

## Metaverse-Based Islamic Learning Environment to Improve Students' Spiritual Engagement and Religious Digital Literacy at SMP Negeri 35 Medan

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**Abstract:** Digital transformation in education requires Islamic Religious Education (IRE) to go beyond the delivery of religious knowledge by fostering students' spiritual engagement and their ability to access, evaluate, and responsibly use religious information in digital environments. This study aims to analyze the effectiveness of a Metaverse-Based Islamic Learning Environment in enhancing students' spiritual engagement and religious digital literacy at SMP Negeri 35 Medan. The study employed a quantitative approach using a quasi-experimental pretest-posttest control group design. The participants were students of SMP Negeri 35 Medan who were divided into an experimental group and a control group. The experimental group received Islamic Religious Education through a metaverse-based learning environment designed with virtual Islamic spaces, learning simulations, exploratory activities, collaborative discussions, interactive quizzes, digital religious source verification, and spiritual reflection. Meanwhile, the control group participated in Islamic Religious Education using regular instructional approaches. Data were collected using a spiritual engagement scale and a religious digital literacy instrument. Data analysis included descriptive statistics, instrument validity and reliability testing, normality testing, homogeneity testing, paired-sample t-tests, independent-sample t-tests, and effect-size calculations. The findings are expected to determine the extent to which the metaverse-based learning environment can enhance students' spiritual engagement and religious digital literacy compared with regular instruction. This study is expected to contribute to the development of Islamic Religious Education that is immersive, reflective, critical, and adaptive to the digital ecosystem.

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**Abstrak:** Transformasi digital dalam pendidikan menuntut pembelajaran Pendidikan Agama Islam (PAI) tidak hanya mampu menyampaikan pengetahuan keagamaan, tetapi juga membangun keterlibatan spiritual dan kemampuan peserta didik dalam mengakses, mengevaluasi, serta menggunakan informasi keagamaan secara bertanggung jawab di ruang digital. Penelitian ini bertujuan menganalisis efektivitas Metaverse-Based Islamic Learning Environment dalam meningkatkan keterlibatan spiritual dan literasi digital religius peserta didik di SMP Negeri 35 Medan. Penelitian menggunakan pendekatan kuantitatif dengan desain quasi-experimental pretest-posttest control group. Subjek penelitian adalah peserta didik SMP Negeri 35 Medan yang dibagi menjadi kelompok eksperimen dan kelompok kontrol. Kelompok eksperimen memperoleh pembelajaran PAI melalui lingkungan metaverse yang dirancang dengan ruang virtual Islami, simulasi pembelajaran, aktivitas eksplorasi, diskusi kolaboratif, kuis interaktif, verifikasi sumber keagamaan digital, dan refleksi spiritual. Kelompok kontrol mengikuti pembelajaran PAI dengan pendekatan pembelajaran reguler. Data dikumpulkan menggunakan skala keterlibatan spiritual dan instrumen literasi digital religius. Analisis data meliputi statistik deskriptif, uji validitas dan reliabilitas instrumen, uji normalitas, uji homogenitas, paired sample t-test, independent sample t-test, dan perhitungan effect size. Hasil penelitian nantinya digunakan untuk menentukan sejauh mana lingkungan pembelajaran berbasis metaverse mampu meningkatkan kedua variabel dibandingkan pembelajaran reguler. Penelitian ini diharapkan memberikan kontribusi terhadap pengembangan pembelajaran PAI yang imersif, reflektif, kritis, dan adaptif terhadap ekosistem digital.

**Kata Kunci:** Metaverse; Pendidikan Agama Islam; Keterlibatan Spiritual; Literasi Digital Religius; Pembelajaran Imersif; SMP.

