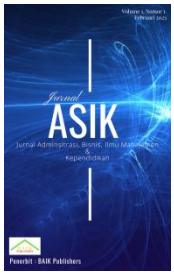
ASIK: JURNAL ADMINISTRASI, BISNIS, ILMU MANAJEMEN, & KEPENDIDIKAN,
VOL. 3, NO. 3, OCTOBER 2025
ISSN 2986-0334



EXPLORING THE INFLUENCE OF INTERACTIVE LEARNING MEDIA ON THE NUMERICAL ABILITY OF EARLY CHILDHOOD LEARNERS AT PAUD GEMILANG TANGERANG SELATAN

Suharni Rahayu
dosen00964@unpam.ac.id

(Submitted September ; Accepted: October ; Published: October)

ABSTRACT

This qualitative study explores the influence of interactive learning media on the numerical ability of early childhood learners at PAUD Gemilang. The research addresses the problem of low motivation and understanding in early numeracy among young children and aims to investigate how interactive media impact children's engagement, comprehension, and skill development in numerical concepts. Guided by constructivist learning theories and employing semi-structured interviews, observations, and document analysis, the study gathered rich qualitative data from both learners and educators. Findings reveal that interactive media significantly enhance children's motivation and participation by providing multi-sensory, playful, and self-paced learning experiences. Educators observed clearer understanding of numerical concepts and faster acquisition of counting and number recognition skills in children using interactive media compared to conventional methods. Challenges related to digital literacy and technical issues were mitigated by guided support and institutional backing. This study concludes that interactive media is an effective pedagogical tool for early numeracy development, offering recommendations for educators and PAUD institutions to optimize media use in classrooms. The results contribute to advancing educational practices in early childhood settings by integrating technology-enhanced learning tailored to young learners' needs.

Keywords: interactive learning media, early childhood education, numeracy skills, qualitative study, PAUD Gemilang

I. INTRODUCTION

A. Research Background

The early childhood period is fundamentally significant in human development, as it lays the foundation for cognitive, emotional, social, and physical growth. Early childhood learners require educational approaches that are tailored to their developmental characteristics, which include limited attention spans, high activity levels, and diverse learning styles. One crucial cognitive skill at this stage is numerical ability, which forms the basis for future mathematical understanding and problem-solving skills. However, many early childhood education programs still rely on conventional teaching methods, such as rote memorization or lecture-based instruction, which can result in

disengagement and ineffective learning outcomes among young children.

In recent years, the integration of technology in education has led to the development of media pembelajaran interaktif designed to engage multiple senses simultaneously, such as sight, sound, and touch. Such media offer dynamic and stimulating learning experiences that can capture children's attention and motivate active participation. Studies have demonstrated that early childhood learners respond positively to interactive media that incorporate multimedia elements like animations, sounds, and games, as these elements align well with how young children explore and learn about their environment through play and interaction.

At PAUD Gemilang, educators have observed challenges in maintaining children's interest and motivation in learning numeracy skills using traditional media. The limited employment of interactive media may hinder children's ability to fully comprehend numerical concepts such as counting, number recognition, and basic arithmetic operations. The lack of engaging learning materials can lead to passive learning where children become mere recipients of information rather than active constructors of knowledge.

Furthermore, the advent of digital technology has shifted educational paradigms toward more learner-centered approaches, privileging exploratory and hands-on learning experiences. Interactive learning media, accessible through smartphones, tablets, or desktop computers, provide children with opportunities for self-paced, exploratory learning, allowing them to experiment with concepts and receive immediate feedback. This interactivity supports children's natural curiosity and facilitates deeper understanding of abstract numerical concepts.

The global COVID-19 pandemic has accelerated the urgency for innovative learning tools that adapt to remote and hybrid learning environments, amplifying the role of media pembelajaran interaktif. In the context of PAUD Gemilang, where face-to-face interaction was limited, educators needed effective ways to sustain learning momentum remotely without compromising the quality of instruction. Despite the recognized potential of interactive media, there remains a gap in understanding the specific impact of these media on the numerical abilities of young learners within this local context.

