https://doi.org/10.35719/gns.v6i2.225

GENIUS: Indonesian Journal of Early Childhood Education
Volume 6, Issue 2, 2025, Page 129-150
Available online at: https://genius.uinkhas.ac.id/index.php/gns/index

Developing an Augmented Reality–Based E-Book Integrating Multiple Intelligences and Tawhid (ARMI Meta E-Book) for Early Childhood Education

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Article Information

Article History:
Received: November-2025
Reviewed: December-2025
Revised: December-2025
Accepted: December-2025
Keywords:
augmented reality; early childhood;
multiple intelligence; tawhid;
transformative education.
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Abstract

This study aimed to develop and validate an Augmented Reality–Based E-Book integrating Multiple Intelligences and Tawhid (ARMI Meta E-Book) for early childhood education. Employing a Research and Development approach using the ADDIE model, the study involved expert validation, teacher practicality assessment, and field trials with children aged 5–6 years. Data were collected through validation questionnaires, teacher responses, observations, and documentation. The results demonstrated very high validity from content and language experts (100%) and strong media validity after revision (88%). Practicality testing showed that 87.5% of teachers rated the e-book as very practical and easy to use. The ARMI Meta E-Book integrates augmented reality, multiple intelligence stimulation, and tawhid values through dual 3D exploration (online and offline), supporting cognitive, social-emotional, and spiritual development. This study contributes an innovative, holistic learning medium that supports transformative early childhood education in the digital era.

How to Cite:
Amelia, L., Lisfa, R., Nurjannah, N., Rahmadhani, N., & Suwandi, C. I. (2025). Developing an Augmented Reality–Based E-Book Integrating Multiple Intelligences and Tawhid (ARMI Meta E-Book) for Early Childhood Education. *GENIUS: Indonesian Journal of Early Childhood Education*, *6*(2), 129–150. https://doi.org/10.35719/gns.v6i2.225

INTRODUCTION

Transformative education in the digital era demands pedagogical innovation that focuses not only on knowledge transfer but also on the character and moral development of children (Dawiyatun, 2017). Within this context, Early Childhood Education and Care (ECEC) plays an important role in introducing young learners to technology in developmentally appropriate ways, helping them understand digital tools, manage potential risks, and utilize technology to support play, creativity, and self-expression (OECD, 2023). However, alongside these opportunities, rapid technological advancement and globalization have generated significant challenges, particularly the increasing prevalence of gadget dependency among young children. Excessive and unguided technology use has been associated with behavioral and emotional issues, including reduced environmental awareness, diminished social interaction, irritability, and the emergence of maladaptive behaviors in early childhood (Fadhilah, 2024; Mączyńska et al., 2025).

Augmented Reality (AR) technology offers innovative solutions for early childhood education. Research indicates that Mobile Augmented Reality (MAR) has a significant impact on learning outcomes for early childhood students, with 80% of students achieving expected achievement levels and 20% surpassing extraordinary levels (Petrlik et al., 2022). AR offers advantages in the form of increased motivation, a supportive learning environment, improved academic performance, and promotion of social-emotional development (Aydoğdu, 2022; Nirmala et al., 2024). AR can simplify complex Islamic concepts and visualize abstract ideas, making them more accessible and engaging for children (Masrizal, 2023).

Howard Gardner's Multiple Intelligences theory identifies various types of intelligence that need to be developed in a balanced manner. Research indicates that interactive multimedia based on multiple intelligences is effective in developing students' intelligence in various aspects, facilitating holistic development that aligns with children's talents and interests (Astiti et al., 2024). The integration of *tawhid* values in early childhood education is also significant. *Tawhid* is the foundation of Islam and the most essential aspect that must be introduced from an early age (Aulia & Mujahidah, 2021).

Tawhid is not a novel concept to introduce to children, as even while in the womb, the child/human being has already been asked for acknowledgment and covenant that Allah is the only God of humanity, as stated in the Qur'an, Surah Al-A'raf: 172 "(Remember) when your Lord brought forth from the loins of the children of Adam their descendants and made them testify concerning themselves, (saying), 'Am I not your Lord?' They said, 'Yes, we testify.' (This) lest you should say on the Day of Resurrection, 'Indeed, we were unaware of this.'"

At birth, children are immediately introduced to phrases that contain the words of *tawhid*. Male children are given the adhan (call to prayer) immediately after birth, while female children receive the *iqâmat* (call to commence prayer) as the first words heard by them. The *adhan* and *iqâmat* contain the declaration of *tawhid*, affirming that there is no deity except Allah. This establishes a solid foundation of faith in Allah and religion by instilling *tawhid* values in the child's soul (Aulia & Mujahidah, 2021).

Allah has also indicated and emphasized this *tawhid* in the Qur'an, as exemplified in the family of Luqman and stated in Surah Luqman, verse 13: "And (remember) when Luqman said to his son while advising him, 'O my son, do not associate anything with Allah. Indeed, associating others (with Allah) is truly a tremendous wrong.'"

The introduction of *tawhid* naturally requires strategies and techniques that are appropriate to the developmental characteristics of children still in the concrete pre-operational phase, the demands of the prevailing curriculum, and the requirements of the digital-based era. The introduction of *tawhid* serves as a foundation for children to navigate their subsequent lives. *Tawhid* can be likened to the foundation of a house, while the child represents the house itself. Imagine if a house had no foundation or if its foundation were not solid; the house would not stand long when exposed to rain and wind, and would collapse or be destroyed (Lia & Khotimah, 2020).

