

Digitalizing Multiple Intelligence Assessment in Early Childhood: A Needs Analysis from Teachers' Perspectives

Journal of Early Childhood Education Research
ISSN 3123-4143
Vol. 1 (2), pp.99-115, 2025
<https://doi.org/10.58230/jecer.v1i2.525>
© 2025 SSED Publications

Dita Masdalena¹, Tri Milda Alfudjar², Lina Amelia³, Romlah Delfianda⁴, Aina Nabila⁵

¹²³⁴⁵ Universitas Islam Negeri Ar-Raniry Banda Aceh, Indonesia

Abstract

Purpose	: The digitalization of assessment instruments has become critical in early childhood education, yet implementation gaps persist. Multiple intelligence assessment continues to rely on manual methods that are time-consuming and prone to errors. This study analyzes the needs for digitalizing multiple intelligence assessment from teachers' perspectives, examining current practices, technological readiness, perceived benefits and barriers, and requirements for user-friendly digital systems.
Methodology	: A qualitative exploratory case study was conducted at Khalifah 3 Islamic Kindergarten, Indonesia, during 2024/2025. Data were collected through semi-structured interviews with early childhood teachers as primary assessment implementers. Interviews explored current assessment practices, perceptions of digital technology, digital literacy levels, and digitalization needs. Data were analyzed thematically using Technology Acceptance Model (TAM) and Diffusion of Innovations theory as analytical frameworks.
Results	: Findings reveal that the kindergarten has not implemented multiple intelligence assessment, with evaluation focused on standard Child Development Achievement Standards (STPPA). Teachers demonstrated positive perceptions toward digital tools with high perceived usefulness regarding time efficiency, documentation ease, improved accuracy, and collaborative capabilities. However, implementation faces constraints including limited digital literacy in advanced spreadsheet functions, inadequate technological infrastructure with insufficient devices and unstable connectivity, and absence of technical support, indicating low perceived ease of use.
Conclusions	: Based on TAM and Diffusion of Innovations frameworks, the kindergarten is in early technology adoption stages (knowledge and persuasion phases). The contrast between high perceived usefulness and low perceived ease of use indicates recognition of digital benefits but lack of implementation capabilities. Successful digitalization requires comprehensive institutional support including intensive digital literacy training, enhanced technological infrastructure, ongoing technical assistance, and user-friendly assessment templates. Digital transformation must follow a gradual approach encompassing digitalization roadmaps, continuous professional development, and sustained mentoring systems. These findings illuminate the gap between digital assessment potential and implementation reality, offering evidence-based recommendations for supporting teachers' transition to technology-enhanced assessment in resource-constrained contexts.

Keywords: digitalization needs; teacher perspectives; technology acceptance; early childhood assessment; digital literacy

Corresponding Author:

Dita Masdalena, Universitas Islam Negeri Ar-Raniry Banda Aceh, Indonesia. Email ditamasdalena@gmail.com

Article History

Received: 17 August, 2025
Accepted: 3 October, 2025
Published: 30 October, 2025



© 2025 JECER. This article is published under the Creative Commons Attribution-ShareAlike 4.0 International License (CC BY-SA 4.0). <https://creativecommons.org/licenses/by-sa/4.0>

1. Introduction

The rapid advancement of digital technology has fundamentally transformed educational practices worldwide, creating both opportunities and challenges for early childhood education. Globally, the integration of digital tools in early childhood settings has expanded significantly, with technology being increasingly used for documentation, communication, and assessment purposes (Dong & Newman, 2018). However, this digital transformation has revealed a critical gap in teachers' digital literacy, particularly in developing countries where infrastructure and training remain limited (Astuti et al., 2021). In Indonesia, early childhood education institutions face similar challenges, where teachers still predominantly rely on manual, paper-based assessment instruments that are time-consuming and prone to errors (Septiani et al., 2024). The COVID-19 pandemic further accelerated the urgency of digital transformation in education, forcing educational institutions to rapidly adapt to technology-enhanced practices (Permatasari et al., 2023). Despite this momentum, many early childhood educators lack the necessary digital competencies and adequate technological infrastructure to effectively implement digital assessment systems (Andriani & Rasto, 2023; Astuti et al., 2021). Moreover, existing assessment instruments often fail to capture the multidimensional nature of children's

development, particularly in identifying and documenting the diverse intelligences that each child possesses (Rahmawati & Fauziddin, 2022).

Early childhood education (ECE) serves as a critical foundation for character development and the optimization of children's potential across multiple developmental domains. During the golden age period, children experience rapid and comprehensive growth in physical, cognitive, social-emotional, and moral-spiritual aspects (Nurjanah et al., 2022). Assessment practices at this developmental stage must be authentic, continuous, systematic, and capable of providing a holistic picture of each child's unique developmental trajectory (Fitria & Jannah, 2021; Fantozzi, 2022). Developmentally appropriate assessment in early childhood education requires instruments that consider all aspects of child development rather than focusing narrowly on academic abilities alone (UNESCO, 2018). Research indicates that comprehensive developmental assessment not only serves as an evaluation tool but also functions as a foundation for reflective teaching practice and individualized instructional planning based on children's observed achievement levels (Purnama et al., 2021; Anhusadar, 2020). However, traditional assessment systems still widely implemented in Indonesian early childhood institutions remain predominantly manual, requiring substantial time investment, and demonstrate limited capacity to comprehensively capture the complexity and diversity of children's developmental profiles (Hidayati & Nurhayati, 2024). These conventional approaches often result in fragmented documentation, difficulty in longitudinal developmental tracking, and challenges in translating assessment data into actionable pedagogical decisions (Bening et al., 2022).

Within the context of holistic child development assessment, the theory of multiple intelligences proposed by Howard Gardner offers a valuable framework for recognizing and nurturing the diverse capabilities that children possess. Gardner's theory identifies nine distinct types of intelligence linguistic, logical-mathematical, spatial, bodily-kinesthetic, musical, interpersonal, intrapersonal, naturalist, and existential emphasizing that each child possesses unique strengths in how they learn, process information, and express their abilities (Gardner, 1993; Safitri & Lestarinigrum, 2021). This theoretical framework challenges the conventional notion of intelligence as a singular, uniform construct measured primarily through standardized testing (Masdudi, 2017). Research demonstrates that understanding and assessing multiple intelligences is essential for designing differentiated learning experiences that align with individual children's characteristics and optimize their developmental potential (Wulandari & Suryana, 2021; Yin, 2018). The application of multiple intelligence theory in early childhood settings enables educators to identify each child's dominant intelligences, provide targeted stimulation, and create learning environments that honor diverse ways of knowing and demonstrating competence (Wardan, 2022; Wijaya et al., 2024). Consequently, assessment practices in early childhood education cannot be conducted uniformly but must accommodate the diversity of potential and individual characteristics that each child brings to the learning environment (Mubarak et al., 2022). However, implementing multiple intelligence assessment in practice presents significant challenges, as it requires systematic observation across multiple domains, documentation of varied forms of expression, and interpretation of complex developmental patterns tasks that are difficult to accomplish effectively using traditional paper-based methods (Setyawan et al., 2021; Septiani et al., 2024).