Thus, this study is driven by the need to explore how interactive learning media influence the numerical ability of early childhood learners at PAUD Gemilang. It aims to identify the advantages, barriers, and practical applications of such media in real classroom settings. By focusing on this, the research hopes to contribute valuable insights for educators, curriculum developers, and policymakers to enhance early childhood numeracy education through effective use of interactive technologies.

This inquiry is not only timely but essential to ensure that early learners develop strong numerical foundations through engaging and meaningful learning experiences. It offers the possibility to shape future educational innovations that better suit the developmental needs of young children and the evolving technological landscape.

B. Research Questions

1. How do early childhood learners at PAUD Gemilang experience the use of interactive learning media in developing their numerical abilities?
2. What are the perceptions of PAUD Gemilang educators regarding the effectiveness of interactive learning media for teaching numeracy?
3. What challenges and facilitators do children and educators encounter when using interactive learning media in early childhood numeracy instruction?
4. How does the use of interactive learning media influence children's motivation and engagement in learning numerical concepts at PAUD Gemilang?

C. Research Objectives

1. To explore the experiences of early childhood learners in using interactive learning media to enhance their numerical abilities.
2. To understand educators' perceptions of the effectiveness and practicality of interactive learning media in numerical education at PAUD Gemilang.
3. To identify obstacles and supporting factors in the implementation of interactive learning media within early childhood numeracy instruction.
4. To examine the impact of interactive learning media on children's motivation and engagement during numeracy learning activities.

II. LITERATURE REVIEW

A. Interactive Learning Media in Early Childhood Education

Interactive learning media refer to educational tools that actively engage learners by integrating multimedia elements such as text, images, animations, audio, and user interaction. According to Mayer's Cognitive Theory of Multimedia Learning, using both visual and auditory channels enhances learner processing and retention. In early childhood settings, interactive media are particularly effective as they cater to children's developmental needs for multisensory learning and play-based discovery. Studies highlight that media pembelajaran interaktif stimulate curiosity, maintain attention, and foster active participation, which are critical for young learners experiencing rapid brain development.

Research by Nugroho et al. (2024) underscores the positive role of interactive multimedia in early numeracy, enabling children to manipulate numbers and objects digitally, thereby constructing their understanding more deeply than passive learning formats. Furthermore, the availability of tablets and educational apps has expanded access to such media, though success largely depends on pedagogical integration and teacher facilitation

B. Development of Numerical Ability in Early Childhood

Numerical ability encompasses skills such as counting, number recognition, comparing quantities, and basic arithmetic operations. Foundational numeracy skills during early childhood set the stage for more complex mathematical learning. Piaget's theory of cognitive development emphasizes the preoperational stage (ages 2-7) where children begin symbolic thinking but require concrete experiences to grasp abstract concepts like numbers.

Vygotsky's Social Development Theory stresses the mediation role of social interaction and scaffolding in learning, which media pembelajaran interaktif

can facilitate by providing guided feedback and adaptive difficulty. Research indicates that numeracy instruction that is contextual, interactive, and responsive to individual learner needs results in better outcomes compared to rote methods.

C. Educator and Learner Experiences with Interactive Media

Educator attitudes and competencies are crucial to the effective use of interactive media. Teachers who are confident in technology integration create more engaging learning environments. Studies have found that educators perceive media pembelajaran interaktif as beneficial for differentiating instruction and enhancing student motivation. However, challenges such as limited resources, insufficient training, and classroom management issues can hinder implementation.

From the learner perspective, children show increased motivation and enjoyment when learning involves interactive elements. Such media support exploratory learning, critical thinking, and self-paced mastery. Observation studies highlight that children often engage more deeply and exhibit positive social behaviors when learning is mediated through interactive technology.

D. Challenges and Factors Affecting Implementation

Despite the benefits, multiple barriers affect the use of interactive learning media in early childhood. Technical issues, lack of infrastructure, varying digital literacy levels, and resistance to change are common obstacles. Cultural and contextual factors at PAUD Gemilang, including parental support and curriculum alignment, also influence integration success.

