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Swipe, Tap, Learn: Assessing Digital Competence of Preschool Students through Technology-Mediated Educational Media

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***Abstract*—** *This study assesses the digital competence of preschool students engaged with technology-mediated educational media, focusing on their ability to navigate and interact with digital learning media. The objectives of the research are to assess operational skills and identify challenges requiring teacher intervention. The research employed a qualitative approach, where data was collected through observations and interviews. Findings reveal that preschool students demonstrate foundational digital competence, independently performing basic operational tasks such as swiping screens, dragging objects, and executing touch commands. These skills correlate with emergent literacy development, as children interpret icons, symbols, and visual cues embedded in the media. However, significant challenges were observed in tasks requiring emergent literacy, specifically tasks requiring textual literacy (e.g., password entry) or advanced device management (e.g., adjusting settings) necessitated teacher assistance, underscoring the interplay between independent digital exploration and guided scaffolding. The study highlights how technology-mediated educational media fosters early digital literacy while emphasizing the critical role of educators in bridging skill gaps. It underscores the necessity for personalized digital pedagogy and developmentally appropriate app design to accommodate varying digital competence in preschoolers. It also emphasizes the importance of addressing equity and viewing digital literacy as a socially mediated process, informing future research for iterative improvements in digital education.*

***Keywords*—** *Digital competence, preschool education, educational media, technology-mediated learning, emergent literacy.*

I. INTRODUCTION

The integration of digital technologies into early childhood education has transformed pedagogical approaches, offering interactive and personalized learning experiences. In an era where digital literacy is foundational, educational communication now encompasses technology-mediated interactions that enhance cognitive and communicative development [1]. Preschool students today are growing up in digitally saturated environments, where tablets and educational applications serve as gateways to literacy, numeracy, and problem-solving skills [2]. However, the extent to which young learners—still developing foundational literacy and motor skills—can independently navigate these tools remains underexplored. This gap is particularly pronounced in contexts like Indonesia, where digital infrastructure and teacher training vary widely, and localized solutions such as offline-accessible apps are critical [3], [4].

This study addresses these gaps by examining how preschool students develop digital competence—defined as the ability to effectively use digital tools for learning—through engagement with educational media. The objectives are twofold: (1) to assess operational skills demonstrated during app-based learning, and (2) to identify challenges requiring teacher intervention (e.g., password entry, device management). By focusing on technology-mediated learning environments, this research contributes to broader efforts to optimize digital pedagogy while addressing equity and accessibility in early childhood education.

II. LITERATURE REVIEW

A. Educational Communication and Technology-Mediated Learning

Educational communication, as a field, emphasizes the role of mediated interactions in shaping learning outcomes [1]. In digital contexts, this involves designing tools that align with children's developmental stages while fostering engagement and critical thinking [5]. Technology-mediated learning, rooted in sociocultural theory, positions digital tools as scaffolds for guided participation, enabling children to internalize concepts through iterative practice and feedback [6]. For instance, gamified apps like Sekolah Enuma blend literacy activities with gameplay, allowing preschool students to decode symbols and navigate interfaces independently [7]. Such tools exemplify digital play—a hybrid of traditional play and technology-mediated interaction—that strengthens operational skills and creative engagement [8].

B. Digital Learning Media in Early Childhood

Digital learning media, including apps, simulations, and multimedia platforms, are designed to cater to diverse learning styles through multisensory inputs [9]. Studies highlight their potential to enhance hand-eye coordination, problem-solving, and motivation [10], [11]. For example, Neumann and Neumann [12] found that touchscreen interactions improve emergent literacy by enabling children to interpret icons and spatial relationships. However, challenges persist in optimizing these tools for universal effectiveness. Research in low-resource settings reveals disparities in device access and

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educator preparedness, limiting scalability [13]. Additionally, while children master basic operational skills quickly, tasks requiring textual literacy demand scaffolding from teachers [14].