## **A. Introduction**

Digital transformation has brought fundamental changes to the educational ecosystem, including the instructional processes of Islamic Religious Education (*Pendidikan Agama Islam* / PAI) in junior high schools. The rapid expansion of the internet, mobile devices, social media, artificial intelligence, and digital learning

platforms means that students no longer acquire religious knowledge solely through teachers, textbooks, and family environments, but also through openly accessible digital sources (Sahin, 2018; Zaidan et al., 2021). This shift presents both opportunities and challenges for Islamic education. On one hand, technology enables students to gain broader access to the Qur'an, Hadith, Islamic history, and religious learning materials that were previously difficult to reach. On the other hand, open digital spaces expose students to religious information with varying levels of validity, authority, and interpretation. Consequently, digital transformation in religious education cannot merely focus on technology adoption; it must be accompanied by critical thinking, source evaluation abilities, digital ethics, and the internalization of religious values (Nurdin et al., 2023). Islamic education in the digital era must produce students who are not only knowledgeable in religion but also critical, responsible technology users grounded in a spiritual orientation amidst an increasingly complex information landscape.

The changing characteristics of younger generations further emphasize the need for instructional innovation in PAI. Junior high school students belong to a cohort that interacts intensively with digital technologies and social media in their daily lives (Buckingham, 2008). The digital environment plays a key role in shaping their knowledge, identity, communication, and social interactions. Students can encounter lecture videos, Quranic verses, Hadith citations, edicts (*fatwas*), religious opinions, and proselytization (*da'wah*) content within seconds. However, technical proficiency in technology does not automatically equate to religious digital literacy (Eshet-Alkalai, 2004). While students may possess high technical competence in accessing information, they often lack the capacity to discern valid religious information from claims lacking adequate foundational evidence. Therefore, PAI instruction must provide direct, hands-on experience in searching, inspecting, comparing, interpreting, and evaluating digital religious information, establishing religious digital literacy as a core competency (Evolvi, 2020).

In this context, the concept of religious digital literacy holds a strategic position in contemporary Islamic education. Religious digital literacy is defined as the ability of students to access, understand, evaluate, verify, use, and disseminate religious

information through digital media critically, ethically, and responsibly (Campbell & Vitullo, 2016). Moving beyond technical operation, this concept encompasses an epistemic capability to interrogate information origin, source credibility, contextual integrity, and alignment with authoritative religious texts. Students must be trained not to accept religious claims based merely on view counts, follower numbers, account popularity, or visual aesthetics, recognizing that religious authority and source credibility are essential determinants of information quality (Campbell, 2010). Thus, integrating religious digital literacy into PAI serves as a crucial preventive mechanism against unverified religious content, decontextualized snippets, and religious disinformation in digital spaces.

Beyond digital literacy, PAI possesses unique characteristics that distinguish it from purely cognitive-oriented instruction. The ultimate goal of religious education extends beyond memorizing concepts, laws, history, or doctrines; it aims to help students internalize these values and apply them in daily life (Halstead, 2007). Spiritual engagement is therefore a vital dimension of PAI, reflected in students' attention to religious values, reflective capacity regarding learning meaning, awareness of connecting content to daily experiences, moral internalization, and motivation to manifest these values in behavior (Sahin, 2013). If PAI instruction yields only higher cognitive test scores without deepening the student's personal connection to the taught values, it falls short of fulfilling its core educational mission. Hence, pedagogical innovations must integratively link cognitive, affective, social, moral, and spiritual dimensions.

Spiritual engagement becomes even more critical as students navigate fast-paced, highly stimulating digital environments. Digital media encourages rapid switching between information streams, rendering learning fragmented and unreflective (Carr, 2010; Laurillard, 2012). Religious information that demands deep contemplation is easily reduced to superficial, bite-sized content consumption. To counteract this, PAI must create intentional spaces for students to pause, reflect, connect information with personal experiences, and consider moral implications. Incorporating reflective

activities within digital learning environments ensures technology accelerates not just information delivery, but meaningful, reflective learning (Schön, 1983).

One emerging technology capable of fostering such immersive and reflective learning experiences is the metaverse. In an educational context, the metaverse represents an immersive digital environment that enables users to interact with virtual spaces, digital artifacts, avatars, and peers more interactively than conventional digital platforms (Mystakidis, 2022; Smart et al., 2007). Unlike text- or video-based learning where students are passive receivers, the metaverse positions learners as active participants engaged in exploration, navigation, simulation, and collaboration (Dede, 2009). Although studies highlight its potential for interactive, contextual, and collaborative learning, the metaverse is not a panacea. Its pedagogical efficacy depends heavily on environmental design, instructional alignment, content quality, teacher-student dynamics, technological readiness, and student appropriateness (Hwang & Chien, 2022). The primary challenge lies in developing virtual environments with sound pedagogical utility rather than merely migrating traditional instruction into 3D spaces.