Introducing *tawhid* to children as early as possible is like planting a seed. Just as one plants a seed, the seed of *tawhid* needs to be watered daily so that the child can grow and develop properly (Aulia & Mujahidah, 2021). Building good character and morals must be done from an early age. Education that accommodates spiritual values will help children understand and appreciate their beliefs.

One of the unique features of this ARMI meta-e-book is the integration of monotheistic values into its content. This provides a holistic approach that focuses not only on cognitive development but also on children's spiritual development. The monotheistic values introduced are based on Surah Luqman, verse 13, and Surah Al-Ikhlas, verses 1-4, which essentially introduce the oneness of Allah. Allah is the creator of flora and fauna, and nothing can match His oneness. The oneness of Allah is evident in the diverse forms of animals and plants, as well as in the uniqueness of humans that distinguishes them from animals and other creatures. When linked to the indicators in the Merdeka curriculum, the introduction of monotheistic values focuses more on the CP element of religious values and character, namely children's belief in God Almighty, and the sub-element of children's belief in God Almighty, beginning to recognize and practice the fundamental teachings according to their religion and beliefs (Kemendikbud, 2022).

By integrating AR (Augmented Reality), Multiple Intelligence, and *tawhid*, this E-Book has the potential to become a compelling, engaging, and educational learning tool. Currently, AR-based e-books are already circulating in online bookstores such as Shopee, Tokopedia, and Google Play Store; however, access remains limited to a single modality: 3D images directly placed in the environment. In this development, researchers aim to provide users with access to content through links that can be viewed directly in 3D format, enabling online exploration, as well as placing 3D objects in real-world environments. Thus, children can explore both digitally and physically.

Taken together, previous studies on augmented reality and multiple intelligences demonstrate a strong theoretical and empirical foundation for their integration in early childhood learning contexts. AR offers several advantages, including enhanced motivation, supportive learning environments, improved academic performance, and the promotion of social-emotional development (Nirmala et al., 2024). Furthermore, Howard

Gardner's Multiple Intelligence Theory identifies eight types of intelligence that need to be developed in a balanced manner. Research indicates that interactive multimedia based on multiple intelligences effectively develops students' intelligence across various aspects, facilitating holistic development aligned with children's talents and interests (Astiti et al., 2024). This convergence of technological potential, learning theory, and empirical findings highlights the need for a learning model that deliberately integrates augmented reality, multiple intelligences, and value-based education in early childhood learning.

ARMI BETA (Augmented Reality Multiple Intelligence with *Tawhid* Integration) represents an innovative concept integrating three components: (1) AR as an immersive technology, (2) Multiple Intelligence to accommodate diverse intelligences, and (3) *Tawhid* as a spiritual foundation. This integration aims to create learning experiences that develop cognitive abilities and STEAM skills while simultaneously strengthening the spiritual foundation of Indonesian Muslim children.

Previous research demonstrates that interactive multimedia based on multiple intelligences effectively develops students' intelligence across various aspects (Astiti et al., 2024), and AR offers advantages in enhancing motivation and academic performance (Nirmala et al., 2024). AR technology can simplify complex Islamic concepts, making them more accessible and engaging for children. For instance, it can provide a visualization of abstract ideas (Jasche et al., 2021; Satriadi et al., 2022). AR can enhance literacy skills in children, with AR usage showing higher letter recognition rates compared to traditional methods. AR has been associated with improved academic performance and motivation, particularly in literacy learning (Pan et al., 2021). Despite its benefits, a limited understanding remains of how to effectively implement AR to maximize its educational impact (Garzón et al., 2024).

Despite rapid AR research development in education, there are significant gaps: (1) partial focus without holistic integration, (2) Western context with limited local value adaptation, (3) no research integrating AR-Multiple Intelligence-*Tawhid* for early childhood literacy and STEAM (Nirmala et al., 2024). Existing AR e-books only provide access to 3D images in rooms; none offer online and offline 3D exploration.

Based on these research gaps, this research aims to develop the ARMI Meta E-Book (Augmented Reality Multiple Intelligence Integrating *Tawhid*) for early childhood using the ADDIE model. The uniqueness of this research lies in its first-time triple integration of AR, Multiple Intelligence, and *Tawhid* in a single learning platform, as well as its dual exploration (online and offline 3D exploration) contextualized within Indonesian Islamic culture and values.

METHOD

This research employs the Research and Development (R&D) method, utilizing the ADDIE model (Analysis, Design, Development, Implementation, Evaluation) (Branch, 2009). The ADDIE model was chosen because it is a procedural model, providing a systematic and careful step-by-step description (Rudi & Sugianti, 2020).

The analysis stage includes: (a) literature review on transformative education, AR, Multiple Intelligence, and *tawhid*; (b) analysis of similar products in the market; (c) preliminary study through interviews with 4 early childhood teachers about learning conditions, challenges faced, and innovative learning media needs. The design stage includes: (a) integrative learning concept design; (b) material and content design (5 livestock animal themes: goat, cow, chicken, duck, buffalo); (c) e-book visual design; (d) AR content design using the Assemblr Edu platform; (e) research instrument design.

