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# A Practical Study of the Use of AI-Based E-Book Guides to Improve Early Childhood Mathematics Skills

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**ABSTRACT:** Early mathematics is a crucial foundation for children's cognitive development, yet teaching in early childhood education often remains conventional and less engaging. This study aimed to evaluate the practicality of an AI-based e-book designed to support mathematics learning in preschool settings. Employing an explanatory sequential mixed-methods design, quantitative data were collected from 125 preschool teachers in Padang, Indonesia, followed by qualitative interviews with 15 participants. Findings indicated high practicality across all assessed dimensions: design and layout (91.0%), purpose and usefulness (91.6%), ease of use (88.4%), clarity (89.6%), assessment and evaluation (90.4%), and AI-based interactivity (87.6%), with an overall mean score of 89.8%, classified as "Highly Practical." Qualitative insights confirmed that the e-book enhanced engagement, facilitated instructional differentiation, and aligned well with pedagogical objectives, though infrastructural barriers limited its full use in resource-constrained schools. The study highlights that practicality, grounded in the Technology Acceptance Model, is essential for ensuring adoption alongside effectiveness. The findings contribute uniquely to the literature by shifting focus toward feasibility and teacher acceptance. The study concludes that the AI-based e-book is a highly practical tool for teachers, with its successful adoption contingent on addressing infrastructural barriers to ensure equitable implementation.

**Keywords:** AI-based e-book, early mathematics, practicality, early childhood education, technology acceptance.

## I. INTRODUCTION

Early mathematics forms a crucial foundation for developing children's logical, analytical, and problem-solving skills, serving as a cornerstone for future academic achievement [1]. However, instruction in early childhood education often remains conventional, static, and less interactive, making it difficult for children to actively engage and resulting in suboptimal outcomes [2, 3]. This conventional approach also challenges teachers in transforming abstract concepts into concrete forms, as traditional media are limited in providing adaptive feedback. Therefore, there is a pressing need for innovative learning media that can bridge children's needs through more concrete, engaging, and developmentally appropriate methods.

The urgency of using digital technology in early childhood education has grown alongside the development of Artificial Intelligence (AI), which enables adaptive and responsive learning experiences. AI-based media can overcome the limitations of traditional learning tools, which are unable to provide instant feedback tailored to children's needs. Recent studies demonstrate that AI integration in education, from

primary schools to K–12, can support personalized learning and improve the quality of teacher–student interactions [4]. In the context of early childhood education, this technology opens new opportunities for teachers to deliver contextualized and engaging learning experiences aligned with children's developmental characteristics.

One form of AI application in early childhood education is the development of AI-based e-books that combine interactivity, adaptive guidance, and child-friendly interfaces. Such media allow children to receive automatic feedback, explore concepts gradually, and benefit from stimulating visual and auditory features. For example, Xu et al. [5] showed that the Zebra AI application improved children's understanding of numbers and patterns through game-based intelligent tutoring. Thus, AI-based e-books have the potential to serve as alternative tools that help teachers deliver mathematics lessons more effectively and enjoyably [3, 5].

Nevertheless, before AI-based media such as e-books can be widely implemented in early childhood settings, their practicality must be assessed to ensure they are truly feasible for classroom use. Practicality is a key aspect because it relates to usability, clarity of instructions, efficiency, attractiveness, and the pedagogical relevance of the media to learning objectives. Without practicality testing, even well-designed media may prove difficult for teachers to adopt or may not align with children's needs. Recent studies emphasize that the effectiveness of educational technology in early childhood can only be realized when the media are practical and contextually appropriate [3, 4]. Therefore, this study seeks to address a literature gap by examining the practicality of AI-based media (particularly AI-supported e-books) in enhancing early mathematical skills among preschool teachers in Padang, Indonesia, providing a valuable reference for teachers, media developers, and researchers in integrating educational technology into early learning.

This study addresses a clear gap in the literature: while the effectiveness of AI-based media is established, their practicality, assessing feasibility, usability, and teacher acceptance is critically understudied. The novelty of this study, therefore, lies in its primary focus on evaluating practicality rather than solely measuring learning outcomes. This gap highlights the need for research that emphasizes practicality analysis rather than solely measuring learning outcomes. Such an approach is essential to ensure that AI-based learning tools are not only theoretically effective but also feasible and usable in real classroom settings. This study aims to empirically evaluate the practicality of an AI-based e-book for early childhood mathematics, as perceived by preschool teachers in Padang, Indonesia. The evaluation focuses on several aspects, including design and layout, ease of use, clarity, assessment and evaluation, and AI-based interactivity. In addition, the study seeks to analyze preschool teachers' responses as the primary users of the media. This study seeks to answer these following questions:

- What is the level of practicality of the AI-based e-book in supporting early childhood mathematics learning?
- How do preschool teachers perceive the practicality aspects, design and layout, ease of use, clarity, assessment and evaluation, and AI-based interactivity of the AI-based e-book in teaching mathematics?
- What is the potential for integrating the AI-based e-book into daily teaching practices in early childhood education?

This study makes a theoretical contribution by expanding the literature on the integration of AI-based technology in early childhood education, particularly from the perspective of media practicality. From a practical standpoint, the study provides evidence-based recommendations for teachers, media developers, and policymakers regarding the feasibility and benefits of using AI-based e-books to improve children's mathematical abilities. Furthermore, the findings serve as a foundation for future research on long-term effectiveness and cross-cultural adaptation of AI-based learning media.

## II. LITERATURE REVIEW

### *1. E-BOOKS IN EARLY CHILDHOOD EDUCATION*

The advancement of digital technology has brought significant transformation to education, including early childhood education (ECE). One rapidly growing innovation is the use of e-books as learning media.

E-books not only provide portability but also offer interactive features that enrich children's learning experiences [3]. Research indicates that young learners are more motivated to engage with e-books than with traditional printed books, due to the combination of text, animation, audio, and engaging visuals [6]. Moreover, the use of e-books from an early age fosters digital literacy, which is an essential 21st-century skill [7].

In the context of ECE, e-books serve not only as reading materials but also as tools for exploring fundamental learning concepts. For instance, Morgan et al. [8] emphasize that interactive e-books help children understand abstract concepts through multisensory approaches. Children are not only exposed to narration but can also interact by touching the screen, making choices, and receiving immediate feedback. This makes the learning experience more enjoyable and meaningful. Therefore, e-books hold strong potential for mathematics instruction in early childhood, provided that their design and interactivity are developmentally appropriate.