Digital technology offers transformative solutions to address the limitations of traditional assessment approaches in early childhood education. The digitalization of assessment instruments provides multiple advantages, including enhanced efficiency in data collection, accelerated processing and analysis of assessment results, more informative visualization of developmental patterns, secure long-term data storage, and improved accessibility for collaborative review by educators and families (Septiani & Cahyati, 2023). Digital assessment tools enable teachers to conduct real-time developmental monitoring, generate immediate feedback, and make more informed instructional decisions based on accurate, comprehensive

data (Pratiwi et al., 2024). Furthermore, digital platforms facilitate more personalized differentiated instruction, as assessment results can be immediately analyzed and utilized as a foundation for designing learning strategies tailored to individual children's developmental needs and learning profiles (Liu et al., 2025). Empirical evidence demonstrates the effectiveness of digital assessment instruments in early childhood contexts. Studies show that digital applications for child development assessment significantly improve teachers' time efficiency in recording and reporting developmental progress (Maharani & Khasanah, 2023). Research on digital platforms for multiple intelligence assessment indicates that technology-enhanced tools help teachers identify children's dominant intelligences more objectively and systematically compared to traditional methods (Rahmawati & Fauziddin, 2022). Additionally, web-based developmental assessment systems have proven effective in increasing parental engagement in monitoring their children's progress, thereby strengthening home-school partnerships (Susanto et al., 2021). These findings suggest that thoughtfully designed digital assessment instruments have the potential to enhance both the efficiency and quality of developmental assessment practices in early childhood education.

Despite the documented benefits of digital assessment tools, their implementation in early childhood education contexts continues to face substantial barriers. Many ECE teachers lack the digital competencies required to effectively integrate technology into their teaching and assessment practices (Andriani & Rasto, 2023). Multiple intelligence assessment conducted in Indonesian early childhood settings still predominantly relies on manual observation and conventional recording methods that are subsequently compiled periodically, a process that demands considerable time and effort while remaining vulnerable to documentation errors and difficulties in longitudinal developmental tracking (Hidayati & Nurhayati, 2024). Research identifies multiple implementation challenges including limited technological infrastructure in schools, insufficient professional development opportunities, inadequate technical support, and psychological resistance to transitioning from familiar traditional methods to digital approaches (Mulyono et al., 2025). Teachers often express concerns about the complexity of digital tools, uncertainty about technical troubleshooting, and anxiety about their ability to master new technologies (Hendar, 2020). These challenges are particularly pronounced in resource-constrained settings where access to devices, reliable internet connectivity, and ongoing technical assistance remains limited (Astuti et al., 2021).

The development of digital assessment instruments for early childhood requires careful consideration of developmental appropriateness and alignment with core principles of ECE assessment. Digital tools must preserve the essential characteristics of authentic assessment that is observation-based, contextualized in meaningful activities, and conducted without imposing psychological pressure on children (Lestari et al., 2022; Merriam & Tisdell, 2016). Digitalization should be conceptualized as a supportive tool that facilitates teachers' documentation and analysis of children's development rather than a replacement for direct observation and personal interaction with children (Fantozzi, 2022). The principle of Developmentally Appropriate Practice (DAP) must remain the foundational framework guiding the design of digital assessment instruments to ensure alignment with the developmental stages, cultural contexts, and individual needs of young children (NAEYC, 2020). User-centered design approaches that prioritize teachers' perspectives, technical capabilities, and contextual realities are essential for developing digital assessment systems that are both pedagogically sound and practically feasible (Wijaya & Setyawan, 2023).

The need for digitalization of multiple intelligence assessment instruments in early childhood education has become increasingly urgent in the post-pandemic educational landscape. Teachers require assessment tools that not only streamline administrative processes but also provide accurate, comprehensive, and actionable information about children's developmental profiles across multiple intelligence domains (Wijaya et al., 2024). Such instruments should support evidence-based instructional planning that responds to the

unique potential and individual learning needs of each child (UNESCO, 2018). Conducting thorough user needs analysis is a critical preliminary step in developing educational information systems, ensuring that the resulting products align with end-users' expectations, technical capacities, and practical requirements (Wijaya & Setyawan, 2023). However, research that systematically examines the needs for digitalizing multiple intelligence assessment instruments from the perspectives of practicing early childhood educators remains notably limited. Most existing studies focus on the technical development of digital tools or their implementation outcomes, with insufficient attention to the preliminary analysis of users' actual needs, readiness levels, and contextual constraints (Latif et al., 2025; Lincoln & Guba, 1985; Liu et al., 2025).

2. Methodology

2.1. Research Design

This study employed a qualitative approach with an exploratory case study design to examine in depth the needs for digitalizing multiple intelligence assessment instruments at Khalifah 3 Kindergarten. The qualitative approach was selected as most appropriate for exploring the perspectives, experiences, and needs of teachers as the primary implementers of assessment systems (Sun et al., 2023). Case study design enables intensive investigation of a contemporary phenomenon within its real-world context, particularly when boundaries between phenomenon and context are not clearly evident (Yin, 2018). This design is especially suitable for understanding complex educational processes and capturing the nuanced perspectives of practitioners in their authentic settings (Merriam & Tisdell, 2016).

The exploratory nature of this case study aligns with the research purpose of investigating a relatively new phenomenon, the digitalization of multiple intelligence assessment—in contexts where existing knowledge remains limited. As Ahmed et al. (2025) emphasize, qualitative research in early childhood education requires methods capable of capturing participants' perspectives in depth to ensure they remain central to research efforts. The flexible and adaptive nature of this research design allowed for in-depth exploration of teachers' experiences, perceptions, and specific needs related to multiple intelligence assessment and its potential digitalization. Figure 1 presents the systematic procedural steps employed in this research.