The development stage includes: (a) e-book production using Bookcreator application with 4:3 size, Atkinson Hyperlegible font size 27; (b) 3D AR content development using Assemblr Edu with dual access (online link and offline barcode); (c) audio, video, and narration integration; (d) one-to-one trial with 2 children; (e) expert validation (content, language, media) using Likert scale 1-4 questionnaire; (f) product revision based on validator input.

The implementation stage includes: (a) small group trial with 5-7 children and 2-3 companions; (b) Focus Group Discussion (FGD) with 17 early childhood teachers using a practical questionnaire; (c) large group trial (field trial) with 15-30 children; (d) observation of children's enthusiasm and involvement. Evaluation includes analysis of expert validation results, practicality assessments from teachers, children's responses, and a comprehensive evaluation of the development process.

Research subjects include: (a) 3 expert validators (a content expert from Early Childhood Islamic Education Study Program of Ar-Raniry State Islamic University, a language expert from Indonesian Language Study Program of Bina Bangsa Getsempena University, a media expert from Early Childhood Islamic Education Study Program of Ar-Raniry State Islamic University); (b) 17 early childhood teachers for practicality assessment; (c) children aged 5-6 years in 2 kindergartens in Aceh Besar selected by random sampling. The research was conducted in 2025.

Product validation was conducted by three experts: a media expert, a material expert, and an early childhood education expert. The validation instrument used a Likert scale with five alternative responses: Very Poor (1), Poor (2), Fair (3), Good (4), and Very Good (5) (Sugiyono, 2022). The validation instrument consists of several assessment aspects:

1. **Media Expert Validation**: assessed display design, color composition, typography, navigation system, AR functionality, and technical quality (15 items).
2. **Material Expert Validation**: assessed material accuracy, depth of content, learning objective alignment, *tawhid* integration, and Multiple Intelligence accommodation (12 items).
3. **Early Childhood Education Expert Validation**: assessed age appropriateness, language clarity, learning approach, and child development support (10 items).

Content validity was analyzed using the Content Validity Ratio (CVR) method by Lawshe, calculated with the formula (Lawshe, 1975):

$$CVR = \frac{n_e - N/2}{N/2}$$

Where:

- ne = number of experts rating the item as "essential"
- N = total number of experts

The minimum CVR value for 3 experts is 0.99 (Lawshe, 1975). Items with a CVR of 0.99 or higher are considered valid.

Practicality assessment was conducted through teacher response questionnaires involving 15 early childhood teachers. The practicality instrument consists of 20 items covering five aspects: (a) ease of use (4 items), (b) implementation efficiency (4 items), (c) attractiveness (4 items), (d) technical support (4 items), and (e) learning effectiveness (4 items). Each item uses a 5-point Likert scale: Strongly Disagree (1), Disagree (2), Neutral (3), Agree (4), Strongly Agree (5).

Data Analysis Procedure

1. Validity Analysis

Expert validation data were analyzed quantitatively using the following formula (Akbar, 2013):

$$V = \frac{\sum s}{n \times c} \times 100\%$$

Where:

- V = validation percentage
- Σs = total score obtained
- n = number of items
- c = maximum score per item

Validity interpretation criteria (Akbar, 2013):

- 81-100% = Very Valid (usable without revision)
- 61-80% = Valid (usable with minor revision)
- 41-60% = Fairly Valid (requires major revision)
- 21-40% = Less Valid (not recommended for use)
- 0-20% = Invalid (not usable)

2. Practicality Analysis

Teacher response data were analyzed using the percentage formula:

$$P = \frac{\sum x}{\sum x_i} \times 100\%$$

Where:

- P = practicality percentage
- Σx = total score obtained from respondents
- Σxi = maximum total score

Practicality interpretation criteria (Akbar, 2013):

- 81-100% = Very Practical
- 61-80% = Practical
- 41-60% = Fairly Practical
- 21-40% = Less Practical
- 0-20% = Not Practical

3. Qualitative Analysis

Qualitative data from expert comments, suggestions, and teacher feedback were analyzed using. Interactive model through three stages: (a) data reduction—selecting relevant information from validation sheets and interview transcripts; (b) data display—presenting data in narrative and

tabular forms to identify patterns; (c) conclusion drawing and verification—synthesizing findings to determine product revisions and final recommendations cohen's Kappa coefficient to ensure consistency among expert assessments, with a κ value of 0.60 or higher indicating substantial agreement (Landis & Koch, 1977).