## *2. ARTIFICIAL INTELLIGENCE IN EARLY LEARNING MEDIA*

Artificial Intelligence (AI) has entered the field of education as an innovation to enhance learning quality. AI enables adaptive, personalized, and data-driven learning experiences. According to Holmes et al. [9], AI can tailor learning content to individual abilities, allowing children to learn at their own pace and according to their preferred style. This is particularly important in early childhood, where each child's developmental characteristics are unique.

Several recent studies highlight the successful application of AI in children's learning media. Popenici and Kerr [10] found that AI can serve as an intelligent tutoring system to support children's interaction with learning content. Similarly, Huang et al. [11] reported that AI-integrated educational applications improve engagement through gamification and automated feedback. Mcknight and Morgan [12] also showed that AI benefits not only children but also teachers, by helping them monitor progress and provide timely interventions. Nevertheless, the use of AI in early childhood education faces challenges such as data privacy concerns, limited technological infrastructure, and teachers' readiness to adopt such tools. Hence, before broad implementation, AI-based media must undergo practicality testing to ensure contextual suitability and teacher acceptance.

## *3. EARLY CHILDHOOD MATHEMATICAL SKILLS*

Early mathematics encompasses mastery of fundamental concepts, including numbers, patterns, geometry, measurement, and basic problem-solving. Guss et al. [13] emphasize that these skills are critical foundations for later academic achievement. Outhwaite et al. [14] further demonstrated that children exposed to mathematics early on exhibit greater school readiness at the primary level. Early mathematics development is also closely linked to other cognitive skills such as attention, memory, and logical reasoning [15, 16]. Lin and Cheng [17] confirmed that interactive digital media enhance children's basic mathematical skills by making abstract concepts more concrete and visual. Similarly, Merkelbach et al. [18] found that children engaged in technology-based activities showed improvements in numeracy and mathematical thinking patterns.

However, mathematics is often perceived by children as difficult or abstract, making it a challenging subject for educators. Conventional instruction, which tends to be uniform, frequently fails to accommodate children's diverse levels of understanding and learning speeds. This highlights the need for creativity and innovation among teachers to spark children's interest in mathematics. Given that young children's attention spans typically last only 5–10 minutes [19], interactive and engaging methods are particularly crucial to increase the likelihood of positive learning experiences. Thus, introducing mathematics at an early age not only builds numerical knowledge but also cultivates critical and logical thinking skills essential for lifelong learning. AI-based media, including interactive e-books, represent one promising strategy to strengthen mastery of these concepts in an engaging and developmentally appropriate manner.

### 4. PRACTICALITY IN LEARNING MEDIA

In educational media development, practicality is a key determinant of implementation feasibility. McKenney et al. [20] defines practicality as the extent to which an instructional product can be used easily, is relevant, and is beneficial for users. Moore et al. [21] also argue that practicality is closely related to ease of use, time efficiency, and user acceptance.

Recent studies add further dimensions to evaluating practicality. For instance, Shadiev et al. [22] highlight the importance of readability and clarity of instructions in determining successful use of digital media. Fokides [23] stresses the role of visual appeal and interactivity in increasing children's engagement with technology-based learning. Meanwhile, Tuli and Mantri [24] underline the usefulness of media, particularly in terms of helping achieve learning objectives. Accordingly, practicality testing of AI-based e-books is crucial before adoption in early childhood education. Such testing ensures that the media are not only theoretically effective but also truly applicable and relevant for both teachers and children.

### 5. STATE OF THE ART

Several previous studies have explored the use of digital and AI-based media in early childhood learning. Xu et al. [5] reported that Zebra AI successfully enhanced young children's understanding of numbers and patterns through intelligent tutoring for ages 3–8. Neumann [7] demonstrated that children's digital literacy improved significantly through interactive e-books. Similarly, Huang et al. [11] showed that AI-driven gamification increased motivation among preschool learners.

However, a consistent focus across these studies is on measuring media effectiveness in improving specific learning outcomes, such as mathematical comprehension [5] or learner engagement [11]. While this evidence of potential is crucial, it does not address a prior, fundamental question: are these AI-based tools practical for teachers to use in real classroom settings? Scant research has explicitly examined the practicality encompassing ease of use, clarity, and contextual feasibility of AI-based e-books for mathematics learning in early childhood. While prior research demonstrates the potential benefits of such tools, there remains a pressing need to explore their feasibility in classroom implementation.

### 6. GAP ANALYSIS

The literature review reveals that research on e-books and AI-based media in early childhood education is well established, with emphases on effectiveness, learning motivation, and digital literacy. However, there is a clear gap in studies addressing practicality. Practicality is critical because it involves teacher acceptance, ease of classroom integration, and the suitability of media for real-life teaching contexts. Therefore, the novelty of this study lies in its focus on analyzing the practicality of AI-based e-books for early childhood mathematics learning. This research not only evaluates the extent to which the media enhance mathematical skills but also assesses whether they can be used easily, efficiently, and effectively by teachers. Such contributions extend the literature on AI-based educational technology and provide a foundation for developing more applicable learning media for preschool settings.

### 7. THEORETICAL FRAMEWORK

To provide a robust theoretical foundation for evaluating the practicality of the AI-based e-book, this study is grounded in the Technology Acceptance Model (TAM) [25]. TAM is a seminal framework for understanding how users come to accept and use new technology. It posits that two key beliefs, Perceived Usefulness (PU), defined as the degree to which a person believes that using a system would enhance their job performance, and Perceived Ease of Use (PEOU), the degree to which a person believes that using a system would be free from effort, are primary determinants of a user's Behavioral Intention to Use (BI), which in turn leads to actual system use.