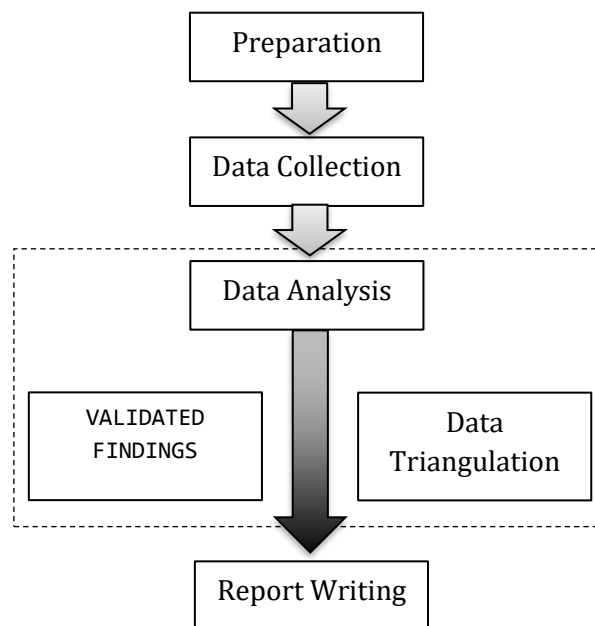


Figure 1. Systematic Procedural Steps in Research Design

2.2. Research Setting and Participants

This research was conducted at Khalifah 3 Kindergarten, located in South Sulawesi, Indonesia, during the second semester of the 2024/2025 academic year. The kindergarten serves approximately 60 children aged 4-6 years across multiple classrooms. Site selection was based on purposive sampling criteria guided by preliminary observations revealing that multiple intelligence assessment had not become a serious concern for teachers at the institution, either manually or digitally. This absence of existing multiple intelligence assessment practice made the setting particularly relevant for analyzing digitalization needs from a foundational perspective, providing insights into the initial stages of technology adoption in early childhood assessment contexts.

Research participants consisted of five early childhood teachers who were actively involved in daily child development assessment practices. Participant selection employed purposive sampling to ensure inclusion of teachers with varying levels of teaching experience (ranging from 2 to 8 years) and diverse educational backgrounds to capture a comprehensive range of perspectives on assessment practices and technology integration. All participants were female, reflecting the demographic composition of early childhood educators in the Indonesian context. Prior to data collection, informed consent was obtained from all participants, and ethical considerations including confidentiality, voluntary participation, and right to withdrawal were strictly observed throughout the research process.

2.3. Data Collection Methods

To ensure comprehensive data collection and methodological triangulation, this study employed three complementary data collection methods: semi-structured interviews, non-participant observation, and document analysis. This multi-method approach strengthens the validity and credibility of findings by enabling cross-verification of data from multiple sources (Creswell & Poth, 2018).

Semi-structured interviews. Semi-structured interviews served as the primary data collection method, conducted individually with each of the five teacher participants. Each interview lasted approximately 45-60 minutes and was conducted in a private, comfortable setting at the kindergarten during non-teaching hours to minimize disruption and ensure participants' comfort. Semi-structured interviews were selected because they provide a balanced structure that guides research focus while offering flexibility to explore emergent topics in depth (Ahmed et al., 2025). The researcher developed an interview guide covering key areas including: (a) current assessment practices and challenges, (b) understanding and experience with multiple intelligence theory, (c) perceptions of digital technology in education, (d) digital literacy levels and technological competencies, (e) perceived benefits and barriers to digital assessment implementation, and (f) specific needs and preferences for digital assessment tools. The interview guide allowed for probing questions and follow-up exploration of participants' responses, enabling deeper understanding of their perspectives and experiences. All interviews were audio-recorded with participants' permission and subsequently transcribed verbatim for analysis.

Non-participant observation. To complement interview data and provide contextual understanding of actual assessment practices, non-participant observation was conducted over four weeks during daily classroom activities. Observations focused on documenting teachers' current assessment practices, including methods of recording children's developmental progress, tools and instruments utilized, time allocation for assessment activities, and challenges encountered during the assessment process. Structured observation protocols guided data collection, focusing on specific aspects relevant to understanding digitalization needs: types of assessments conducted, frequency of assessment activities, recording and documentation methods, data storage and retrieval practices, and collaborative assessment practices among teachers. Detailed field notes were maintained, capturing both descriptive accounts of observed practices and reflective memos regarding implications for digital

assessment needs. Observation data provided valuable insights into the practical realities of assessment implementation that might not emerge through interviews alone, revealing gaps between espoused beliefs and actual practices.

Document analysis. Document analysis examined existing assessment instruments, recording forms, and child development reports currently utilized at Khalifah 3 Kindergarten. Documents analyzed included: assessment rubrics and checklists, daily observation forms, weekly and monthly developmental reports, parent communication documents regarding child progress, and any existing guidelines or policies related to assessment practices. Document analysis served multiple purposes: understanding the structure and content of current assessment instruments, identifying the scope and domains of developmental assessment, examining documentation formats and their affordances and constraints, and revealing gaps in current assessment practices that digital tools might address. Analysis of these documents provided concrete evidence of current assessment practices and highlighted specific areas where digitalization could offer improvements in efficiency, comprehensiveness, or usability.

2.4. Data Analysis

Data analysis followed Braun and Clarke's (2006) thematic analysis approach, which is particularly well-suited for identifying, analyzing, and reporting patterns (themes) within qualitative data. The analysis process proceeded through six systematic phases: familiarization with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report.

In the familiarization phase, all interview transcripts, observation field notes, and document analysis notes were read and re-read multiple times to develop deep familiarity with the data corpus. During this immersive reading, preliminary ideas for coding were noted. The initial coding phase involved systematic identification of interesting features across the entire dataset. Data were coded manually using NVivo 12 software to facilitate organization and retrieval. Codes were applied to meaningful segments of data that related to research questions, with particular attention to teachers' perspectives on current assessment practices, their understanding of multiple intelligence assessment, their technological readiness, perceived benefits and barriers to digitalization, and specific support needs.

The theme development phase involved collating codes into potential themes and gathering all relevant coded data extracts for each potential theme. Themes were developed both inductively from the data and deductively guided by the Technology Acceptance Model (TAM) framework, which informed analysis of perceived usefulness and perceived ease of use constructs. The Diffusion of Innovations theory additionally guided interpretation of adoption readiness stages. Candidate themes were reviewed against coded extracts and the entire dataset to ensure internal homogeneity within themes and external heterogeneity between themes. Themes were refined and clearly defined, with detailed analysis of each theme's scope and boundaries. Throughout the analysis process, constant comparison was employed to identify patterns, variations, and relationships among themes across different data sources (interviews, observations, documents), enabling triangulation and comprehensive understanding of digitalization needs.

2.5. Trustworthiness and Rigor

To ensure trustworthiness of findings, this study employed Lincoln and Guba's (1985) criteria including credibility, transferability, dependability, and confirmability. Credibility was enhanced through methodological triangulation (using multiple data sources), prolonged engagement at the research site (four weeks of observation), and member checking whereby interview transcripts and preliminary findings were shared with participants to verify accuracy of interpretation. Transferability was addressed through thick description of the research context, participants, and processes, enabling readers to assess applicability to other settings. Dependability was maintained through detailed documentation of all research procedures and

decisions in an audit trail. Confirmability was ensured through reflexive journaling where the researcher documented personal assumptions, reactions, and potential biases throughout the research process, as well as through maintaining clear linkages between raw data, codes, themes, and interpretations. These rigor strategies collectively strengthen confidence in the validity and reliability of research findings.

