collaboration and reflection, ensuring that digital media strengthens conceptual understanding rather than functioning merely as entertainment.

F. Supporting and Inhibiting Factors for IFP Implementation

Supporting factors for IFP implementation include adequate school infrastructure, ICT training for teachers, and the availability of appropriate digital learning content (Salsabila, 2022). Synergy between technological resources and teachers' pedagogical roles is essential for the success of digital learning. Leadership support from school principals and institutional policies also plays a vital role in sustaining the integration of digital media into instructional practices.

However, several challenges remain, such as limited technological skills among teachers, insufficient development of locally relevant digital content, and technical issues including unstable internet connectivity. Parental involvement in facilitating technology use at home also influences learning outcomes. By identifying both supporting and inhibiting factors, schools can design targeted programs to strengthen teacher competencies and maintain technological resources to ensure optimal IFP functionality in the classroom.

The primary supporting factor for the implementation of Interactive Flat Panels (IFPs) in learning is the availability of adequate school infrastructure. This includes appropriate classroom facilities, fully functional IFP devices, and stable electricity and internet connections. Such infrastructure enables teachers and students to use digital media consistently without technical disruptions, thereby supporting seamless and interactive learning experiences (Salsabila, 2022). Additionally, the availability of curriculum-aligned digital content that corresponds to children's developmental levels is crucial for maximizing the instructional potential of IFPs.

In addition to infrastructure, teachers' competence in operating digital technology is a critical determinant of successful IFP implementation. Teachers who have received ICT training are better equipped to integrate digital media into effective instructional strategies, including designing interactive activities, providing scaffolding, and monitoring students' learning progress. The synergy between technology and teachers' facilitative roles forms the foundation for creating meaningful and enjoyable learning experiences. Therefore, continuous professional development programs are essential to enhance teachers' digital literacy and pedagogical creativity.

School policies and leadership support also contribute significantly to the sustainability of digital media implementation. Schools that encourage instructional innovation and allocate budgets for IFP maintenance and digital content development facilitate more effective use of interactive media by teachers. Institutional support further includes regular maintenance schedules, software updates, and integrated learning platforms to ensure that IFPs function reliably without major technical constraints.

Conversely, several inhibiting factors must be addressed to ensure effective IFP implementation. One major challenge is teachers' limited technological skills, particularly in designing interactive learning activities and maximizing the advanced features of IFPs. Additionally, the lack of locally developed content tailored to students' characteristics may reduce the relevance and attractiveness of digital media. Technical disruptions, such as unstable internet connections, hardware malfunctions, or software failures, can further

diminish the effectiveness of IFP-supported learning.

Parental involvement represents an additional factor influencing digital learning outcomes. Parents who support the use of digital media at home—by facilitating access to devices or providing guidance during children's learning activities—can enhance the effectiveness of IFP implementation. By systematically identifying supporting and inhibiting factors, schools can formulate strategies to strengthen teacher competencies, develop locally relevant content, and maintain and improve technological infrastructure. These efforts are essential to ensure the optimal and sustainable implementation of IFPs and to support the achievement of holistic learning objectives.

Research Methodologi

This study employed a qualitative descriptive approach to provide an in-depth description of teachers' strategies in utilizing Interactive Flat Panels (IFPs) to enhance children's language and cognitive abilities within classroom contexts. This approach was selected because it allows for the exploration of teachers' experiences and students' responses during the learning process, thereby generating a comprehensive understanding of the meanings embedded in instructional practices (Sugiyono, 2021).

The research was conducted at Barida Kindergarten and Nurul Qur'an Elementary School in Semarang, both of which have implemented Interactive Flat Panels (IFPs) as interactive digital media in teaching and learning activities. The research participants consisted of classroom teachers who taught children aged 4–8 years and students who were actively involved in learning activities using IFPs. Participants were selected through purposive sampling, based on the consideration that the selected teachers possessed adequate understanding of the technology and actively utilized IFPs in their instructional practices (Miles & Huberman, 2014).