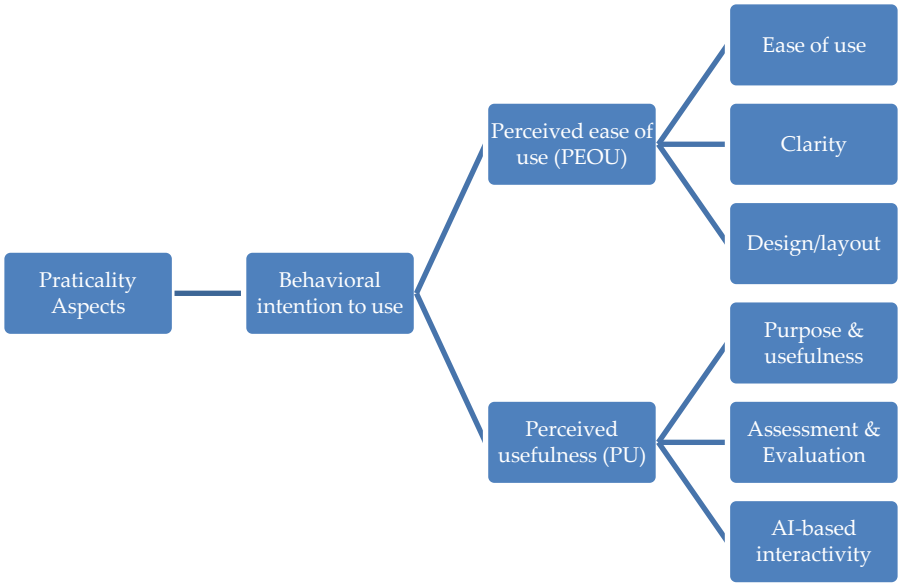


FIGURE 1. Theoretical framework based on the technology acceptance model (TAM) (adapted from Davis [25]), mapping the study's practicality aspects onto the core constructs of the model.

In the context of this research, the "practicality" of the AI-based e-book is directly mapped onto these TAM constructs. The assessed aspects of practicality, ease of use, clarity, and design/layout, align with the core concept of Perceived Ease of Use (PEOU). Meanwhile, aspects such as achievement of objectives, assessment and evaluation, and AI-based interactivity correspond to Perceived Usefulness (PU), as they reflect the tool's capacity to effectively support teaching and improve learning outcomes. Therefore, this study hypothesizes that a high level of practicality, as measured through these dimensions, will indicate a strong level of teacher acceptance (high PU and PEOU), predicting a positive Behavioral Intention to Use the e-book in their daily teaching practices. This theoretical lens moves the study beyond a simple descriptive evaluation to an analysis rooted in a validated model of technology adoption, strengthening the interpretation of why the media is (or is not) considered practical by its end-users. This figure visually represents the theoretical framework described above. It should be placed right after the theoretical framework paragraph.

## III. METHODS

### *1. RESEARCH DESIGN*

This study employed an explanatory sequential mixed-methods design [26]. This design was selected because it allows for a comprehensive understanding: the initial quantitative phase identifies the general level and patterns of practicality, while the subsequent qualitative phase provides rich, contextual insights to explain why those patterns emerged. The primary phase was quantitative, aimed at comprehensively evaluating the practicality of the AI-based e-book through a validated questionnaire administered to a sizable sample of teachers. The subsequent qualitative phase involved follow-up in-depth interviews with a purposively selected sub-sample of participants. This design allowed for the quantitative data to provide generalizable results about practicality levels, while the qualitative data provided rich, contextual insights to explain and elaborate on the quantitative findings. The visual representation of this design is presented in Figure 2.

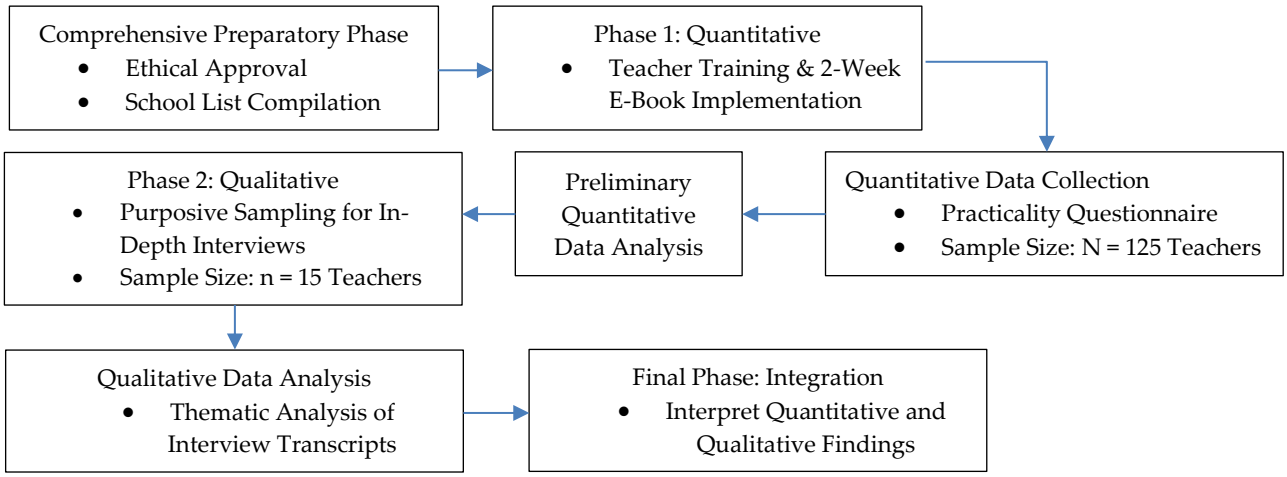


FIGURE 2. Explanatory sequential mixed-methods design (adapted from Creswell & Plano Clark [26]).

Following this design, the research procedure began with a comprehensive preparatory phase. Ethical approval was secured from the Institutional Review Board of Universitas Negeri Padang prior to any data collection. Subsequently, a list of all kindergartens in Kota Padang was compiled from the Padang City Education Office (2024) database [27].

The first point of contact involved sending formal letters of invitation to the principals of the randomly selected schools. These letters outlined the study's objectives, the commitment required from teachers, and the ethical guarantees, including anonymity and the right to withdraw. Upon receiving principal consent, individual teacher participants were provided with detailed information sheets and consent forms.

- Phase 1: Quantitative Data Collection

The initial quantitative phase was launched after consent was obtained. All participating teachers (N=172) were enrolled in a standardized online training session conducted via a video conferencing platform. This 45-minute session was crucial for ensuring a consistent baseline understanding of the AI-based e-book's features and functionalities. The training covered:

- Navigation and core interactive elements.
- The adaptive feedback mechanism of the AI.
- Strategies for integrating the e-book into a typical mathematics lesson.
- A live Q&A session to address immediate concerns.