Effective implementation requires holistic approaches encompassing professional development, community involvement, and alignment with pedagogical goals. Research advocates for continuous evaluation and adaptation of media tools to suit local learner profiles and educational contexts.

III. RESEARCH METHODOLOGY

A. Research Types

This study employs a qualitative research design to explore the lived experiences, perceptions, and interactions of early childhood learners and educators regarding the use of interactive learning media in developing numerical ability. Qualitative methods are appropriate for gaining in-depth understanding of complex educational phenomena through rich descriptive data. Data collection methods include semi-structured interviews, participant observations, and document analysis to capture diverse perspectives and contextual factors affecting learning processes. The study adopts an exploratory and descriptive approach, aiming to uncover patterns, themes, and meanings related to the research focus.

B. Population and Sample

The population for this research includes all children aged 4 to 6 years enrolled at PAUD Gemilang, as well as the educators involved in teaching numeracy at the institution. Purposeful sampling is used to select a representative subset of participants who are actively engaged with interactive learning media. This includes approximately 15-20 children depending on age and developmental level, and 3-5 educators with experience using such media in instruction. Sampling aims to ensure diversity in gender, age, and learning

abilities to provide a comprehensive understanding of experiences with the media.

C. Location and Subject

The study is conducted at PAUD Gemilang, a preschool institution located in Tangerang Selatan, which integrates interactive learning media as part of its curriculum. The site provides a relevant context for exploring how technology-enhanced tools are implemented and experienced within early childhood education settings in Indonesia. Subjects include children who participate in learning activities utilizing interactive media, their educators who facilitate these activities, and relevant educational documents or artifacts used in the learning process. This setting allows exploration of real-world pedagogical practices and interactions around digital learning media.

IV. RESEARCH RESULT

A. Experiences of Early Childhood Learners with Interactive Learning Media

Children exhibited remarkable enthusiasm and curiosity during activities incorporating interactive learning media, such as digital games featuring animated numbers and counting exercises. This high level of engagement stems from the multisensory nature of the media, which stimulates visual and auditory channels simultaneously, supporting how young children naturally explore and learn. Animated numbers, vibrant colors, and lively sound effects captured the children's attention and encouraged repeated interaction with the materials. Rather than passively receiving information, children actively participated in the learning process by dragging and dropping numbers, answering quizzes, and solving interactive puzzles, which transformed abstract numeracy concepts into tangible, enjoyable experiences.

Interactive features like audio cues and instant feedback further sustained children's focus and motivation. The ability of the media to provide immediate responses to children's input allowed for adaptive learning, where children learned from mistakes in a non-threatening environment and reinforced correct understanding through repetition. Audio guidance helped children follow instructions clearly, and rewards such as sounds or animations upon successful completion of tasks motivated them to continue practicing. As a result, learners engaged more deeply and frequently independently repeated numerical tasks, which enhanced memory retention and skill development. The media's adaptability to different learning paces and styles made the numeracy activities accessible for children with varying levels of prior knowledge and competencies.

Moreover, children expressed enjoyment and a clear preference for the interactive learning approach over traditional methods, which often involve passive listening or static visual stimuli. Playful and game-like features of the interactive media made learning fun and reduced resistance to numerical learning often a challenging subject for young learners. Through guided exploration and playful experimentation, children developed positive attitudes towards numbers and counting, gaining confidence and curiosity to explore further. Observations showed increased social interactions during these activities, as children collaborated, shared strategies, and encouraged peers, fostering a social learning environment. Teachers reported that children's

enthusiasm translated into better learning outcomes, including improved ability to recognize numbers, count objects accurately, and solve simple arithmetic problems.

This aligns with studies indicating that interactive, multimedia-rich learning environments can significantly enhance early childhood numeracy development by engaging multiple senses and providing contextual, meaningful experiences. The combination of visual animations, gamification elements, audio feedback, and hands-on interactivity supports cognitive processes and motivation more effectively compared to conventional rote learning. Ultimately, these advantages contribute to deeper concept internalization and foster a lifelong positive disposition towards mathematics.