3. Results

3.1. Current Assessment Practices at Khalifah 3 Kindergarten

Based on triangulated data from interviews, classroom observations, and document analysis, this study reveals that Khalifah 3 Kindergarten has never implemented multiple intelligence assessment in their child development evaluation practices. Interview data from all five teacher participants consistently confirmed the absence of any MI-based assessment experience, either manually or digitally. One teacher explicitly stated: "Honestly, I don't know how to conduct multiple intelligence assessment yet. What should be observed, how to measure it, what the instruments are like, I have never received training or guidance about it. The school has never implemented MI assessment at all."

This interview finding was corroborated by direct classroom observations conducted over four weeks, which revealed that teachers' assessment activities focused exclusively on standard developmental domains prescribed by the Ministry of Education and Culture's Child Development Achievement Level Standards (STPPA). Observational data documented teachers recording children's progress in six areas: religious and moral values, social-emotional development, cognitive skills, language development, physical-motor abilities, and arts. No evidence of systematic observation or documentation related to multiple intelligence domains, such as musical, spatial, naturalist, or existential intelligence—was observed during the fieldwork period.

Document analysis further validated these findings. Examination of the kindergarten's assessment instruments, including observation forms, developmental checklists, and progress reports, revealed that all existing documentation tools were structured around STPPA domains with no provisions for capturing multiple intelligence profiles. The assessment forms examined contained pre-defined indicators aligned with standard developmental milestones but lacked categories or criteria that would enable identification of children's diverse intelligence strengths as conceptualized in Gardner's multiple intelligence framework.

Beyond the absence of MI assessment, observation and interview data converged in revealing significant inefficiencies in current manual assessment practices. Teachers were observed spending considerable time during and after class hours manually recording observations in physical notebooks, often resulting in scattered documentation across multiple locations. One teacher described this fragmentation: "We still use manual notebooks to record children's development. Sometimes the notes are scattered in various places, some in daily books, some in observation sheets. When we have to make development reports, we have difficulty collecting and analyzing all that data comprehensively." Document analysis confirmed this fragmentation, as assessment records were found stored in diverse formats—handwritten notebooks, loose observation sheets, and inconsistently formatted progress reports—creating challenges for longitudinal tracking and comprehensive analysis of children's developmental trajectories.

3.2. Teachers' Understanding and Perceptions of Multiple Intelligence Assessment

Interview data revealed limited conceptual understanding of multiple intelligence theory and its application in early childhood assessment among participating teachers. While teachers demonstrated awareness that children possess different strengths and learning styles, their understanding remained general and not grounded in the specific theoretical framework of Gardner's multiple intelligences. When asked about their familiarity with MI assessment, teachers' responses indicated they had encountered the concept peripherally—through brief

mentions in professional development workshops or informal discussions—but had never received systematic training in its theoretical foundations or practical application.

This limited understanding was evident in teachers' inability to articulate specific indicators or observation strategies for different intelligence types. Teachers expressed uncertainty about what behaviors or competencies would constitute evidence of musical-rhythmic intelligence versus bodily-kinesthetic intelligence, or how naturalist intelligence might manifest differently from logical-mathematical intelligence in early childhood contexts. This conceptual gap represents a foundational barrier to MI assessment implementation, as teachers cannot systematically observe and document developmental aspects they do not clearly understand.

Despite limited MI-specific knowledge, teachers expressed strong recognition of the value proposition underlying the multiple intelligence approach. Interview participants articulated beliefs consistent with MI philosophy that children possess diverse capabilities, that standardized assessment may overlook important strengths, and that individualized understanding of each child's unique profile is essential for effective teaching. One teacher reflected: "I can see that each child is different. Some are very good at singing and moving, others are quieter but very observant with nature. But I don't have a proper way to document these differences systematically." This statement illustrates teachers' intuitive alignment with MI principles despite lacking formal assessment frameworks to operationalize these observations.

3.3. Perceived Usefulness of Digital Assessment Tools

Interview data revealed unanimously positive perceptions among teachers regarding the potential usefulness of digital assessment tools, particularly spreadsheet-based systems, for child development documentation. All five participants identified multiple benefits they anticipated from digitalization, demonstrating high perceived usefulness in Technology Acceptance Model terms. Teachers articulated perceived benefits across several dimensions: time efficiency in data entry and retrieval, improved accuracy in developmental tracking, enhanced organization of assessment records, secure long-term data storage through cloud systems, ease of generating comprehensive reports for parents and administrators, and facilitation of collaborative assessment practices among teaching staff.

One teacher expressed strong enthusiasm for digital solutions: "I am very interested in the idea of using spreadsheets for assessment. I have used Excel for personal purposes and I think it's very practical. If it can be applied to assess children, it will definitely help our work greatly." This statement reflects teachers' extrapolation from positive personal technology experiences to professional assessment contexts, suggesting perceived transferability of digital skills across domains.

Teachers specifically valued the potential for digital systems to address current pain points observed in manual assessment. They anticipated that spreadsheets would reduce the time-consuming nature of handwritten documentation, eliminate the problem of scattered and lost records, enable quick searching and filtering of child development data, and provide visual representations of developmental progress through graphs and charts. Additionally, teachers recognized that cloud-based systems would enable access to assessment data from multiple locations and devices, potentially allowing for more flexible documentation practices—for example, entering observations immediately after activities rather than waiting until the end of the day when details might be forgotten.

The environmental benefit of reduced paper consumption was also mentioned by multiple teachers, who noted the considerable volume of printed forms, reports, and documentation currently required. One teacher observed: "If we can do this digitally, we won't need to print so many forms every week. It's better for the environment and also saves costs." This attention to sustainability suggests that perceived usefulness extended beyond immediate practical benefits to encompass broader institutional and societal values.

3.4. Barriers to Digital Assessment Implementation: Low Perceived Ease of Use

Despite high perceived usefulness, interview and observational data converged in revealing significant barriers related to perceived ease of use—teachers' confidence in their ability to successfully operate digital assessment systems. Analysis identified two primary barrier categories: limited digital competence among teachers and inadequate technological infrastructure at the institutional level.

Limited digital literacy. Interview data revealed considerable variation in teachers' digital competence, with most participants describing their technology skills as basic and insufficient for advanced spreadsheet operation. A senior teacher with six years of experience articulated this limitation: "I have been teaching for 6 years, but my experience with technology is still limited. I can use WhatsApp and social media, but for more technical things like Excel or Google Sheets, I am still unfamiliar. Sometimes I feel left behind compared to younger teachers who are more tech-savvy." This statement illustrates both the specific skill gap (familiarity with communication apps but not productivity software) and the psychological dimension of technology anxiety, particularly in relation to generational differences in digital fluency.

Teachers' self-reported competence limitations were validated through observation of their current technology use in classroom and administrative contexts. During the four-week observation period, teachers were observed using smartphones primarily for communication (WhatsApp groups for parent communication) and simple photography (documenting children's activities). No instances of teachers using computers for data management, analysis, or report generation were observed, with all documentation activities conducted through manual handwriting. This observational evidence corroborates interview claims of limited experience with productivity software and data management tools.