Data were collected through classroom observations of learning activities using Interactive Flat Panels (IFPs), with particular attention to language stimulation practices such as digital storytelling, verbal interaction, and the use of literacy applications. In addition, observations focused on cognitive stimulation activities, including object classification, problem-solving tasks, and numeracy-based educational games. In-depth interviews were conducted with teachers to explore instructional planning and the implementation of IFP-based strategies, as well as to identify supporting and inhibiting factors influencing IFP use. Documentation in the form of photographs of learning activities, instructional materials, and digital applications was also collected as supplementary and visual evidence to support the research findings.

The collected data were analyzed using the interactive data analysis model proposed by Miles and Huberman (2014), which consists of data reduction, data display, and conclusion drawing/verification. Data analysis was conducted simultaneously with data collection, allowing for immediate follow-up and clarification in the field. To ensure data validity, technique and source triangulation were applied by comparing information obtained from observations, interviews, and documentation to confirm consistency and credibility.

The researchers adhered to ethical principles in educational research, including maintaining the confidentiality of children's identities, respecting their comfort and well-being, and ensuring that the data collection process did not disrupt learning activities. Informed consent was obtained from schools, teachers, and parents prior to the study, ensuring that all procedures were conducted in accordance with established ethical standards and that child safety remained a top priority.

Results and Discussion

1. Teachers' Strategies in Using IFPs for Language Development at Barida Kindergarten and Nurul Qur'an Elementary School

The findings indicate that teachers at Barida Kindergarten and Nurul Qur'an Elementary School employed a variety of strategies to utilize Interactive Flat Panels (IFPs) in supporting the language development of children aged 4–8 years. One primary strategy was guided verbal interaction, in which teachers posed open-ended questions, facilitated group discussions, and

encouraged children to express their ideas, experiences, and emotions verbally. These activities helped children develop listening and speaking skills, as well as pragmatic abilities such as turn-taking, adapting language to conversational partners, and using appropriate intonation and facial expressions (Bee & Boyd, 2012).

Classroom observations revealed that teachers consistently facilitated group conversations, for example by asking each child to share a personal experience while pointing to images displayed on the IFP. Children showed high enthusiasm, waited for their turn to speak, and used appropriate intonation and facial expressions to convey meaning. In an interview, a teacher at Barida Kindergarten stated: *"I usually ask children about their experiences at home and then ask them to share with their classmates. I use the IFP to display images or animations related to their stories so they can more easily express their ideas and vocabulary."*

In addition, teachers employed digital storytelling by utilizing animations, sounds, and interactive images to expand children's vocabulary, practice more complex sentence construction, and enhance narrative comprehension. Observations indicated that when teachers played interactive stories about animals, children actively pointed at the screen, imitated animal sounds, and attempted to construct descriptive sentences related to the story content.

These activities integrated visual, auditory, and kinesthetic stimulation, enabling children to learn language through multisensory experiences. One teacher explained: *"When we learn about animals, I choose interactive stories that show animals with sounds and movements. The children become more enthusiastic about telling stories about the animals after seeing them on the screen."* Teachers also implemented language scaffolding strategies by providing gradual support, ranging from full assistance to encouraging independent performance, in line with Vygotsky's concept of the zone of proximal development.