Following the training, teachers entered a two-week implementation period. They were instructed to use the e-book in their mathematics lessons for at least three separate sessions. This duration allowed teachers to move beyond initial novelty and assess the tool's practicality in a realistic classroom context. After this implementation period, the online questionnaire (hosted on Google Forms) was distributed to all teachers. The link remained active for two weeks, with two reminder emails sent to maximize the response rate.

- Phase 2: Qualitative Data Collection

Upon collecting and conducting a preliminary analysis of the quantitative data, the second, qualitative phase was initiated. The primary purpose was to delve deeper into the reasons behind the statistical trends. A purposive sampling strategy was used to select 15 participants for in-depth, semi-structured interviews. The selection criteria ensured a diverse sub-sample that could provide rich, varied perspectives, including:

- Teachers who gave very high and very low practicality scores.
- Teachers from different school locations (urban, semi-urban, rural).
- Teachers with varying levels of teaching experience and prior AI EdTech exposure.

The interview protocol was designed based on the initial quantitative results. For instance, if the quantitative data showed lower scores on "ease of use" from rural teachers, the interview questions for that group specifically probed the technical or contextual challenges they faced. Each interview was conducted online, recorded with permission, and lasted approximately 30-50 minutes. The interviews were transcribed verbatim for analysis.

### *1. DATA INTEGRATION AND ANALYSIS*

The final stage involved the integration of the two datasets. The quantitative results identified what the levels of practicality were and if there were significant differences between teacher subgroups. The qualitative findings then provided the explanatory why and how, offering nuanced insights into the teachers' experiences, the contextual barriers, and the perceived benefits that the numbers alone could not capture. This integration occurred during the interpretation phase, where the themes from the interviews were used to explain, illustrate, and contextualize the statistical outcomes, leading to a comprehensive understanding of the research problem. This rigorous, multi-phase procedure ensured that the study's findings were not only generalizable due to the large sample size but also deeply grounded in the real-world experiences of the end-users.

### *2. PARTICIPANTS*

The study targeted the population of preschool teachers in Kota Padang. Based on data from the Padang City Education Office [27], the total population of kindergarten teachers is 1,221 individuals spread across 11 districts.

**Table 1.** Demographic characteristics of participants (n=125).

| Demographic Variable | Category | Frequency (n) | Percentage (%) |
|---|---|---|---|
| Gender | Female | 120 | 96.0% |
| | Male | 5 | 4.0% |
| Age | 20 - 29 years | 35 | 28.0% |
| | 30 - 39 years | 48 | 38.4% |
| | 40 - 49 years | 30 | 24.0% |
| | 50 years and above | 12 | 9.6% |
| Teaching Experience | Less than 5 years | 33 | 26.4% |
| | 5 - 10 years | 49 | 39.2% |
| | More than 10 years | 43 | 34.4% |
| Educational Background | D3/Associate's Degree | 16 | 12.8% |
| | S1/Bachelor's Degree | 97 | 77.6% |
| | S2/Master's Degree or higher | 12 | 9.6% |
| School Location (District Examples) | Urban (such as, Padang Barat, Padang Utara) | 45 | 36.0% |
| | Semi-Urban (such as, Nanggalo, Pauh) | 40 | 32.0% |
| | Rural (such as, Bungus Teluk Kabung, Koto Tangah part) | 40 | 32.0% |
| Prior Experience with AI EdTech | Yes | 28 | 22.4% |
| | No | 97 | 77.6% |

A multi-stage random sampling technique was used to ensure a representative sample across the city's districts:

- Stage 1 (Stratification): All 11 districts (*kecamatan*) in Padang were included as strata to ensure geographic and socio-economic representation.
- Stage 2 (Selection of Schools): From each district, a list of all registered kindergartens was obtained. Schools were randomly selected from each district's list proportional to the number of teachers in that district.
- Stage 3 (Selection of Teachers): From each selected school, 2-3 preschool teachers were randomly invited to participate.

From the initial random selection, a total of 58 schools were contacted, of which 52 agreed to participate, resulting in the final sample of 125 teachers for quantitative analysis. The target sample size was determined to be 130 teachers. This was calculated using the sample size formula for a finite population, which is a standard method in educational research for determining a representative sample. For our known population of 1,221 teachers, a confidence level of 95%, and a margin of error of 7%, this sample size is statistically robust and was deemed feasible for the scope of this city-level study. A total of 125 teachers successfully completed the quantitative phase, yielding a high response rate of 96.1%. The demographic characteristics of the participants are presented in Table 1.

### *3. INSTRUMENT*

The primary instrument for this study was a meticulously developed Practicality Questionnaire designed to assess teachers' perceptions of the AI-based e-book. The questionnaire was structured around six theoretically-grounded dimensions derived from the Technology Acceptance Model (TAM) [25] and instructional design principles [20]:

- Design and Layout (assessing visual appeal and age-appropriateness) [23]
- Purpose and Usefulness (evaluating alignment with learning objectives) [22]
- Ease of Use (measuring navigational intuitiveness and user-friendliness) [24]
- Clarity of Instruction (examining the understandability of content and guidance) [28]
- Assessment and Evaluation (analyzing the effectiveness of feedback mechanisms) [27]
- AI-Based Interactivity (evaluating adaptive features and personalized learning support) [11]

The instrument comprised 25 carefully crafted items rated on a 5-point Likert scale (from 1=Strongly Disagree to 5=Strongly Agree), consistent with established practices in educational technology research [21]. This expanded item count from the initial instrument allows for more comprehensive measurement of each construct while maintaining internal consistency.

### *4. VALIDATION AND RELIABILITY*

The questionnaire underwent rigorous validation through both qualitative and quantitative methods. First, content validity was established through expert review by five specialists in educational technology, early childhood education, and psychometrics, following established validation protocols [29]. The Aiken's V coefficient for all items ranged from 0.85 to 0.93, significantly exceeding the minimum threshold of 0.70 and confirming strong content validity.