Even among younger teachers who expressed greater comfort with technology generally, specific gaps in spreadsheet competency were evident. Teachers reported familiarity with basic data entry but acknowledged lacking skills in formula creation, data validation, pivot table use, or chart generation—precisely the functions that would be most valuable for assessment data analysis and reporting. A younger teacher explained: "I once tried to learn Excel on my own from YouTube, but it's also difficult to learn alone. Sometimes I don't know where to start, and if there's an error I don't know how to solve it. I need structured training with direct mentoring." This statement highlights not only skill deficits but also unsuccessful prior attempts at self-directed learning, suggesting that informal learning approaches may be insufficient and that structured professional development is necessary.

Inadequate technological infrastructure. Beyond individual competence limitations, observational and interview data revealed institutional-level infrastructure constraints that would impede digital assessment implementation. Classroom observations documented that Khalifah 3 Kindergarten possessed limited technological resources: three desktop computers located in the administrative office, two laptops used primarily by the principal and administrative staff, and no devices dedicated for teacher use in assessment activities. Teachers themselves did not have institutional computers assigned to them and relied on personal smartphones for any technology-mediated professional activities.

Interview participants identified this hardware scarcity as a significant practical barrier. Teachers noted that if digital assessment were implemented, they would need to compete for access to the limited institutional computers or rely on personal devices—a solution that raised concerns about data security, professional-personal boundary blurring, and inequity among teachers who might not possess suitable personal devices. One teacher questioned: "If we need to use spreadsheets, where will we do this? The computers at school are always used for administrative work. Should we buy our own laptops? That seems expensive for teachers."

Internet connectivity emerged as an additional infrastructure concern. Observations confirmed that while the kindergarten had internet access, the connection was frequently unstable, particularly during peak usage times. Teachers expressed concerns that cloud-based assessment systems might be unreliable given connectivity issues, potentially resulting in data loss or inability to access assessment records when needed. The absence of backup systems or contingency plans for technology failure further heightened teachers' anxiety about

transitioning to digital assessment, as they worried about scenarios where technical problems might prevent them from accessing or updating critical child development data during time-sensitive situations such as parent conferences or report card preparation periods.

3.5. Institutional Support Requirements for Successful Digitalization

When asked about what support would be necessary for successful digital assessment implementation, teachers across all interviews converged on three essential requirements: comprehensive training programs, technological infrastructure enhancement, and ongoing technical support systems. The consistency of these themes across participants, combined with corroborating evidence from observations and documents, suggests these represent genuine priority needs rather than superficial responses.

Need for structured training. All teachers emphasized that training would be essential for building digital competence, but they specified particular characteristics that such training should possess. Teachers requested training that was hands-on and practice-oriented rather than lecture-based, conducted in small groups to allow personalized attention, scheduled during non-teaching hours to avoid disrupting classroom responsibilities, and sequenced progressively from basic to advanced skills. Additionally, teachers emphasized the importance of training that specifically addressed assessment applications rather than generic spreadsheet instruction, wanting to learn through authentic examples of early childhood developmental data rather than abstract or business-oriented scenarios.

Teachers also advocated for follow-up support after initial training, recognizing that skills learned in workshops might not immediately transfer to independent practice. They suggested mentoring systems where more digitally-skilled teachers or external experts could be available for consultation as teachers begin implementing digital assessment, providing troubleshooting assistance and guidance through challenges encountered during real application. This recognition of the need for sustained support beyond one-time training demonstrates sophisticated understanding of professional learning processes.

Infrastructure enhancement needs. Teachers identified specific infrastructure improvements necessary for digital assessment viability. Priority needs included provision of laptop computers for each teacher or at minimum, shared devices adequate in number that teachers would not face access barriers; stable, high-speed internet connectivity throughout the kindergarten facility; secure data storage solutions with reliable backup systems; and consideration of mobile-friendly assessment platforms that could leverage teachers' existing smartphone ownership if institutional computer provision proved financially prohibitive. Teachers also mentioned the need for comfortable workspace arrangements where teachers could engage in digital assessment tasks, noting that the current teacher workspace lacked adequate furniture, electrical outlets, or environmental conditions conducive to extended computer use.

Ongoing technical support. Teachers expressed concerns about their ability to troubleshoot technical problems independently, particularly during the initial implementation period. They requested establishment of technical support mechanisms—whether through designation of a tech-savvy staff member as the in-house resource person, subscription to external IT support services, or arrangement of regular consultations with technology specialists who could address emerging issues. Teachers emphasized that knowing help was available would reduce their anxiety about digital adoption and increase their willingness to persist through initial implementation challenges rather than reverting to familiar manual methods when difficulties arose.

4. Discussion

The findings of this study reveal a characteristic pattern when interpreted through the Technology Acceptance Model (TAM) framework proposed by Davis (1989): teachers at Khalifah 3 Kindergarten demonstrate high perceived usefulness but low perceived ease of use regarding digital assessment tools. This configuration represents a critical juncture in technology adoption processes, where potential users recognize the value proposition of an

innovation but lack confidence in their capacity to successfully implement it. According to TAM, both perceived usefulness and perceived ease of use significantly influence behavioral intentions to use technology. The pattern observed in this study suggests that external factors, particularly institutional support interventions such as comprehensive training programs and infrastructure enhancement, may be decisive in determining whether recognition of benefits translates into actual adoption. This finding aligns with research by Akbarini (2024) and Latif et al. (2025), who demonstrated that early childhood teachers' technology acceptance is strongly mediated by their confidence in technical competence and availability of adequate support systems.

The simultaneously low perceived ease of use presents a significant adoption barrier that must be addressed through targeted interventions. This finding resonates with Hendar's (2020) research demonstrating that teachers' self-efficacy in using technology substantially affects their job satisfaction and willingness to integrate digital tools into professional practice. The digital competence limitations revealed in this study—teachers' unfamiliarity with spreadsheet functions beyond basic data entry, unsuccessful prior attempts at self-directed learning, and anxiety about technical troubleshooting—constitute psychological barriers that may prove as consequential as material constraints. The divergence between high usefulness and low ease of use perceptions suggests that awareness campaigns highlighting digital assessment benefits would be insufficient to drive adoption. Instead, interventions must directly address the ease of use dimension through intensive competency-building initiatives, as teachers already recognize technology benefits but require skill development to transform recognition into confident implementation.