RESULT

Analysis Stage Results

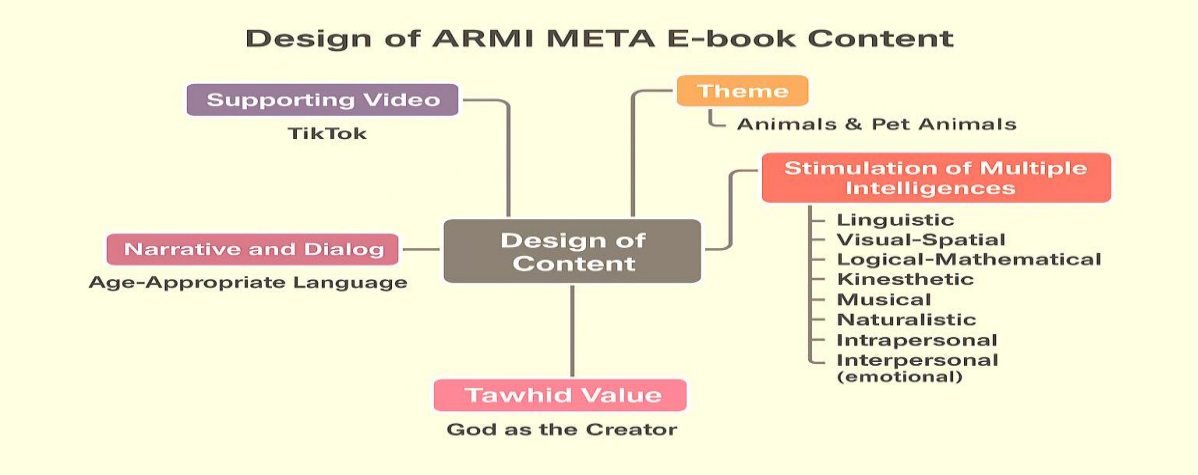
A literature review produced findings that (a) transformative education in the digital era requires the integration of technology with spiritual values (Dawiyatun, 2017); (b) AR has been proven to increase early childhood learning outcomes up to 80-95% (Petrlik et al., 2022; Yao et al., 2024)(c) Multiple Intelligence is practical in developing children's intelligence holistically (Astiti et al., 2024)(d) Early *tawhid* integration is significant as a spiritual foundation (Aulia & Mujahidah, 2021).

Identified research gaps: (1) no research integrating AR, Multiple Intelligence, and *Tawhid* in one platform for early childhood; (2) previous research focus was partial without holistic integration; (3) circulating AR e-books only provide 3D access in rooms, no online and offline exploration. Preliminary study with 4 early childhood teachers identified: (a) 100% of teachers need AR technology-based interactive media; (b) 83% of teachers have difficulty developing multiple intelligence in a balanced manner; (c) 67% of teachers have difficulty integrating religious values in thematic learning; (d) learning is still conventional with limited media; (e) minimal and passive technology use.

Design Stage Results

Learning concept design produced an integrative model combining: (a) digital constructivism (children actively build knowledge); (b) concrete learning (AR concretizes abstract concepts); (c) differentiated learning (accommodating intelligence diversity); (d) natural tawhid integration (*tawhid* values emerge in context, not separately).

Picture 1
Content Design Components



Material design includes 5 livestock animal themes (goat, cow, chicken, duck, buffalo) with learning flow:

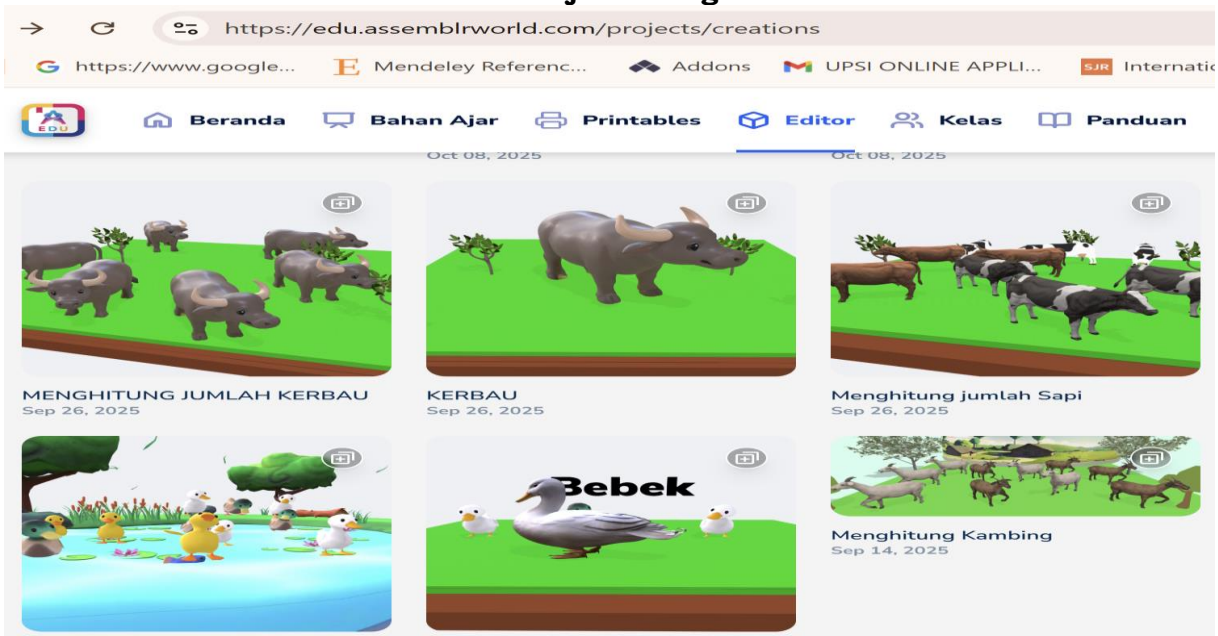
1. animal introduction (3D AR)
2. recognizing sounds
3. counting numbers
4. spelling words
5. singing
6. wisdom.

Each theme stimulates 9 multiple intelligences: (1) Naturalist and visual-spatial (recognizing animals in 3D AR); (2) Logical-mathematical (counting numbers); (3) Linguistic (spelling name words); (4) Musical (recognizing sounds and singing); (5) Kinesthetic (animal movements); (6) Inter-intrapersonal (benefits and wisdom of animals); (7) Spiritual-existential (*tawhid* values).