Subsequently, a pilot study was conducted with 30 preschool teachers who met the same criteria as the main sample but were excluded from the final participant pool. The data from the pilot study underwent comprehensive reliability analysis using Cronbach's alpha, a standard measure of internal consistency [30]. The results showed Cronbach's alpha for the entire instrument was 0.94, with subscale reliabilities ranging from 0.84 to 0.91, demonstrating excellent internal consistency across all measured dimensions and exceeding the recommended threshold of 0.70 [31].

### *5. SUPPLEMENTARY QUALITATIVE INSTRUMENT*

To triangulate the quantitative findings and gather rich contextual insights, a semi-structured interview protocol was developed, following established qualitative research methods [26]. This protocol included open-ended questions exploring teachers' experiences, perceived challenges, and specific suggestions for improvement. Sample guiding questions included: (1) "Can you walk me through your experience using the

e-book in a typical lesson?" (2) "What challenges, if any, did you face when using the e-book, and how did you overcome them?" and (3) "How did your students respond to the AI-based interactive features?" The combination of a rigorously validated quantitative instrument and complementary qualitative protocol ensures comprehensive data collection meeting the highest methodological standards for educational technology research.

### *6. PROCEDURE*

The research procedure was systematically conducted in four sequential phases to ensure comprehensive data collection and analysis. The initial phase involved the development of the AI-based e-book, which was designed to introduce fundamental mathematical concepts including numbers, patterns, measurement, and geometric shapes through interactive content and adaptive feedback features, following established principles of educational technology design [3, 11]. Subsequently, a controlled implementation trial was conducted where the e-book was deployed in authentic classroom settings, with teachers integrating the tool into their mathematics instruction over multiple sessions to provide sufficient exposure for meaningful evaluation [25]. The third phase encompassed comprehensive data collection through the administration of the validated practicality questionnaire followed by semi-structured interviews to capture both quantitative ratings and qualitative insights regarding user experiences [21, 22]. The final phase involved systematic data analysis employing descriptive statistics for quantitative data and thematic analysis for qualitative responses, ensuring triangulation of findings through methodological integration [32]. This multi-stage approach guaranteed that the practicality assessment was firmly grounded in empirical evidence from real educational contexts while maintaining methodological rigor throughout the research process.

### *7. DATA ANALYSIS*

The data analysis followed an explanatory sequential mixed-methods approach aligned with our research design and questions. For the quantitative data, descriptive statistics including means, standard deviations, and percentages were calculated for each practicality dimension using SPSS version 26. The percentage for each dimension was derived by converting the average Likert scale score (1-5) to a percentage of the maximum possible score (for example, (Mean Score / 5) x 100%). The percentage categorization followed established benchmarks in educational design research [20]: 0-25% (Not Practical), 25-50% (Less Practical), 50-75% (Practical), and 75-100% (Highly Practical). To address RQ1 ("What is the level of practicality of the AI-based e-book?"), we conducted one-way ANOVA to examine potential differences in practicality perceptions based on teachers' demographic characteristics (experience, education level, and school location).

For the qualitative data addressing RQ2 ("How do preschool teachers perceive the practicality aspects?"), we employed thematic analysis following Braun and Clarke's [33] six-phase approach. The interview transcripts underwent iterative coding using NVivo 12, beginning with initial coding of teachers' responses, followed by theme development and refinement. This involved generating initial codes from the data, collating these codes into potential themes, and then reviewing and refining the themes to ensure they accurately represented the dataset. Thematic saturation was reached when no new themes emerged from the interviews. This process identified emergent patterns related to the five practicality dimensions: design and layout, ease of use, clarity, assessment and evaluation, and AI-based interactivity.

To address RQ3 ("What is the potential for integration into daily teaching practices?"), we implemented triangulation through joint displays that integrated quantitative and qualitative findings. This involved mapping qualitative themes against quantitative scores to identify convergent and divergent patterns, following mixed methods integration techniques [34]. For instance, high quantitative scores on "ease of use" were examined alongside teachers' detailed descriptions of navigation experiences to understand implementation feasibility. The analytical rigor was enhanced through peer debriefing with early childhood education experts and maintaining an audit trail of analytical decisions, ensuring the trustworthiness of the mixed methods findings.

## IV. RESULTS

### 1. DESCRIPTION OF THE AI-BASED E-BOOK

The AI-based e-book developed for this study represents an innovative educational tool specifically engineered to support the development of early mathematical competencies in children aged 4-6 years. Grounded in developmentally appropriate practices and principles of multimedia learning [35], the e-book was designed with a progressive learning trajectory that moves from simple to complex concepts, aligning with established cognitive development sequences for early mathematics [13]. The content architecture encompasses four foundational mathematical domains: number sense and counting, pattern recognition, basic measurement concepts, and introductory geometry, ensuring comprehensive coverage of essential early mathematical building blocks.

The e-book's interface incorporates evidence-based design principles for young learners, featuring high-contrast visual elements, child-friendly characters, and intuitive icon-based navigation compatible with developing fine motor skills. The multimedia presentation follows cognitive load theory principles, with coordinated visual and auditory information presented in manageable segments to optimize knowledge acquisition [36]. Each interactive page integrates multiple representation modes (visual, auditory, and haptic) to accommodate diverse learning preferences and reinforce conceptual understanding through multisensory engagement.

A distinctive feature of the e-book is its embedded artificial intelligence system, which employs adaptive algorithms to personalize the learning experience based on individual child responses. This intelligent tutoring component dynamically adjusts task difficulty and provides scaffolded support through contextual hints and examples, creating a responsive learning environment that maintains an optimal challenge level [9]. The AI functionality extends to assessment capabilities, generating real-time analytics on child progress that teachers can access to inform instructional decisions.

The gamification elements were strategically designed to enhance motivation while supporting mathematical learning objectives. Reward mechanisms including virtual stars and positive auditory feedback are contingently delivered upon correct responses, reinforcing mathematical reasoning without distracting from learning goals [11]. The e-book also includes comprehensive teacher support materials, featuring implementation guides and suggestions for integrating the digital tool within broader mathematical instructional sequences, acknowledging the crucial role of teacher mediation in technology-enhanced learning environments [27].