Rogers' (2003) Diffusion of Innovations theory provides additional interpretive framework for understanding Khalifah 3 Kindergarten's current position in the technology adoption process. According to this theory, innovation adoption proceeds through five sequential stages: knowledge, persuasion, decision, implementation, and confirmation. The findings clearly position the kindergarten at the intersection of the knowledge and persuasion stages. Teachers possess awareness that digital assessment technologies exist and understand potential benefits (knowledge stage), while simultaneously forming positive attitudes toward the innovation (persuasion stage). However, persuasion remains incomplete because teachers harbor concerns about complexity and lack opportunities for hands-on experimentation. Critically, the kindergarten has not yet reached the decision stage, where formal commitment to adopt would occur, as evidenced by the absence of institutional planning, budget allocation, or formal training programs. This gap between persuasion and decision represents a point where many potential innovations stall, requiring catalytic interventions such as institutional leadership commitment, resource allocation, and concrete implementation roadmaps to move from contemplation to action.

A significant finding of this study is the complete absence of multiple intelligence assessment at Khalifah 3 Kindergarten, despite the theoretical and practical value of MI frameworks in early childhood education. This finding reflects broader patterns documented in early childhood education research, where Gardner's multiple intelligence theory enjoys substantial rhetorical support but faces considerable implementation challenges in actual practice (Mubarak et al., 2022; Wardan, 2022). The absence appears to stem from multiple factors: teachers lack conceptual clarity about operational MI assessment (what behaviors to observe, how to interpret evidence); existing assessment instruments and institutional requirements (STPPA) do not incorporate MI frameworks, creating structural constraints; and manual assessment creates time and cognitive load constraints making comprehensive MI assessment practically infeasible. These findings suggest that MI assessment implementation requires dual interventions: conceptual professional development on MI theory and practical tool development including digital instruments that operationalize MI observation and documentation (Binsa & Handayani, 2020; Braun & Clarke, 2006)

The technological infrastructure limitations identified at Khalifah 3 Kindergarten reflect broader challenges facing many early childhood education institutions, particularly in developing country contexts where educational technology investment often prioritizes higher

educational levels over early childhood settings. Research by Hidayat et al. (2020) and Mulyono et al. (2025) documents similar infrastructure constraints across Indonesian educational institutions. These material constraints present significant equity concerns, as they create differential opportunities for educational innovation based on institutional resources rather than pedagogical need. When assessment systems remain manual and inefficient, the quality and comprehensiveness of developmental documentation may suffer, potentially impacting teachers' ability to provide responsive, individualized instruction. This represents an equity concern extending beyond institutional convenience to affect educational quality and children's developmental opportunities. The finding that teachers suggested possible reliance on personal devices raises additional concerns about professional burden distribution and data security, underscoring that digital transformation must be supported at institutional and policy levels with adequate public investment rather than devolving responsibility to individual teachers' personal resources.

The constellation of findings—positive attitudes toward digital assessment coupled with substantial competence and infrastructure barriers—suggests that successful implementation would require gradual, multi-faceted intervention rather than rapid wholesale transition. Research on educational technology implementation consistently demonstrates that rushed adoption without adequate preparation often results in superficial use, user frustration, or outright abandonment (Isma et al., 2022). A gradual approach might proceed through several phases: initial digital literacy development through comprehensive training in low-stakes contexts; pilot implementation where early-adopter teachers experiment with digital assessment for limited purposes; expansion where successful practices scale to full implementation with continued support; and optimization focused on advanced features and system integration. This phased approach aligns with recommendations by Dantika and Aliyah (2025) and Dong & Newman (2018) that mitigates risks by limiting disruption while enabling learning from early experiences. However, gradual implementation must maintain momentum through clear timelines, accountability mechanisms, and visible institutional commitment to prevent indefinite delays when competing priorities arise or initial enthusiasm wanes.

The specific context of Khalifah 3 as an Islamic kindergarten raises important questions about cultural and value alignment in digital assessment implementation. As Jamil (2022) emphasizes, technology integration in Islamic educational settings must be approached thoughtfully, ensuring that digital tools serve rather than conflict with institutional values, pedagogical approaches, and community expectations. While teachers expressed no principled objections to digitalization, future implementation efforts should proactively consider how digital assessment systems can reflect Islamic educational values, including incorporating assessment of spiritual and moral development dimensions, ensuring technology facilitates rather than replaces personal teacher knowledge of children, and creating approaches that engage families consistent with Islamic perspectives on parent-educator partnerships. The broader lesson is that digital assessment implementation should not import generic technology solutions but rather thoughtfully develop tools serving the specific pedagogical approaches, values, and community contexts of particular educational settings, with continued attention to stakeholder perspectives throughout implementation.

The findings generate several practical implications for early childhood institutions considering digital assessment adoption. First, institutions should invest in comprehensive, sustained professional development rather than one-time training workshops, recognizing that digital competence development requires extended learning with hands-on practice and ongoing support. Second, infrastructure investment must precede or accompany adoption initiatives, as inadequate hardware, unstable connectivity, or insufficient devices will undermine even well-trained teachers' implementation efforts. Third, institutions should adopt user-centered design approaches, involving teachers in selection and customization of digital tools to ensure alignment with actual needs, workflows, and competency levels rather than imposing externally-developed solutions that may prove impractical in specific contexts. Fourth, leadership commitment and institutional prioritization are essential, as digital transformation requires sustained resource allocation, policy support, and organizational

culture change that only intentional leadership can provide. Finally, realistic expectations and patience are necessary, as meaningful digital integration unfolds over extended periods rather than through rapid implementation, requiring tolerance for initial challenges and commitment to iterative improvement.

This study's methodological strengths include data triangulation through multiple methods (interviews, observations, documents) and prolonged engagement enabling observation of typical practices. However, several limitations warrant acknowledgment. The single-site case study design limits transferability of findings to other contexts, though the challenges identified likely resonate with many resource-constrained institutions. This study examined teachers' perspectives prior to actual implementation, without observing authentic use of digital tools; future research should examine implementation processes when institutions actually adopt digital assessment systems, investigating how perceptions evolve through experience and whether anticipated benefits materialize in practice. The study focused exclusively on teacher perspectives without incorporating administrators', parents', or technology developers' views; multi-stakeholder research could identify convergences and divergences in needs and priorities. Future research should also investigate whether digital tools can facilitate MI assessment implementation through design-based research or pilot studies that develop and test MI-specific digital assessment tools.

In conclusion, this study illuminates the complex landscape of digital assessment adoption readiness in early childhood education contexts, revealing that successful technology integration requires far more than tool provision. The findings demonstrate that while teachers recognize digital assessment benefits and desire such capabilities, meaningful adoption depends on addressing multifaceted barriers encompassing individual competence development, institutional infrastructure enhancement, and organizational culture change. The application of Technology Acceptance Model and Diffusion of Innovations frameworks provides theoretical grounding for understanding the kindergarten's current positioning at the knowledge-persuasion stages, suggesting clear pathways forward through targeted interventions that build perceived ease of use while leveraging existing positive perceptions of usefulness. Ultimately, the success of digital transformation in early childhood assessment will depend on sustained institutional commitment, adequate resource investment, and recognition that technology serves as a means to enhance rather than replace the relational, developmentally-responsive assessment practices that remain at the heart of quality early childhood education.