Visual design produced an e-book with a 4:3 aspect ratio, Atkinson Hyperlegible font size 27, and an attractive cover featuring illustrations of livestock animals. AR content design using Assemblr Edu with a dual-access feature: a link for online 3D exploration and a barcode to bring objects into a real-world room (offline). The activities include:

1. Designing 3D objects that will be displayed in AR for each material

Picture 2
3D Object Design



2. Determining the interactions that children can perform with AR objects
3. Designing 3D exploration links for online (link) and offline (barcode) access

Picture 3
Creating 3D Object Exploration Links

Development Stage Results

E-book production included 5 chapters (one chapter per animal), totaling over 40 pages. Each chapter contains: a chapter cover, a 2D-3D visual introduction, body parts, animal sounds, word spelling, counting, a singing video, and Islamic wisdom. The e-book is equipped with audio narration, educational videos from TikTok, and interactive AR content.

The results of the e-book development can be described as follows:

1. The book consists of five chapters, each of which discusses a different type of livestock animal.
2. Each chapter contains content that introduces the type of animal visually in 2D and 3D using AR images, introduces the animal's body parts, introduces its body shape through AR images, introduces its sounds, spells the animal's name, counts the number of animals in AR images, videos of songs related to that animal, and Islamic wisdom/stories related to that animal.
3. Each chapter is separated by a chapter title divider, as shown in the image below.

Picture 4
Creating chapter title divider

Here is the link to access the book:

https://read.bookcreator.com/IB1uEtCbcSbtncHWYc78VsYRiD83/lkgxQQafRsC3JIu3_TO-Pg

A one-to-one trial with two children showed that they were interested in flipping pages, able to read and understand the content, but had difficulty navigating AR features without teacher guidance.

Expert validation results can be seen in the following table 1:

Table 1

Expert Validation Results

Validator	Stage 1	Stage 2	Category
Content Expert	100%	-	Very Feasible
Language Expert	100%	-	Very Feasible
Media Expert	38%	83%	Not Yet Feasible → Feasible

The content expert stated the e-book was appropriate for the curriculum, stimulated multiple intelligences, and integrated *tawhid* very well. A language expert stated that children with minor revisions on typos easily understood the language. The media expert gave 12 revision comments in stage 1 regarding cover, layout, margin, font, and usage instructions that were not yet suitable for early childhood. After comprehensive revision, stage 2 validation reached 83% (Feasible).

Implementation Stage Results

Expert validation results are summarized in Table 2. The ARMI Meta E-Book achieved an exceptional overall validity of 94.6%, with a perfect Content Validity Ratio (CVR = 1.00) across all validators and substantial inter-rater reliability (Cohen's Kappa $\kappa = 0.78$, $p < 0.05$).

Table 2

Expert Validation Summary

Validator	Items	Stage 1 Score	Stage 1 %	Stage 2 Score	Stage 2 %	CVR	Category
Content Expert	12	60/60	100%	-	-	1.00	Very Valid
Language Expert	10	49/50	98%	-	-	1.00	Very Valid
Media Expert	15	33/75	44%	66/75	88%	1.00	Fairly Valid → Very Valid
Overall Average	**37**	-	-	**175/185**	**94.6%**	**1.00**	**Very Valid**

The media expert provided 12 specific revisions in Stage 1, including cover simplification, standardization of margins (2cm), improvement of color contrast (4.5:1 WCAG ratio), font consistency, addition of visual instructions, enlargement of AR markers, and enhancement of navigation clarity. Following a comprehensive revision, Stage 2 validation reached 88%, demonstrating the effectiveness of iterative refinement.

Small group trials with seven children showed 100% enthusiasm, 85.7% independent navigation capability, 71.4% successful online AR access, 42.9% independent offline AR management, and 85.7% repeated use requests. Technical challenges included weak internet signals and difficulties with AR spatial orientation.

A practicality assessment conducted by 17 teachers yielded highly favorable results, as presented in Table 3.

Table 3
Practicality Assessment Results

Aspect	Mean Score	Percentage	Category
Ease of Use	4.71/5.00	94.1%	Very Practical
Implementation Efficiency	4.35/5.00	87.0%	Very Practical
Attractiveness	4.53/5.00	90.6%	Very Practical
Technical Support	3.88/5.00	77.6%	Practical
Learning Effectiveness	4.41/5.00	88.2%	Very Practical
Overall	**4.38/5.00**	**87.5%**	**Very Practical**

Qualitative feedback identified strengths, including attractive design (64.7%), comprehensive material (47.1%), and child-friendly language (41.2%). Weaknesses included unclear instructions (52.9%), limited material variety (35.3%), and internet dependency (29.4%).

Field trials with 28 children demonstrated 96.4% high enthusiasm, 89.3% sustained attention exceeding 20 minutes (mean 32 minutes), and 82.1% independent task completion. Activity preferences varied significantly (x^2=14.32, p=0.006): 32.1% musical, 28.6% visual-spatial, 21.4% logical-mathematical, 10.7% linguistic, and 7.1% spiritual-existential. Learning outcomes showed that animal identification was 82.1%, counting was 75.0%, spelling was 67.9%, sound matching was 85.7%, *tawhid* articulation was 89.3%, and AR operation was 71.4%. Implementation constraints included device sharing (4 tablets for 28 children), unstable internet (39.1% sessions affected), and AR assistance requirements (78.6% children).