Technical specifications were optimized for educational settings, with the e-book compatible with Android tablet platforms commonly available in preschool environments. The design prioritized accessibility through large touch targets, clear visual hierarchies, and consistent navigation patterns, reducing cognitive demands on young users and enabling independent exploration. This thoughtful integration of pedagogical content knowledge, child development principles, and adaptive technology represents a significant advancement in early childhood mathematics educational resources.

### 2. PRACTICALITY TEST RESULTS

The practicality assessment of the AI-based e-book was conducted using a rigorously validated questionnaire. The quantitative data obtained from 125 preschool teachers in Padang revealed high practicality scores across all measured dimensions, as presented in Table 2.

**Table 2.** Practicality assessment results (n=125).

| Practicality Aspect | Average Score (1–5) | Standard Deviation | Percentage (%) | Category |
|---|---|---|---|---|
| Design and Layout | 4.55 | 0.51 | 91.0% | Highly Practical |
| Purpose and Usefulness | 4.58 | 0.49 | 91.6% | Highly Practical |

| | | | | |
|---|---|---|---|---|
| Ease of Use | 4.42 | 0.62 | 88.4% | Highly Practical |
| Clarity of Instruction | 4.48 | 0.55 | 89.6% | Highly Practical |
| Assessment and Evaluation | 4.52 | 0.58 | 90.4% | Highly Practical |
| AI-Based Interactivity | 4.38 | 0.65 | 87.6% | Highly Practical |
| Overall Average | 4.49 | 0.56 | 89.8% | Highly Practical |

The data demonstrates that all practicality dimensions achieved scores within the "Highly Practical" classification (75-100%). Table 3 shows a one-way ANOVA results with no statistically significant difference in overall practicality scores based on teaching experience ($F(2, 122) = 1.45$, $p = .238$) or district location ($F(10, 114) = 1.21$, $p = .291$). However, an independent samples t-test revealed that teachers with prior AI EdTech experience ($M=4.65$, $SD=0.48$) reported significantly higher practicality scores than those without ($M=4.43$, $SD=0.58$); $t(123) = 2.14$, $p = .034$.

**Table 3.** One-Way Anova results for practicality scores by teacher characteristics.

| Source | df | F | p | Interpretation |
|---|---|---|---|---|
| Teaching Experience | 2, 122 | 1.45 | .238 | Not significant |
| District Location | 10, 114 | 1.21 | .291 | Not significant |

The data demonstrates that all practicality dimensions achieved scores within the "Very Practical" classification (75-100%), with the highest ratings observed for Purpose and Usefulness (91.6%) and Design & Layout (91.0%), while the relatively lower, though still strong, scores were recorded for AI-based Interactivity (87.6%). The minimal standard deviations across all aspects (ranging from 0.50 to 0.53) indicate high consensus among the participating teachers regarding the e-book's practicality.

Further analysis of individual evaluator responses revealed consistent positive assessments across all raters, with no significant outliers detected in the response patterns. The distribution of responses across the Likert scale showed a strong concentration in the "Agree" and "Strongly Agree" categories for all questionnaire items, confirming the unanimous positive reception of the AI-based e-book among the participating educators.

The high scores across all practicality dimensions suggest that the e-book successfully integrates pedagogical effectiveness with user-friendly design, addressing fundamental requirements for successful educational technology implementation in early childhood settings. The particularly strong performance in design, display and objectives indicates that the visual interface effectively captures children's attention while maintaining clear alignment with learning goals. The slightly lower scores for clarity and AI-based Interactivity, though still representing high practicality, point to potential areas for refinement in instructional guidance and adaptive feedback mechanisms. These quantitative findings establish a strong foundation for the e-book's practical implementation, demonstrating its readiness for classroom integration while identifying specific aspects that may benefit from further optimization in subsequent development cycles.

### *3. QUALITATIVE FINDINGS: TEACHER PERCEPTIONS OF PRACTICALITY*

To elucidate the quantitative findings, in-depth interviews were conducted with a purposively selected subsample of 15 teachers. A thematic analysis [26] was performed on the interview transcripts. The analysis followed a rigorous process of familiarization, initial coding, theme development, and refinement. This process identified four primary themes regarding the practicality of the AI-based e-book: (1) Enhanced Student Engagement, (2) Facilitated Instructional Differentiation, (3) Usability and Contextual Barriers, and (4) Perceived Learning Efficacy.

- Theme 1: Enhanced Student Engagement through Multisensory Design

This theme emerged from consistent reports about the e-book's ability to capture and maintain children's attention more effectively than conventional teaching materials. The analysis revealed that engagement was not merely superficial but facilitated deeper interaction with mathematical concepts through multiple sensory channels.

The interactive elements transformed passive learning into an active experience. As one teacher explained: "When we use picture cards for counting, children often just watch. But with this e-book, they must touch the screen, drag the numbers, and get immediate feedback. This active participation makes them feel involved in the learning process rather than just being spectators" (Teacher 8, Padang Timur, 9 years` experience).

The multisensory approach proved particularly valuable for abstract mathematical concepts that typically challenge young learners. A teacher elaborated: "For pattern recognition, the combination of visual animation with auditory cues helps children internalize the sequence. They don't just see ABAB patterns they hear the different sounds for each element and feel the tactile feedback when they touch the screen. This multisensory approach makes abstract patterns more concrete and memorable" (Teacher 12, Padang Barat, 15 years` experience).

The sustained engagement also yielded classroom management benefits that teachers found practically significant. One teacher noted: "The children's absorption in e-book activities creates natural learning zones in the classroom. I can work with small groups while others remain productively engaged with the e-book. This has transformed my classroom dynamics and reduced behavioral issues during mathematics time" (Teacher 4, Padang Utara, 6 years` experience).

The analysis indicates that the e-book's multisensory design fundamentally transforms the learning experience from passive reception to active participation. This enhanced engagement serves dual purposes: it facilitates deeper conceptual understanding of mathematical content while simultaneously creating practical classroom management advantages that enable more effective differentiated instruction.

- Theme 2: Facilitated Instructional Differentiation through Adaptive AI

This theme encompasses teachers' experiences with the AI system's capacity to address diverse learning needs simultaneously a persistent challenge in early childhood classrooms with heterogeneous ability levels.