Observations showed that teachers offered direct guidance when children encountered difficulties in expressing ideas and gradually reduced intervention as children became more capable of constructing sentences independently. As one teacher noted: *"Some children still need continuous guidance when using the IFP, while others can explore independently. I always adjust my support so that every child feels confident."*

The use of digital literacy applications, such as phonics games, vocabulary quizzes, and interactive stories, further reinforced phonological awareness and early literacy skills. Observations recorded children enthusiastically guessing words or forming sentences through interactive IFP-based games. These activities not only enhanced reading and writing skills but also fostered early interest in language learning. A teacher at Nurul Qur'an Elementary School added: *"Children are highly motivated when they can guess words or form sentences through IFP games. They enjoy learning while playing, and their reading skills develop more quickly."*

Overall, integrating IFPs into language development strategies enabled teachers to create contextual, interactive, and child-centered learning environments while fostering early literacy interest. Interview and observation data emphasized that digital media use must be accompanied by active teacher guidance, careful content selection, and developmentally appropriate levels of difficulty to ensure that each child experiences optimal and enjoyable learning

2. Teachers' Strategies in Using IFPs for Cognitive Development at Barida Kindergarten and Nurul Qur'an Elementary School

The findings also revealed that teachers at Barida Kindergarten and Nurul Qur'an

Elementary School applied various strategies to support children's cognitive development through Interactive Flat Panels (IFPs). One key strategy involved problem-solving activities, in which teachers provided challenges or educational games designed to stimulate critical, logical, and creative thinking. These activities included object classification based on color, shape, size, or category, as well as simple numerical puzzles that encouraged analytical reasoning. Through these tasks, children were trained to find solutions independently, test hypotheses, and evaluate the outcomes of their actions (Setyawan, 2022).

Field observations indicated that when teachers guided children in using object-classification applications on the IFP, children enthusiastically sorted items and discussed their classification criteria. Some children experimented with different strategies before deciding on answers, while teachers posed prompting questions such as, "Why did you choose that method?" or "Is there another way to solve this problem?" These questions encouraged critical thinking and self-reflection. In an in-depth interview, a teacher from Nurul Qur'an Elementary School explained: "I use numeric and visual games on the IFP to stimulate children's logic. I allow them to try different approaches and then ask why they chose a particular strategy. In this way, children not only solve problems but also learn to think critically and reflectively."

In addition to problem-solving strategies, teachers employed interactive visual-motor activities such as connecting patterns, imitating animated movements, and manipulating objects on the IFP screen. Observations showed that children better understood basic mathematical concepts, simple science ideas, and cause-and-effect relationships when content was presented visually and interactively. These activities also supported the development of fine motor coordination, attention, and analytical skills (Hsin & Tsai, 2019).

Teachers further implemented cognitive scaffolding strategies by providing gradual guidance, from full support to encouraging independent work, in alignment with Vygotsky's zone of proximal development. For instance, when children encountered numerical puzzles, teachers initially demonstrated problem-solving steps and gradually reduced support while monitoring progress and posing guiding questions. A teacher from Barida Kindergarten remarked: "When children work on challenges using the IFP, I start by giving examples. Then I let them try on their own while I observe and ask guiding questions. This helps them think independently while strengthening their cognitive skills."

Additionally, teachers used memory- and logic-based educational games to reinforce categorization, counting, and understanding of cause-and-effect relationships. Observations indicated that children were able to remember numerical sequences or steps in interactive logic games and later apply them to other learning activities. These exercises not only enhanced memory and concentration but also consistently developed analytical thinking skills (Santrock, 2018).

Overall, integrating IFPs into cognitive development strategies enabled teachers to create experiential, interactive, and contextual learning environments. Interview and observation data highlighted that effective strategies included selecting developmentally appropriate digital content, using probing questions to stimulate critical thinking, and providing gradual guidance to support independent learning. Within this approach, IFPs functioned not merely as entertainment tools but as effective instructional media for optimizing logical reasoning, problem-solving abilities, and holistic cognitive development.

3. Supporting and Inhibiting Factors in the Implementation of IFP at Barida Kindergarten and Nurul Qur'an Elementary School

The findings indicate that the successful implementation of *Interactive Flat Panels* (IFPs) is strongly influenced by both supporting and inhibiting factors within the school environment. One of the primary supporting factors is the availability of adequate school infrastructure. Observations conducted at Barida Kindergarten and Nurul Qur'an Elementary School revealed that classrooms were equipped with fully functional IFPs, stable electricity supply, and sufficient internet connectivity. These conditions enabled teachers and students to utilize IFPs regularly without significant technical disruptions (Salsabila, 2022).