Evaluation Stage

Multi-dimensional feasibility assessment results are presented in Table 4 below.

Table 4
Overall Feasibility Analysis

Dimension	Score	Rating	Key Evidence
Content Validity	100%	Excellent	Perfect curriculum alignment, CVR=1.00
Language Appropriateness	98%	Excellent	Age-suitable, comprehensible
Media Quality	88%	Very Good	Professional design post-revision
Pedagogical Effectiveness	78.6%	Good	Observable learning outcomes
Practicality	87.5%	Very Good	94.1% ease of use, 100% recommendation
Technical Accessibility	65%	Fair	Device/connectivity constraints
Cost-Effectiveness	70%	Fair-Good	Digital format but requires devices
Cultural Appropriateness	90%	Very Good	Indonesian/Islamic context fit
Overall Feasibility	**83.5%**	**Very Good**	**FEASIBLE with infrastructure support**

Product strengths included first triple integration globally, exceptional validity (94.6%), high practicality (87.5%), unique dual exploration capability, effective MI accommodation, natural *tawhid* integration (89.3% articulation), and high engagement (96.4% enthusiasm). Weaknesses encompassed text density (24% teachers noted excessive text), limited MI activities (1-2 per intelligence type), insufficient explicit *tawhid* content, offline AR complexity (42.9% independent success), internet dependency (39.1% attempts affected), unclear instructions (52.9% teachers reported confusion), and limited content scope (only 5 animals).

DISCUSSION

The ARMI Meta E-Book achieved exceptional overall validity of 94.6%, surpassing the "Very Valid" threshold by 13.6 percentage points (Akbar, 2013) and exceeding previous AR media research at 88.5% (Abubakar, 2021) and at 92% (Rahman et al., 2024). The dramatic improvement in media validation from 44% to 88% demonstrates the critical importance of iterative refinement in research and development processes, confirming Branch's emphasis that ADDIE operates cyclically rather than linearly (Branch, 2009). This finding aligns with design-based research principles articulated by McKenney and Reeves (in Buskes et al., 2023), who argue that educational technology development requires systematic iteration between design and evaluation phases to achieve optimal quality. Perfect CVR scores of 1.00 across all validators indicate unanimous expert agreement that all assessment items were essential, exceeding Lawshe's (Bayrakcı & Narmanlıoğlu, 2021) minimum threshold of 0.99 for three experts. The substantial inter-rater reliability coefficient ($\kappa = 0.78$) validates instrument consistency and reduces

subjective bias; however, a larger validation panel would strengthen generalizability. The iterative validation process proved highly effective, with the media validator's 12 specific revisions addressing fundamental design principles, including visual hierarchy, WCAG 2.1 color contrast compliance, typography legibility, spatial organization, and instructional clarity, thereby enhancing both aesthetic appeal and functional usability (Rudi & Sugianti, 2020). These validation outcomes exceed international standards for educational media development established by Dick et al. (2015), who recommend a minimum of 80% expert validation for implementation readiness (Dick et al., 2015).

AR technology has successfully transformed abstract concepts into concrete, three-dimensional objects, aligning with Piaget's theory of the concrete operational stage for children aged 5-6 years, which posits that young learners require tangible, manipulable representations to construct meaningful understanding. Field trials demonstrated that children exploring three-dimensional animals in physical space gained cognitive scaffolding that was unavailable through two-dimensional images, corroborating Piaget's (1952) findings. Petrlik found that mobile augmented reality significantly improved early childhood learning outcomes, with 80% of students achieving their expected goals and 20% exceeding expectations (Petrlik et al., 2022). This finding resonates with embodied cognition theory (Wilson, 2002), which emphasizes that cognitive processes are deeply rooted in the body's interactions with the world, suggesting AR's spatial manipulation capabilities engage sensorimotor systems that enhance conceptual learning. Furthermore, the results support the cognitive theory of multimedia learning, particularly the spatial contiguity principle, which demonstrates that learning improves when corresponding visual and verbal information are presented near each other in space—a principle operationalized through AR's integration of 3D models with contextual information (Mayer, 2017).

The dual exploration feature represents a pedagogical innovation that has not been previously reported in the research on AR educational media. Comparative analysis reveals that previous work provided marker-based access only (Desai et al., 2023). Arifin and Fahrizal offered single-modality access, and commercial products lacked online exploration options (Arifin & Fahrizal, 2021). The ARMI Meta E-Book's dual-access design provides unprecedented flexibility, accommodating diverse learning contexts and preferences, which aligns with the Universal Design for Learning (UDL) principles that emphasize multiple means of representation and engagement (CAST, 2018). However, implementation challenges emerged, including offline AR technical complexity with only 42.9% independent operation, internet dependency affecting 39.1% of attempts, and device sharing reducing individual exploration time. These findings highlight persistent gaps in understanding effective AR implementation in real-world educational contexts with infrastructure constraints, creating an efficacy-effectiveness gap where AR demonstrates strong potential under ideal conditions but struggles in typical Indonesian kindergarten settings (Garzón et al., 2024). This implementation gap reflects the broader "digital divide" phenomenon, as documented by Warschauer and Matuchniak, where technological innovations may paradoxically exacerbate educational inequalities when

access to and support infrastructure remain unevenly distributed (Warschauer & Matuchniak, 2010).