These findings underscore the transformative potential of interactive learning media in early childhood education by making numeracy learning more engaging, enjoyable, and effective through an experiential, child-centered approach. Educators are encouraged to integrate such media thoughtfully to complement traditional teaching, tailor experiences to individual learner needs, and optimize learning outcomes within early childhood settings.

This detailed understanding of children's engagement and enjoyment offers valuable insights for curriculum designers and policymakers aiming to enhance foundational numeracy skills using interactive technology, helping prepare learners for future mathematical success in a digital age.

B. Educator Perceptions on Effectiveness of Interactive Learning Media

Educators have consistently noted that the incorporation of interactive media into early childhood classrooms has facilitated a clearer and more comprehensive understanding of numerical concepts among children. This is largely attributed to the multi-sensory approach that interactive media employs, engaging visual, auditory, and kinesthetic learning channels simultaneously. Unlike traditional teaching methods, which often rely heavily on verbal explanations or static visual aids, interactive media provides dynamic and engaging content that captures children's attention and supports diverse learning styles. By integrating animations, sound effects, and interactive elements, children are able to see, hear, and manipulate numerical information, making abstract concepts more concrete and accessible. For instance, when children interact with animated numbers or counting games, they not only recognize symbols but also associate them with quantities and actions, thus deepening their conceptual understanding.

Teachers have observed that children exposed to such interactive media grasp counting and number recognition skills more quickly and effectively compared to peers taught through conventional methods. The immediate feedback that interactive media offers is a significant factor in this accelerated learning. When children answer correctly, positive reinforcement in the form of sounds or animations encourages repetition and reinforces learning. Conversely, gentle corrective feedback allows children to identify mistakes without negative consequences, fostering a safe and supportive environment for trial and error. This adaptability of interactive media supports individual learning paces and styles, allowing children who may need more time or alternative approaches to still participate meaningfully. Educators also highlight that interactive media

often encourages self-directed learning; children demonstrate increased autonomy and confidence as they engage with digital activities independently or with minimal guidance.

Moreover, educators view interactive media as an essential tool for differentiating instruction in classrooms with diverse learners. Early childhood classrooms are naturally heterogeneous, with children varying widely in developmental readiness, learning preferences, and prior knowledge. Interactive media can be calibrated to meet these diverse needs through adjustable difficulty levels, varied content modalities, and personalized learning paths. For example, some children may benefit from media with strong visual cues, while others respond better to audio prompts or hands-on interactive tasks. The flexibility of interactive media helps educators address multiple learning preferences within the same classroom efficiently. This capacity to tailor instruction enhances inclusivity and ensures all children have equitable access to effective numeracy learning experiences. Additionally, media that is engaging and culturally relevant increases children's motivation, leading to more active participation and better retention of numerical concepts.

The richness of multi-sensory experiences provided by interactive media also stimulates cognitive processes such as memory, attention, and problem-solving, which are foundational for numeracy development. Cognitive load theory supports the idea that well-structured multimedia presentations enable learners to process information more easily by distributing cognitive demands across different sensory channels. Consequently, children can focus on understanding numerical relationships without being overwhelmed by complex or abstract representations. The holistic engagement of senses fosters deeper internalization of mathematical concepts, evidenced by children's improved ability to count, recognize numerals, and perform basic arithmetic as reported by educators. Furthermore, the playful and game-like elements of interactive media promote positive attitudes toward learning mathematics, reducing math anxiety and building confidence from an early age.

Research consistent with these observations confirms that interactive media significantly enhances early numeracy skills. Studies have demonstrated that preschool children using interactive teaching tools outperform those in conventional settings, showing better retention and application of counting and number recognition tasks. Qualitative feedback from teachers underscores that interactive media not only boosts cognitive outcomes but also transitions children from passive recipients to active learners, critical to developing lifelong mathematical competencies. However, the successful integration of these media depends heavily on teacher readiness, professional development, and supportive infrastructure within educational settings. Educators need training to effectively select, implement, and integrate interactive media aligned with pedagogical goals. Furthermore, balancing screen time with other developmental activities remains a vital consideration to ensure comprehensive developmental benefits.