Teacher competence in using technology constitutes another critical supporting factor. Teachers who had participated in Information and Communication Technology (ICT) training were able to optimize IFP features, such as designing interactive educational games, annotating directly on the screen, and integrating multimedia content aligned with instructional objectives. A teacher at Nurul Qur'an Elementary School stated that ICT training significantly facilitated the design of interactive IFP-based learning activities, enabling students to understand learning materials more easily through the integration of images, sounds, and animations.

School policies and leadership support also play a crucial role in determining the success of IFP implementation. Observations indicated that schools allocated budgets for device maintenance, digital content development, and routine IFP upkeep. Such institutional support fostered a conducive environment for the sustainable use of digital learning media.

Despite these supporting factors, several inhibiting factors were also identified. One major constraint was the limited technological proficiency of some teachers. Observations showed that several teachers used IFPs merely as display tools rather than as interactive media that encourage exploration and active student participation, thereby limiting the pedagogical potential of digital technology.

Another challenge concerned the limited availability of digital content that was locally relevant and aligned with the curriculum. In an interview, a teacher at Barida Kindergarten emphasized that although many digital applications were visually engaging, they were not always suitable for children's developmental characteristics or curriculum requirements, necessitating independent content adaptation by teachers. Technical issues, such as unstable internet connections, slow device performance, and occasional software disruptions, were also observed to temporarily interfere with interactive activities and affect children's concentration.

Parental involvement at home was identified as an additional factor influencing digital learning outcomes. Teachers observed that children who received parental support in using digital media at home demonstrated faster learning progress, whereas those with minimal guidance encountered difficulties in engaging with IFP-based activities.

Overall, data from observations and interviews suggest that the successful implementation of IFPs depends on the synergy between adequate infrastructure, teacher competence, supportive school policies, relevant digital content, and parental involvement. Conversely, limited technological skills, insufficient locally relevant content, technical problems, and low parental support may hinder the optimal use of interactive media. Understanding these supporting and inhibiting factors enables schools to design targeted programs to enhance teacher competence, provide contextually appropriate digital content, and strengthen infrastructure and parental engagement, thereby ensuring that IFPs are optimally utilized to enhance language and cognitive development among children aged 4–8 years (Salsabila, 2022).

Conclusion

1. Teachers' Strategies for Language Development

Teachers at Barida Kindergarten and Nurul Qur'an Elementary School implemented various strategies, including guided verbal interaction, digital storytelling, conversational scaffolding, and the use of digital literacy applications. These strategies effectively enhanced children's listening and speaking skills, vocabulary acquisition, sentence construction, narrative comprehension, and pragmatic language abilities. Moreover, IFP-based instruction created a multisensory, interactive, and child-centered learning environment.

2. Teachers' Strategies for Cognitive Development

To foster cognitive development, teachers employed problem-solving activities, interactive visual-motor tasks, memory- and logic-based games, and gradual cognitive scaffolding techniques. These strategies stimulated critical thinking, logical reasoning, problem-solving abilities, memory, attention, and analytical skills, enabling children to develop

cognitive competencies holistically through experiential and interactive learning.

3. Supporting and Inhibiting Factors in IFP Implementation

The effectiveness of IFP implementation is influenced by supporting factors such as adequate school infrastructure, teachers' ICT competence, supportive school leadership and policies, relevant digital content, and parental involvement. Conversely, limited technological skills among teachers, insufficient locally relevant content, technical constraints, and low parental support may inhibit optimal utilization. Optimal outcomes are achieved when active teacher guidance, appropriate content selection, gradual scaffolding, and interactive strategies are integrated with strong infrastructural and institutional support.

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