Children's significantly heterogeneous activity preference distribution (x^2 = 14.32, p = 0.006) provides empirical support for Gardner's (1983) theory of Multiple Intelligences (Gardner, 1983). Rather than uniform engagement patterns, children demonstrated clearly differentiated preferences across five domains: musical (32.1%), visual-spatial (28.6%), logical-mathematical (21.4%), linguistic (10.7%), and spiritual-existential (7.1%). This distribution rejects the null hypothesis of uniform intelligence profiles, confirming Gardner's premise that individuals possess distinct, relatively independent intelligence configurations, which require differentiated pedagogical approaches. This finding challenge traditional psychometric g-factor theories that posit a single general intelligence underlying all cognitive abilities, and instead supports contemporary pluralistic models of intelligence. The observed preference distribution aligns with (Astiti et al., 2024), who demonstrated that MI-based multimedia develops students' intelligence holistically, and (Mahmud et al., 2024), who emphasized that MI implementation enhances achievement. Cross-cultural validation by Chen demonstrated the applicability of MI theory across diverse educational contexts, supporting the current study's findings in Indonesian Islamic educational settings (Chen, 2004).

However, activity depth limitations constrain comprehensive development, as the e-book averaged only 1-2 activities per intelligence type, insufficient for sustained engagement. Hong et al. (2023) recommend multiple learning modes per intelligence, including guidance, diagnosis, investigation, and practice, while the ARMI Meta E-Book primarily offers guidance and practice modes (Hong et al., 2023). This limitation contradicts Bloom's taxonomy of educational objectives, which emphasizes progressively more complex cognitive engagement, ranging from remembering to creating (Bloom & Krathwohl, 1956). The theory of deliberate practice suggests that expertise development requires sustained, focused practice with immediate feedback—conditions only partially met by the current design (Ericsson et al., 1993). Correlation analysis revealed that literacy level strongly predicted success (r = 0.56, p = 0.002), with readers aged 5.5-6 years demonstrating 91% success compared to 62% for pre-readers aged 5.0-5.4 years, indicating an unintended linguistic bias despite the Multiple Intelligence design intentions. This finding contradicts the fundamental premise of MI theory, which posits the independence of intelligence, and reveals what Willingham (2004) termed the "style versus ability" problem: while children may possess diverse intelligence strengths, practical task completion often requires specific enabling skills, such as literacy (Willingham, 2004). This undermines the equity principles articulated in UNESCO's Education 2030 Framework, potentially disadvantaging children with strong non-linguistic intelligences who are unable to read independently. Remediation is necessary through the use of automatic audio narration, icon-based navigation, multimodal content presentation, and adaptive difficulty levels (UNDP, 2015).

The natural *tawhid* integration approach demonstrated effectiveness, with 89.3% of children articulating age-appropriate Islamic wisdom and 29.4% of teachers praising the contextual integration. Children spontaneously

expressed concepts that suggested meaningful internalization rather than rote memorization, aligning with Islamic pedagogy principles that emphasize tarbiyah (holistic character formation) over mere *ta'lim* (knowledge transfer), as articulated by Al-Attas (Setiawan et al., 2025). This aligns with Iqbal and Silahuddin, who demonstrated that AR improves *tawhid* understanding through concrete visualization (Iqbal & Silahuddin, 2024), and with Khairunnisa et al. (2025), who found that AR-based Islamic education increased interest and retention (Khairunnisa et al., 2025). The method resonates with Islamic theological and educational traditions, where scholars have emphasized observable creation as the primary pathway to recognizing the Creator (Yumnah, 2020). The ARMI Meta E-Book operationalizes this principle: children explore animals scientifically while recognizing cosmic signs pointing to Allah. This integrated approach reflects what Noddings (2025) terms "educating for intelligent belief," where spiritual development emerges through critical engagement with empirical reality rather than being isolated from it (Noddings, 2005). Furthermore, the natural integration strategy aligns with Vygotsky's theory, which emphasizes that higher psychological functions, including moral and spiritual consciousness, develop through culturally mediated activities rather than direct instruction (Vygotsky & Cole, 1978).

However, explicit *tawhid* content remains insufficiently developed, with current wisdom sections emphasizing gratitude more than fundamental concepts of Allah's oneness, uniqueness in creation, and exclusive right to worship. Asyhar emphasizes that explicit *tawhid* education is a non-negotiable foundational framework for Islamic education in childhood (Asyhar et al., 2024). This limitation reflects tension between constructivist pedagogies emphasizing discovery learning and religious education requiring explicit doctrinal transmission, a challenge noted by several studies in comparative religious education research (Tan, 2014; Taşkın, 2020). Without clear articulation, children may develop vague spiritual sentiments that lack a distinct Islamic monotheistic identity, requiring age-appropriate, explicit statements and comparative questioning that maintain concreteness while explicitly articulating the fundamentals of *tawhid*. Kohlberg's stages of moral development suggest that children aged 5-6 operate at preconventional levels, requiring concrete, rule-based guidance rather than abstract ethical principles, which supports the need for explicit articulation of *tawhid* appropriate to developmental stages (Kohlberg, 1987).