In conclusion, the multi-sensory nature of interactive learning media has revolutionized how numerical concepts are introduced and taught in early childhood education. By facilitating clearer understanding, enabling faster skill acquisition, and supporting diverse learning needs, interactive media empowers educators to offer more effective and engaging numeracy instruction. Its role in

differentiating learning and enhancing motivation presents opportunities to overcome traditional educational challenges and foster a robust foundation for mathematical learning that will benefit children throughout their academic journeys.

C. Challenges and Facilitators in Using Interactive Learning Media

The implementation of interactive learning media in early childhood education, particularly at PAUD Gemilang, presents a combination of valuable opportunities and notable challenges. One of the primary challenges faced involves children's initial unfamiliarity with digital devices. Many young learners, especially those from backgrounds with limited exposure to technology, find it difficult to navigate interactive interfaces independently. This necessitates consistent and patient guided support from educators, who must assist children in understanding how to use the media effectively. Such support is critical not only to overcome technical hurdles but also to prevent frustration, which could diminish children's enthusiasm for numerical learning. Educators often need to spend additional time during learning activities to instruct on basic device handling alongside numeracy content, balancing digital literacy development with mathematical skill acquisition.

In addition to challenges related to learners, technical issues with devices themselves sometimes surface, potentially disrupting the learning process. Limitations such as insufficient numbers of tablets or computers, battery life problems, intermittent internet connectivity, and occasional software glitches were encountered during the study. However, these technical difficulties were managed effectively through proactive strategies by the teaching staff. This included scheduling rotation among students for device usage, keeping backup equipment available, troubleshooting simple technical problems independently, and liaising with technical support when needed. The readiness and resilience of the educators played a significant role in minimizing downtime and maintaining the flow of learning activities. Despite these occasional interruptions, the overall positive impact of the interactive media on numeracy skills remained evident.

Success in implementing interactive learning media at PAUD Gemilang was further facilitated by several key factors. One prominent enabler was the enthusiasm and commitment of the educators themselves. Teachers who embraced the use of technology in the classroom demonstrated higher engagement with the media and were more effective in guiding students' interactions. This positive attitude encouraged experimentation and flexibility, where teachers adjusted their instructional approaches based on observed learner needs and feedback from the interactive tools. Prior training and professional development in digital literacy and media integration were also vital. Teachers who had received dedicated workshops or mentoring on using interactive media felt more confident and skilled, which translated into smoother classroom implementation. This capacity-building ensured that technology was not just an add-on but an integral part of the pedagogical process.

Institutional support from PAUD Gemilang's management constituted another foundational facilitator for success. Leadership prioritized investment in technology infrastructure, including the procurement of devices and reliable internet access. They also fostered a school culture that valued innovation and

continuous improvement, providing resources for ongoing teacher training and encouraging collaborative problem-solving. This supportive environment helped overcome barriers such as limited budget or initial skepticism about digital learning. Additionally, management's role in establishing policies for appropriate media use, screen time limits, and balanced integration with physical and social activities ensured that the media complemented rather than dominated the learning experience.

However, these facilitators did not eliminate all challenges entirely. Educators noted that a delicate balance was needed between technology use and traditional hands-on, social, and physical activities crucial for holistic early childhood development. Excessive screen time could impact children's attention spans or social interactions if not carefully managed. Therefore, the integration of interactive media was most effective when combined with active teacher facilitation and complementary offline activities. Moreover, ongoing technical support and upgrading of equipment remained important to sustain effective use over time. Continued collaboration among teachers, management, parents, and technical staff was necessary to adapt and optimize the learning media according to evolving educational needs.

In summary, while the adoption of interactive learning media at PAUD Gemilang encountered initial challenges such as learner digital unfamiliarity and technical limitations, these obstacles were mitigated by strong educator enthusiasm, targeted training, and robust institutional backing. Together, these facilitators created a conducive environment for leveraging digital tools to enhance early numeracy learning. The success factors and challenges identified offer valuable insights for other early childhood education settings aiming to integrate technology effectively, highlighting the importance of preparation, support, and balanced pedagogy in fostering young children's engagement and learning outcomes through interactive media.