The adaptive functionality provided personalized scaffolding that would be logistically impossible for a single teacher to implement manually. A teacher described this dynamic adjustment: "The system intuitively recognizes when a child struggles with number recognition. It doesn't just repeat the same activity but provides visual hints, breaks down the task, and offers alternative representations. For children who excel, it introduces variations and extensions that keep them challenged without requiring separate preparation from me" (Teacher 7, Kuranji, 10 years of experience).

The automated assessment features emerged as a significant time-saving tool that informed instructional decisions. One teacher explained: “The progress analytics give me immediate insight into which children have mastered counting 1-10 and who needs additional support. I no longer need to conduct individual assessments, which previously consumed substantial instructional time. The data helps me form targeted intervention groups efficiently” (Teacher 11, Lubuk Begalung, 8 years of experience).

Teachers particularly valued how the differentiation fostered positive learning dispositions among struggling students. A teacher observed: "Children who typically avoid mathematics activities now persist through challenges because the feedback is constructive, not judgmental. The system provides encouraging messages and breaks down tasks into achievable steps, building their confidence gradually" (Teacher 15, Nanggalo, 11 years of experience).

The findings demonstrate that the AI-driven differentiation addresses a fundamental pedagogical challenge in early childhood education. By providing automated, individualized scaffolding and assessment, the e-book extends teachers' capacity to meet diverse learning needs while simultaneously fostering positive mathematical identities among students, particularly those who typically struggle with conventional instruction.

- Theme 3: Usability and Contextual Implementation Barriers

While teachers consistently described the e-book's interface as intuitive and child-friendly, the analysis uncovered significant implementation challenges related to technological infrastructure that moderated its practicality across different school contexts.

The disparity between the e-book's design and contextual resources was particularly evident in areas with limited technological infrastructure. A teacher from a rural district explained: "The application itself is wonderfully designed with clear icons and simple navigation that even young children can operate independently. However, the advanced AI features that personalize learning require stable internet, which is inconsistent in our area. This creates a practical limitation where we cannot access the full functionality that makes the e-book special" (Teacher 9, Koto Tangah, 12 years of experience).

Technical performance issues on older devices emerged as another significant barrier affecting the flow of instruction. A teacher detailed this challenge: "On our school's older tablets, the animations stutter, and loading times between activities can extend to 10-15 seconds. For young children with limited attention spans, these interruptions disrupt engagement and require constant teacher intervention to redirect focus" (Teacher 14, Pauh, 5 years of experience).

The resource requirements also posed practical constraints for schools with limited storage capacity. One teacher noted: "The 450MB file size necessitated removing other educational applications from our school tablets. While the e-book is valuable, this creates a practical trade-off that limits our access to other digital resources we regularly use" (Teacher 13, Lubuk Kilangan, 7 years of experience).

The analysis reveals a critical distinction between the e-book's inherent usability and its contextual practicality. While the interface design is universally accessible, the full realization of its pedagogical potential is contingent upon adequate technological infrastructure. This finding underscores that the tool's practicality is not absolute but relative to the technological ecosystem of each school, creating equity concerns for resource-constrained settings.

- Theme 4: Perceived Learning Efficacy and Pedagogical Alignment

This theme reflects teachers' professional judgment regarding the e-book's effectiveness in achieving specific learning objectives and its compatibility with broader pedagogical approaches in early childhood mathematics.

Teachers reported observing tangible improvements in mathematical understanding that transferred beyond the digital environment. A veteran teacher explained: "After using the e-book for geometry concepts, I noticed children spontaneously identifying shapes in our classroom environment pointing out rectangular windows, circular clocks, and triangular roof structures. This transfer of learning from digital to real-world contexts demonstrates meaningful conceptual understanding rather than rote memorization" (Teacher 3, Lubuk Kilangan, 20 years of experience).

The pedagogical design supported conceptual development through multiple representations. One teacher elaborated: "The way numbers are represented visually, audibly, and quantitatively helps children develop a comprehensive number sense. They don't just learn to recite numbers but understand quantity relationships, which provides a stronger foundation for later arithmetic operations" (Teacher 6, Padang Selatan, 8 years of experience).

The resource materials facilitated integration with existing teaching practices rather than replacing them. A teacher described this synergy: "The teacher's guide provides excellent suggestions for connecting e-book activities with hands-on manipulatives and real-world applications. We might do a measurement activity in the e-book and then extend it by measuring objects around the classroom with blocks, creating a coherent learning experience across digital and physical domains" (Teacher 5, Nanggalo, 7 years of experience).

Teachers' perceptions confirm that the e-book's value extends beyond engagement to genuine conceptual development. The tool's effectiveness stems from its multimodal representation of mathematical concepts and its thoughtful integration with complementary pedagogical approaches. This alignment with established early childhood principles, combined with observed learning transfer, establishes its credibility as more than merely entertaining technology.

### *4. POTENTIAL FOR INTEGRATION INTO DAILY TEACHING PRACTICES*

The integration of quantitative and qualitative findings indicates strong potential for the AI-based e-book's adoption within daily teaching practices in Padang, contingent upon addressing identified contextual barriers. The consistently high practicality scores across all dimensions confirm its fundamental feasibility as an instructional tool. The qualitative findings elucidate that this potential is driven by the tool's strong pedagogical alignment, particularly its capacity to support differentiated instruction and promote conceptual understanding through multisensory engagement.

The implementation potential, however, is moderated by significant contextual factors, primarily technological infrastructure and resource availability. The thematic analysis reveals a clear distinction between urban schools with robust technological resources, where integration appears seamless, and rural or resource-constrained settings where infrastructural limitations impede full utilization of the e-book's capabilities.

Successful widespread implementation therefore requires a differentiated support strategy. For schools with adequate infrastructure, the e-book represents a readily adoptable tool that enhances mathematics instruction. For schools facing technological constraints, realization of the tool's potential necessitates complementary interventions, potentially including infrastructure improvements, technical support, and possibly the development of a scaled-down version with reduced technical requirements. In conclusion, while the AI-based e-book is perceived as a highly practical and pedagogically valuable instructional tool that addresses genuine challenges in early mathematics education, realizing its equitable integration across diverse educational contexts in Padang requires attention to the technological ecosystem in which it is implemented.