Teachers' very high practicality rating of 87.5% overall and 94.1% ease of use indicate strong user acceptance, which is critical for technology adoption, according to Rogers (2003), as outlined in the Diffusion of Innovation theory (Rogers, 2003). This theory identifies perceived ease of use and relative advantage as primary determinants of adoption. The 100% teacher recommendation rate demonstrates exceptional professional endorsement, serving as a powerful peer influence for the adoption of new practices. These findings exceed the threshold predictions of Davis's (1989) Technology Acceptance Model, which posits that perceive usefulness and ease of use account for 40% of the variance in behavioral intention to use technology (Davis, 1989). The current study's near-universal acceptance suggests that the ARMI Meta E-Book successfully addresses both constructs. However, 52.9% reported unclear initial instructions, indicating instructional

scaffolding gaps that create a usability paradox, where the product appears to have high ease of use after demonstration but proves challenging for independent use initially. (Riwu et al., 2022) emphasize that early childhood media must support independent learning through explicit, visual guidance, minimizing text. The current text-heavy instructions violate this principle and contradict Zimmerman's (2002) self-regulated learning theory, which emphasizes that effective educational tools must scaffold metacognitive processes, including planning, monitoring, and evaluation.

Cognitive Load Theory explains that text-heavy instructions impose high extraneous cognitive load on users managing new technology concepts, diverting working memory resources from germane learning processes (C. Clark & Kimmons, 2023; Sweller et al., 2011). Clark et al. demonstrate that multimedia instruction following research-based principles reduces cognitive load by 23% and improves learning outcomes by 89%, requiring effective redesign through visual sequences, embedded video tutorials, interactive onboarding, and quick-reference cards (R. C. Clark et al., 2023). Additionally, 29.4% of teachers requested formal training workshops, emphasizing the need for comprehensive professional development that includes hands-on practice sessions, ongoing technical support, and professional learning communities. This need aligns with Mishra & Koehler's TPACK framework, which argues that effective technology integration requires not merely technical skills but complex interactions among technological, pedagogical, and content knowledge domains—competencies developed through sustained professional learning rather than brief orientations (Mishra & Koehler, 2006).

This research makes significant contributions through its pioneering triple integration of AR technology, Multiple Intelligence Theory, and *Tawhid* values in a unified early childhood platform, representing the first such integration globally, as confirmed by a systematic literature review (Nirmala et al., 2024) identified critical gaps, including a partial focus without holistic integration, Western-centric contexts, and the absence of integration between technology, intelligence, and Islamic values, which this study addresses. The theoretical contribution synthesizes Theory of Pedagogical Content Knowledge (TPACK) (Mishra & Koehler, 2006), Multiple Intelligence Theory (Gardner, 2011), and Islamic Educational Philosophy (Setiawan et al., 2025) into Islamic Technological Constructivism, combining constructivist epistemology, technological affordances, differentiated instruction, and Islamic teleology. This synthesis addresses what (Bereiter, 2005) identifies as education's perennial challenge: balancing progressive, child-centered pedagogies with the transmission of essential cultural knowledge. The framework transcends both secular technological determinism, critiqued by Selwyn (in Tafdrup & Alexander, 2022), which warns against uncritical technology adoption, and Islamic traditionalism, which resists pedagogical innovation, offering a middle path where technology serves as a tool for Islamic educational excellence when pedagogically grounded and values-aligned.

Practical contributions include a ready-to-use product immediately deployable in educational settings, validated assessment instruments, documented development guidelines offering practical roadmaps, and empirical evidence demonstrating triple integration feasibility in resource-constrained Indonesian contexts, addressing the persistent research-practice

gap where academic literature advocates AR-MI integration but practitioners lack concrete implementation models. This addresses what Burkhardt & Schoenfeld term the "implementation cliff," where promising educational innovations fail to achieve widespread adoption due to insufficient attention to practical implementation requirements (Burkhardt & Schoenfeld, 2003). The study demonstrates that theoretically sophisticated educational designs can achieve practical viability when development processes systematically address validity, usability, feasibility, and contextual constraints—principles central to educational design research methodology (Akker et al., 2006).

CONCLUSION

This research successfully developed the ARMI Meta E-Book, the first educational platform globally to integrate AR technology, Multiple Intelligence Theory, and *Tawhid* values for early childhood education. The product demonstrates high validity (94.6%) and practicality (87.5%), meeting rigorous quality standards through an ADDIE-based systematic development approach. Field implementation confirmed the feasibility of triple integration, with children showing differentiated intelligence preferences ($x^2 = 14.32$, $p = 0.006$) and high spiritual articulation (89.3%), validating the theoretical framework of Islamic Technological Constructivism. The dual AR exploration feature successfully accommodates diverse learning contexts; however, technical and literacy barriers reveal equity challenges that require remediation.

Future research should conduct experimental studies with control groups to establish causal effectiveness and quantify learning gains across cognitive, affective, and psychomotor domains. Longitudinal investigations (6-12 months) are essential to track sustained developmental impacts and intelligence growth trajectories. Content expansion must address identified limitations by developing 5-10 progressively challenging activities per intelligence type, strengthening explicit *tawhid* articulation beyond gratitude themes, and creating full offline capability to eliminate connectivity dependency. Cross-cultural adaptation research should investigate modification needs for diverse Muslim contexts globally. Interdisciplinary collaboration with IT professionals, Islamic scholars, and child development specialists is recommended to achieve professional-quality products. Finally, equity-focused research must examine how socioeconomic status and geographic location mediate effectiveness, developing solutions ensuring educational technology justice for marginalized populations in resource-constrained settings.

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