D. Impact of Interactive Learning Media on Motivation and Engagement

The use of interactive media in early childhood education has been found to significantly enhance children's motivation to participate actively in learning activities, particularly in numeracy. Unlike traditional teaching methods which may sometimes evoke resistance or disinterest among young learners, interactive media introduces elements of fun, challenge, and immediate gratification that stimulate children's intrinsic desire to engage with numerical tasks. The dynamic and responsive nature of interactive media, such as educational games with animated numbers, sounds, and instant feedback, transforms the learning process into an enjoyable activity rather than a chore. This positive shift in attitude brings about a reduction in children's resistance and anxiety towards math learning, facilitating a smoother and more enthusiastic approach to numeracy.

Furthermore, interactive media allows children to learn at their own pace, an essential factor in early childhood education where learners vary widely in development and readiness. With interactive media, children are not pressured to conform to a fixed pace; instead, they can repeat exercises, explore activities, and receive corrective feedback instantly, fostering autonomy and self-regulation in learning. This self-paced aspect enhances children's confidence as they experience success at their own timing, building a positive self-concept as

mathematic learners. Educators report that children who utilize interactive media exhibit more perseverance and willingness to tackle numerical challenges, attributable to this supportive and non-threatening learning environment.

The playful and interactive features embedded within digital learning media foster active engagement, making lessons more appealing and accessible to young minds. Activities designed as games or story-based learning invite children to participate eagerly and collaborate with peers. Social interactions during group activities mediated by interactive media promote cooperative learning, where children share ideas, assist one another, and develop communication skills alongside numeracy. The social dimension of learning nurtured by such media complements cognitive development, creating a holistic educational experience. Peer collaboration also stimulates motivation, as children are encouraged and inspired by one another's successes and strategies, enhancing overall engagement.

Research supports that interactive media influence not only motivation and engagement but also contribute to significant improvements in early numeracy skills. Children develop deeper conceptual understanding, better counting accuracy, and improved number recognition through repeated practice and meaningful interactions enabled by the media. Teachers observe that students are more likely to retain information and apply mathematical concepts in varied contexts when learning involves interactive and sensory-rich media. The use of bright colors, animations, sound effects, and responsive feedback supports diverse learning styles and sustains children's attention spans for longer periods.

In summary, interactive learning media creates a motivational and supportive environment that reduces resistance, promotes individualized pacing, and encourages active, collaborative learning. Its integration into early childhood numeracy education has shown to foster not only cognitive growth but also positive attitudes towards mathematics, preparing children for continued academic success.

V. CLOSURE

A. Conclution

The findings of this study demonstrate that the use of interactive learning media has a significant positive impact on the numerical ability of early childhood learners at PAUD Gemilang. The interactive media's multi-sensory approach helped clarify numerical concepts, enabling children to better understand and apply counting and number recognition skills. Learners exhibited higher motivation, greater engagement, and enhanced confidence in numeracy activities, facilitated by the playful, stimulating features and instant feedback mechanisms inherent in interactive media. Despite challenges such as limited digital familiarity among some children and occasional technical issues, these were effectively managed with guided support from educators and institutional backing. The enthusiasm and competence of teachers, supported by prior training and management encouragement, played a crucial role in the successful integration of interactive media in the classroom. Overall, the study supports the integration of interactive learning media as an effective tool in

early childhood numeracy education.

B. Suggestion

1. For Educators: Teachers should embrace interactive learning media as a complementary tool in numeracy instruction, focusing on individualized pacing and providing the necessary guidance for children unfamiliar with digital tools. Continuous professional development on technology integration is recommended to enhance teaching efficacy.
2. For PAUD Institutions: Institutions should invest in reliable technological infrastructure and provide ongoing support mechanisms for both teachers and learners to optimize media use. Policies to balance screen time with physical and social play should be implemented to support holistic child development.
3. For Policymakers: Education policymakers should promote the adoption of interactive learning media in early childhood curricula as standard practice and support capacity-building initiatives that train educators in effective technology use.
4. For Future Researchers: Further research could explore long-term impacts of interactive media on various domains of child development, investigate diverse digital tools, and explore parental roles in supporting digital literacy from an early age

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