C. Digital Competence

Digital competence, as defined by Ferrari [15], encompasses skills in accessing, understanding, and creating digital content. Marsh [8] operationalizes this for preschool students, identifying key competencies such as swiping, tapping, and drag-and-drop tasks. These skills correlate with emergent literacy, as children decode visual and symbolic cues embedded in interfaces [12]. However, Ferrari's framework also emphasizes the need for critical engagement—ensuring children understand digital risks and ethical norm [16]. In Indonesia, localized apps like Sekolah Enuma demonstrate how culturally relevant design can bridge gaps in formal education [4], though further research is needed to evaluate long-term cognitive and social impacts.

Sekolah Enuma, an adaptation of the Kitkit School application, was launched in Indonesia in 2020 by U.S.-based Enuma, Inc., aiming to deliver accessible, quality education to children, particularly in areas with limited formal schooling. Sekolah Enuma offers Indonesian curriculum-aligned learning in English, Mathematics, and Indonesian. Through engaging activities like games, videos, and storybooks, it fosters literacy and numeracy skills in early childhood and elementary students. Its design emphasizes independent learning, enabling children to progress without constant adult supervision, and features offline accessibility for flexible, anytime, anywhere learning.

III. Methodology

This study employed a qualitative methodology to assess preschool students' digital competence in technology-mediated learning environments. Data collection methods included classroom observations and teacher interviews. The participants included preschool students aged 4–6 years from early childhood education centers in Bekasi and Jakarta, Indonesia, along with their teachers. These early childhood education centers are participants of the Sekolah Enuma Program, where they were loaned tablets for their students to study using licenced Sekolah Enuma app by an international charitable organization.

Observations were conducted over four weeks, focusing on operational skills such as swiping, dragging, and navigating interfaces, while interviews explored challenges and pedagogical strategies. Data analysis followed the Miles and Huberman (1984) framework, involving data reduction, presentation, and verification. Validity of the research was achieved through data triangulation.

IV. Results and Discussion

A. Results

The observational data revealed distinct patterns in digital competence of preschool students when interacting with educational media. As shown in Table 1, most children demonstrated proficiency in basic operational skills such as swiping screens to navigate content and tapping icons to execute commands. These actions, which formed the core of their independent interactions with the tablets, align with the tactile learning behaviours described by Marsh [8]. Children were particularly adept at dragging items across the screen during puzzle-solving activities, showcasing their ability to translate physical motor skills into digital interactions. However, more complex operations requiring symbolic or textual literacy, such as selecting their profile from a list of names or entering pictorial passwords, proved challenging for some participants. These tasks consistently required teacher intervention, highlighting an important boundary in young children's independent digital competence.

TABLE I. Digital Competence of Preschool Students

No	Digital Competence Skills	Observation Results
1	Swipe the screen (e.g. to change photos, turn the "page" of an e-book)	Most students able to do unassisted.
2	Trace shapes with their fingers	Most students able to do unassisted.
3	Drag items across the screen	Most students able to do unassisted.
4	Open their apps	The apps are used individually, students must choose their names then enter the password which consists of pictures. Students who are unable to read require assistance from their teachers to open their accounts.
5	Draw Things	Some students are observed drawing things in Mathematics lessons.
6	Tap the screen to operate commands	Most students able to do unassisted.
7	Exit apps and enter other apps	Some students are observed exiting the apps and opening other apps i.e. YouTube, which the teacher conditioned.
8	Drag items and trace shapes	Most students able to do unassisted.
9	Turn the device on and off	Some students need assistance.
10	Increase or decrease the volume	Some students need assistance.
11	Use learning apps	All students able to use the Sekolah Enuma app, although some need assistance throughout the course of the time they use it.
12	Unlock the device	Some students demonstrate this ability.
13	Use creativity apps	Not observed/not applicable.
14	Take photos	Not observed/not applicable.
15	Click on a cross in a box to get rid of a pop-up	Most students able to do unassisted.
16	Use gaming apps	Most students able to do unassisted.
17	Enlarge and decrease the size of objects by pinching and dragging	Most students able to do unassisted.
18	Show others e.g. siblings how to use the device	Some students communicate with others to demonstrate how a lesson is to be played on the app.
19	Use video apps	Students are able to go to the Video menu in the app.
20	Use reading apps	Students are able to go to the Books menu in the app.
21	Make videos	Not observed/not applicable.
22	Find new apps in the app-store/marketplace	Not observed/not applicable.
23	Purchase new apps in the app-store/marketplace	Not observed/not applicable.