5. Conclusion

This qualitative exploratory case study examined digitalization needs for multiple intelligence assessment in early childhood education through triangulated data collection employing interviews, classroom observations, and document analysis at Khalifah 3 Islamic Kindergarten, Indonesia. The research reveals several significant findings. First, Khalifah 3 Kindergarten has never implemented multiple intelligence assessment either manually or digitally, with evaluation practices remaining focused exclusively on standard Child Development Achievement Level Standards (STPPA), reflecting not merely absence of practice but fundamental gaps in teachers' conceptual understanding of MI assessment. Second, when interpreted through the Technology Acceptance Model framework, teachers demonstrate high perceived usefulness of digital assessment tools articulating specific benefits including time efficiency, improved accuracy, enhanced organization, secure cloud storage, and collaborative capabilities—but simultaneously exhibit low perceived ease of use due to limited digital literacy, inadequate technological infrastructure, and anxiety about independent troubleshooting. Third, application of Rogers' Diffusion of Innovations theory positions the kindergarten at the knowledge-persuasion stages, where teachers recognize digital assessment benefits and form favorable attitudes but have not progressed to formal decision or implementation stages due to absence of institutional planning, resource allocation, and

support systems. This configuration reveals a critical gap where positive perceptions fail to translate into adoption without catalytic institutional interventions.

These findings generate important theoretical and practical implications. Theoretically, the study contributes to understanding technology acceptance in resource-constrained early childhood contexts by demonstrating how high perceived usefulness coupled with low perceived ease of use creates a specific adoption readiness pattern requiring targeted competence-building interventions. Practically, successful digital assessment implementation at Khalifah 3 Kindergarten—and similar institutions requires comprehensive, multi-faceted support encompassing three essential pillars: sustained professional development programs building teachers' digital competencies through hands-on training, mentoring systems, and ongoing technical assistance; substantial infrastructure enhancement including adequate computing devices, stable internet connectivity, and secure data storage systems; and institutional commitment evidenced through clear implementation roadmaps, resource allocation, and policies supporting gradual, phased adoption rather than rapid transition. While this single-site case study limits transferability and examines pre-implementation perspectives rather than authentic use experiences, the findings illuminate critical barriers and support requirements that likely resonate across many resource-constrained early childhood settings. Future research should examine actual implementation processes, incorporate multi-stakeholder perspectives including administrators and families, and investigate whether digital tools can facilitate multiple intelligence assessment through design-based studies developing MI-specific instruments. Ultimately, digital transformation in early childhood assessment represents not merely technical upgrade but complex organizational change requiring sustained attention to human capacity development, institutional infrastructure, and cultural adaptation a challenge that, if addressed comprehensively, holds genuine potential to enhance assessment practices supporting responsive, individualized education honoring each child's unique developmental strengths.

6. References

- Akbarini, N. R. (2024). Using Technology Acceptance Model (TAM) to Explain Teachers' Adoption of Digital Technology in Business Education. *Jurnal Pendidikan dan Pengajaran*, 57(2), 309-321. <https://doi.org/10.23887/jpp.v57i2.74301>
- Ahmed, S. K., Mohammed, R. A., Nashwan, A., Ibrahim, R. H., Abdalla, A. Q., Amin, B. M. M., & Khdir, R. M. (2025). Using thematic analysis in qualitative research. *Social Science Research Network*. <https://doi.org/10.2139/ssrn.5222482>
- Andriani, S., & Rasto. (2023). Kompetensi digital guru PAUD di era society 5.0. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, 7(3), 3245-3256.
- Anhusadar, L. O. (2020). Asesmen Perkembangan Sosial Emosional Anak Usia Dini. *Yaa Bunayya: Jurnal Pendidikan Anak Usia Dini*, 4(2), 23-37.
- Bening, S., et al. (2022). Optimalisasi Asesmen Perkembangan Anak Usia Dini Melalui Aplikasi Digital. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, 6(5), 4321-4332.
- Binsa, I. M., & Handayani, D. E. (2020). Implementasi Asesmen Otentik dalam Mengembangkan Multiple Intelligence Anak Usia Dini. *Jurnal Pendidikan Anak*, 9(1), 46-55.
- Dantika, R., & Aliyah, S. (2025). Pemanfaatan Google Spreadsheet dalam Meningkatkan Mutu Pendidikan melalui Efisiensi Recording dan Pelaporan Data Akademik. *Jurnal Teknologi Pendidikan*, 15(1), 78-89.
- Fitria, N., & Jannah, M. (2021). Assesmen perkembangan anak usia dini: Pendekatan holistic integrative. *Jurnal Pendidikan Anak Usia Dini*, 5(2), 1124-1135.
- Gardner, H. (1993). *Multiple Intelligences: The Theory in Practice*. Basic Books.
- Gardner, H. (2003). *Multiple Intelligences: Kecerdasan Majemuk Teori dalam Praktek* (Terjemahan). Interaksara.
- Hendar, H. (2020). Efikasi Diri Guru dalam Menggunakan Teknologi dan Kepuasan Kerja. *Jurnal*