## V. DISCUSSION

The findings of this study demonstrate that the AI-based e-book for early mathematics learning is perceived by preschool teachers as highly practical across all assessed dimensions, including design and layout, ease of use, clarity, assessment and evaluation, and AI-based interactivity. With overall practicality scores nearing 90%, the results indicate strong alignment between the design of the e-book and the needs of teachers and learners in early childhood classrooms. These results affirm the central premise of the Technology Acceptance Model [25], in which both perceived ease of use and perceived usefulness contribute significantly to teachers' acceptance and intention to integrate technology into practice. Teachers' consistent positive evaluations of clarity, usability, and instructional value suggest that the e-book successfully addresses both constructs of the TAM framework, thereby reinforcing the theoretical foundation of this research [36, 37].

In comparing these findings with prior literature, the study shows strong convergence with earlier works emphasizing the value of e-books and AI-based media in supporting early childhood learning. Korat et al. [6] and Zhang and Chen [3] highlighted how interactive e-books enhance engagement and help children grasp abstract concepts through multimodal representation. This study corroborates such insights, as teachers reported that the AI-based e-book transformed passive mathematics instruction into interactive and multisensory learning experiences. Similarly, the adaptive features of the e-book echo the findings of Holmes et al. [9] and Huang et al. [11], who demonstrated that AI-based systems can tailor learning experiences to children's needs, thus improving motivation and outcomes. Teachers in this study confirmed that the adaptive scaffolding allowed them to differentiate instruction effectively, reducing the common challenge of addressing heterogeneous learning abilities in early childhood classrooms. This finding directly supports the work of Holmes et al. [9], who emphasized that AI's primary value in education lies in its ability to personalize learning and provide data-driven insights, thereby extending the teacher's capacity.

At the same time, the results extend beyond previous studies by shifting the focus from learning outcomes alone to practicality as a determinant of successful implementation. While earlier works such as Xu et al. [5] and Neumann [7] concentrated on effectiveness in improving mathematical comprehension and digital literacy, this research demonstrates that practicality ease of classroom use, clarity of instructions, and

contextual feasibility is equally crucial for determining whether such tools can realistically be integrated into daily teaching practices. This emphasis fills the identified gap in the literature by showing that high effectiveness does not necessarily guarantee adoption unless the tool is also judged practical by teachers.

Interestingly, the study also uncovered contextual challenges that nuance the otherwise positive results. Teachers in rural or resource-constrained schools pointed out barriers such as unstable internet connectivity, limited device capacity, and slow loading speeds, which disrupted the flow of lessons and constrained the use of adaptive AI features. These findings align with concerns raised by Popenici and Kerr [10] regarding infrastructure and teacher readiness as barriers to adopting AI in education. While the e-book was judged highly practical in principle, its functionality was not equally accessible across contexts, revealing equity gaps in digital integration. This divergence from the otherwise positive literature highlights that the practicality of AI-based media is not universal but is mediated by infrastructural conditions.

Another important finding relates to the perceived pedagogical alignment of the e-book. Teachers reported observing meaningful transfer of mathematical understanding from digital activities to real-world contexts, such as identifying shapes and applying counting skills beyond the screen. This is consistent with the developmental theories of Purpura et al. [14] and Guss et al. [12], which emphasize the role of early mathematical skills in building a foundation for higher-order cognitive development. The integration of multimodal design features appears to support conceptual understanding rather than rote memorization, addressing long-standing challenges in early childhood mathematics instruction [2, 30, 38].

The unique contribution of this study lies in its focus on practicality as a decisive factor in evaluating AI-based e-books for early mathematics learning. Whereas most prior research has examined effectiveness in improving outcomes, this study provides empirical evidence that teachers perceive the AI-based e-book as highly feasible for classroom integration, while also identifying infrastructural barriers that must be addressed for equitable adoption. The combination of quantitative results showing high practicality scores and qualitative insights about usability and contextual challenges offers a comprehensive perspective that bridges the gap between theoretical potential and classroom realities. By grounding the findings in the TAM framework, the study advances our understanding of how practicality interacts with perceived usefulness and ease of use to shape teachers' acceptance of AI-based educational tools.

In summary, this study contributes to the growing body of research on AI in early childhood education by demonstrating that the AI-based e-book is not only theoretically effective but also practically feasible in real classrooms. It strengthens existing literature by confirming the benefits of interactivity, adaptivity, and multisensory design while also extending the discourse by foregrounding practicality and equity issues. The findings underscore the importance of aligning technological innovation with contextual resources and teacher capacities to ensure that digital tools can move beyond pilot projects to sustainable integration in diverse educational settings.

## VI. CONCLUSION

This study set out to examine the practicality of an AI-based e-book designed to support early mathematics learning in preschool education, addressing a gap in prior research that has largely focused on effectiveness rather than feasibility. The findings demonstrate that the e-book is perceived as highly practical across multiple dimensions, with teachers highlighting its intuitive design, usefulness, and capacity to enhance engagement and differentiation. Importantly, these results align with the Technology Acceptance Model, confirming that both perceived ease of use and perceived usefulness are critical drivers of teacher acceptance. Beyond confirming prior studies on the benefits of AI and e-books, this research contributes uniquely by emphasizing practicality as the decisive factor for sustainable classroom adoption. The study carries significant implications: teachers can integrate the e-book to foster meaningful mathematics learning, developers are encouraged to refine clarity and adaptive features while designing lighter versions for low-resource contexts, and policymakers must invest in digital infrastructure to ensure equitable implementation. Nonetheless, the study is limited to one geographical context and focused on short-term practicality rather than long-term impact on learning outcomes. Future studies should explore cross-cultural

contexts, longitudinal effects, and comparative analyses between AI-based and conventional media to deepen understanding of effectiveness and scalability. Overall, the research underscores that practicality must be at the center of evaluating educational technology innovations, ensuring that tools are not only effective in theory but also accessible, usable, and sustainable in diverse classroom realities.

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## Author Contributions

Setiyo Utoyo: Conceptualization, Investigation, Writing–review and editing. Ismaniar Ismaniar: Data collection, Data curation, Investigation, Writing–original draft. Nur Hazizah: Methodology, Writing–review and editing. Elsy Assari Putri: Methodology, Writing–review and editing. Sri Cahaya Sihombing: Literature review, Writing–review and editing.

## Conflicts of Interest

The authors declare that they have no conflict of interest.

## Data Availability Statement

Data is available from the authors upon request.

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