It is worth noting that while most students could easily navigate within the learning apps, some were observed exiting to access other applications like YouTube without prompting. This behaviour suggests that operational competence extends beyond intended educational use, though it also raises questions about attention management in digital learning environments. The study also documented significant variability in engagement duration, with some children remaining focused for the full 30-minute sessions while others lost interest after just 15 minutes and had to be motivated by the teachers to keep using it for the rest of the session. Teacher interviews attributed this variation to both individual differences in attention spans and the app's ability to maintain interest through its gamified elements. These findings collectively paint a picture of preschool digital competence as robust in mechanical interactions but still developing in terms of focused, sustained educational engagement.

B. Discussion

The results presented above substantiate existing frameworks of digital competence development while revealing important nuances in early childhood technology use. Regarding the assessment of operational skills, the children's mastery of basic touchscreen operations confirms Marsh's [8] assertion that contemporary preschoolers are "digital natives" who acquire interface navigation skills through exploratory play. This aligns with broader literature which posits physical interactions with digital devices support cognitive development [17]. Concerning the identification of challenges requiring teacher intervention, the frequent need for teacher assistance with text-based tasks echoes findings by Danby et al. [18], who noted that while touchscreen interfaces lower barriers to digital access, they don't eliminate the need for adult scaffolding in literacy-related activities. This highlights the importance of teacher support in tasks requiring symbolic and textual understanding. Addressing the analysis of the relationship between digital interactions and emergent literacy outcomes, the observed behaviors during app use provide compelling evidence for what Kucirkova [19] terms "personalized digital pedagogy" - the idea that educational technology should adapt to children's individual competency levels. The variability in engagement durations particularly supports this view, suggesting that optimal digital learning experiences for preschoolers require careful balancing of challenge and accessibility. Our findings also contribute to the emerging discourse on "digital play" [20], demonstrating how educational apps occupy a unique space between structured learning and free exploration. The children's ability to fluidly transition between the prescribed learning activities and unauthorized app exploration illustrates the permeable boundaries of digital play spaces in educational contexts. A significant implication emerging from this study concerns the design of authentication systems for early childhood apps. While pictorial passwords were implemented to accommodate non-readers, many children still required assistance, suggesting that even these simplified systems may exceed some preschoolers' cognitive capacities. This finding challenges common assumptions in educational technology design and calls for more nuanced approaches to accessibility in digital learning tools [21]. The study also highlights the importance of considering digital competence as not just individual skill acquisition but as a socially mediated process, where teacher guidance and peer interactions play crucial roles in shaping meaningful technology use [22].

V. Other Recommendations

This study demonstrates that preschool students exhibit strong foundational digital competence in operating technology-mediated learning media, particularly in performing basic touchscreen interactions like swiping, tapping, and dragging objects independently. These findings confirms that operational skills are readily acquired by young children, supporting Marsh's [8] framework of digital literacy development. However, there are challenges related to limitations in children's autonomous use, as tasks requiring emergent literacy skills (e.g., password entry) or device management (e.g., volume control) consistently required teacher assistance. Examining the relationship between digital interactions and learning outcomes showed that while app-based activities reinforced symbol recognition and problem-solving, engagement levels varied significantly among students.

The results imply a need for pedagogical adaptation that recognizes varying digital competence among preschoolers, advocating for personalized digital pedagogy and effective teacher scaffolding, especially for literacy-dependent tasks. Developers should prioritize developmentally appropriate app designs with intuitive interfaces and accessible authentication, while educators must acknowledge digital literacy as a socially mediated process, fostering collaboration and addressing equity in technology access. Future research should build on these findings to iteratively improve digital education tools, ensuring they align with developmental stages and promote equitable learning outcomes.

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