- Pendidikan dan Kebudayaan*, 5(2), 156-168.
- Hidayat, R., et al. (2020). Tantangan Implementasi Teknologi Digital dalam Manajemen Pendidikan. *Jurnal Administrasi Pendidikan*, 27(1), 89-102.
- Hidayati, R., & Nurhayati, S. (2024). Tantangan implementasi asesmen digital di lembaga PAUD. *Indonesia Journal Of Early Childhood Education*, 6(1), 45-58.
- Isma, C. N., Rahmi, R., & Jamin, H. (2022). Urgensi Digitalisasi Pendidikan Sekolah. *At-Ta'dib: Jurnal Ilmiah Prodi Pendidikan Agama Islam*, 14(2), 156-170. <https://doi.org/10.47498/tadib.v14i2.1317>
- Jamil, S. (2022). Teknologi dan Pendidikan Islam: Peluang dan Tantangan dalam Era Digital. *Wistara: Jurnal Pendidikan Bahasa dan Sastra*, 3(1), 78-92. <https://doi.org/10.23969/wistara.v3i1.11239>
- Latif, I. S., Saputro, R. E., & Barkah, A. S. (2025). Improvement of Technology Acceptance Model (TAM) with PLS-SEM: A Systematic Literature Review. *Journal of Information Systems and Informatics*, 7(2), 1376-1399. <https://doi.org/10.51519/journalisi.v7i2.1104>
- Lazar, I. M., Panisoara, G., & Panisoara, I. O. (2020). Digital Technology Adoption Scale in the Blended Learning Context in Higher Education: Development, Validation and Testing of a Specific Tool. *PLoS ONE*, 15(7), 1-27. <https://doi.org/10.1371/journal.pone.0235957>
- Lestari, P., Wahyuni, S., & Dewi, K. (2022). Pengembangan instrument asesmen digital berbasis developmentally appropriate practice untuk anak usia dini. *Jurnal Ilmiah VISI PGTK PAUD dan DIKMAS*, 17(1), 23-24.
- Maharani, D., & Khasanah, U. (2023). Efektifitas aplikasi mobile untuk asesmen perkembangan anak usia dini. *Jurnal Teknologi Pendidikan*, 11(2), 189-201.
- Masduki. (2017). *Kecerdasan Majemuk pada Anak Usia Dini*. Pustaka Pelajar.
- Mubarak, Z., et al. (2022). Pengembangan Kecerdasan Majemuk Anak Usia Dini. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, 6(4), 3145-3156.
- Mulyono, M., Haryati, T., & Wuryandini, E. (2025). Digitalisasi Pendidikan: Peluang dan Tantangan dalam Peningkatan Kualitas di SMK PSM Randublatung. *Indonesian Research Journal on Education*, 5(1), 470-486. <https://doi.org/10.31004/irje.v5i1.1872>
- Muniroh, S. M. (2013). Pengembangan Kecerdasan Interpersonal dan Intrapersonal Anak Usia Dini. *Jurnal Ilmiah PAUD*, 1(1), 23-32.
- Nurjanah, S., Hadipin, & Yetti, E. (2022). Implementasi asesmen autentik dalam pembelajaran anak usia dini. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, 6(4), 3567-3578.
- Permatasari, I., Suyadi, & Fadilah, M. (2023). Transformasi digital pendidikan anak usia dini pasca pandemi COVID-19. *Al-Athfaal: Jurnal Ilmiah Pendidikan Anak Usia Dini*, 6(1), 78-92.
- Pratiwi, H., Nugroho, A., & Setiawan, D. (2024). Sistem monitoring perkembangan anak usia dini berbasis teknologi informasi. *Jurnal Ilmu Komputer dan Pendidikan*, 8(1), 112-125.
- Purnama, S., et al. (2021). Asesmen Perkembangan Anak dalam Pembelajaran di PAUD. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, 5(1), 574-582.
- Putra, A., & Lestari, D. (2020). Penerapan Google Spreadsheet dalam Manajemen Sekolah Dasar. *Jurnal Administrasi Pendidikan*, 27(2), 145-159.
- Rahayu, T., & Wirza, Y. (2022). Digitalisasi asesmen pembelajaran di era pendidikan 4.0. *Jurnal Basicedu*, 6(3), 4321-4332.
- Rahmawati, F., & Fauziddin, M. (2022). Pengembangan instrumen penilaian multiple intelligence berbasis digital untuk anak usia dini. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, 6(5), 4789-4801.
- Safitri, D., & Lestarinigrum, A. (2021). Penerapan teori multiple intelligence dalam

- pembelajaran anak usia dini. *Kumara Cendikia*, 9(3), 201-213.
- Septiani, R., & Cahyati, N. (2023). Pemanfaatan teknologi digital dalam asesmen perkembangan anak usia dini. *Jurnal Pendidikan dan Konseling*, 5(2), 567-578.
- Setyawan, A., et al. (2021). Asesmen Perkembangan Sosio Emosional pada Anak Usia Dini. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, 6(2), 987-998.
- Sun, Y., Blewitt, C., Edwards, S., Fraser, A., Newman, S., Cornelius, J., & Skouteris, H. (2023). Methods and ethics in qualitative research exploring young children's voice: A systematic review. *SAGE Open*, 13(1), 1-23. <https://doi.org/10.1177/16094069231152449>
- Susanto, E., Raharjo, T., & Wijayanti, A. (2021). Sistem informasi penilaian perkembangan anak usia dini berbasis web. *Jurnal Teknik Informatika dan Sistem Informasi*, 7(4), 890-902.
- Wardan, K. (2022). Pendekatan Multiple Intelligence dalam Pendidikan Anak Usia Dini. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, 6(5), 4567-4578.
- Wijaya, K., & Setyawan, B. (2023). Analisis kebutuhan pengguna dalam pengembangan aplikasi pendidikan: Pendekatan user-centered design. *Jurnal Teknologi Pembelajaran Indonesia*, 13(1), 34-47.
- Wulandari, H., & Suryana, D. (2021). Pengembangan kecerdasan majemuk anak usia dini melalui pembelajaran terdiferensiasi. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, 5(2), 1594-1603.
- Yus, A. (2011). *Model Pendidikan Anak Usia Dini*. Kencana Prenada Media Group.
- Astuti, M., Arifin, Z., Mutohhari, F., & Nurtanto, M. (2021). Competency of digital technology: The maturity levels of teachers and students in vocational education in Indonesia. *Journal of Education Technology*, 5(2), 254-262. <https://doi.org/10.23887/jet.v5i3.35108>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77-101. <https://doi.org/10.1191/1478088706qp063oa>
- Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry and research design: Choosing among five approaches* (4th ed.). Sage Publications.
- Dong, C., & Newman, L. (2018). Enacting pedagogy in ICT enabled classrooms: Conversations with teachers in Shanghai. *Technology, Pedagogy and Education*, 27(4), 499-511. <https://doi.org/10.1080/1475939X.2018.1517660>
- Fantozzi, V. B. (2022). Digital tools for learning, creating, and thinking: Developmentally appropriate strategies for early childhood educators. National Association for the Education of Young Children (NAEYC).
- Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Sage Publications.
- Liu, J., Chen, M., He, H., Liu, H., Luo, W., & Li, H. (2025). Forms and functions innovation: A scoping review of digital and intelligence technologies in early childhood education practice. *Education Sciences*, 15(1), 8-24. <https://doi.org/10.3390/educsci15010008>
- Merriam, S. B., & Tisdell, E. J. (2016). *Qualitative research: A guide to design and implementation* (4th ed.). Jossey-Bass.
- NAEYC. (2020). *Developmentally appropriate practice in early childhood programs serving children from birth through age 8* (4th ed.). National Association for the Education of Young Children.
- Septiani, R., Cahyati, N., & Rahmawati, D. (2024). Digital assessment tools in Indonesian early childhood education: Current practices and future directions. *Jurnal Pendidikan Anak Usia Dini*, 8(1), 45-58. <https://doi.org/10.21009/IPUD.081.04>
- UNESCO. (2018). *ICT competency framework for teachers* (Version 3). United Nations Educational, Scientific and Cultural Organization.

- Wijaya, K., Setyawan, B., & Rahman, F. (2024). User-centered design in educational technology development: A systematic review. *International Journal of Educational Technology in Higher Education*, 21(1), 15-32. <https://doi.org/10.1186/s41239-024-00412-9>
- Yin, R. K. (2018). *Case study research and applications: Design and methods* (6th ed.). Sage Publications.