Deploying the metaverse in PAI offers unique opportunities to construct experiential learning environments that are difficult to replicate in conventional classrooms. Religious curricula can be instantiated across dedicated virtual spaces: a virtual mosque for practicing worship rituals and understanding their underlying values; a virtual Islamic history gallery for exploring civilization milestones; a Quranic space for contextualizing scriptural verses; and a moral simulation space for navigating real-world ethical dilemmas (Mystakidis et al., 2021; Tarng et al., 2015). This enables experiential learning and decision-making over rote memorization. Embedded reflective zones ensure virtual exploration translates into meaningful value internalisation.

Despite these possibilities, significant research gaps persist regarding the metaverse in education. Existing literature heavily focuses on higher education, technology acceptance, user perception, motivation, and usability, primarily within STEM, language, and medical fields (Akçayır & Akçayır, 2017; Turan et al., 2022). Empirical research involving middle school students remains sparse, as does research examining metaverse applications in Islamic education where spirituality and value

formation are central. Addressing this gap at the junior high school level is crucial, as early adolescence marks a critical developmental period for identity formation, critical thinking, and digital media habituation.

Another critical research gap lies in the selection of outcome variables. Prior studies predominantly rely on cognitive achievement, motivation, or system usability as success metrics (Akçayır & Akçayır, 2017). While important, these metrics inadequately capture the broader objectives of religious education, which encompass reflection, moral orientation, spiritual depth, and responsible application of religious knowledge. To address these limitations, this study proposes a dual-outcome framework evaluating spiritual engagement and religious digital literacy. This dual approach provides a holistic assessment of how metaverse environments impact both internal value reflection and external digital competence.

SMP Negeri 35 Medan provides an ideal empirical setting to investigate this approach in a real-world classroom environment rather than an isolated laboratory simulation. Conducting research within an active school context captures the complexities of teacher-student interactions, peer collaboration, infrastructure realities, school culture, and contextual learning habits. Thus, the study at SMP Negeri 35 Medan evaluates not only the technical feasibility of the metaverse in PAI but its pedagogical capacity to cultivate spiritual engagement and religious digital literacy within the Indonesian public school context.

To bridge these gaps, a specialized instructional framework is required: the Metaverse-Based Islamic Learning Environment. This environment integrates virtual Islamic spaces, interactive PAI content, exploratory tasks, collaborative learning, ethical simulations, religious information verification activities, and spiritual reflection modules. A key distinguishing feature is the inclusion of dedicated *digital religious information verification* tasks, where students actively evaluate, compare, and verify digital religious claims against credible sources, directly building religious digital literacy through immersive problem-solving.

The novelty of this research lies in designing and empirically testing a metaverse learning environment specifically tailored for junior high school Islamic education that

simultaneously targets spiritual engagement and religious digital literacy. Rather than utilizing the metaverse as a mere visual aid, this study establishes it as a pedagogical environment where students learn through exploration, interaction, verification, and reflection. By shifting the evaluation criteria to spiritual and digital literacy outcomes, this research fills a pivotal gap between immersive technology development and value-driven religious education.

Accordingly, this study aims to analyze the effectiveness of the Metaverse-Based Islamic Learning Environment in enhancing junior high school students' spiritual engagement and religious digital literacy at SMP Negeri 35 Medan. Specifically, the study addresses three research questions: (1) Does the Metaverse-Based Islamic Learning Environment significantly increase students' spiritual engagement? (2) Does the environment significantly improve students' religious digital literacy? and (3) Is there a significant difference in the gain scores of spiritual engagement and religious digital literacy between students in the metaverse-based learning group and those in the traditional instruction group? The findings are expected to contribute theoretically and practically to immersive educational technology in Islamic education while guiding educators in designing digitally adaptive, value-centered learning environments.

## **B. Research Method**

### **Research Design**

This study employs a quantitative approach with a quasi-experimental pretest-posttest control group design to analyze the effectiveness of the Metaverse-Based Islamic Learning Environment in enhancing junior high school students' spiritual engagement and religious digital literacy in Islamic Religious Education. A quasi-experimental design was selected due to field conditions where students were already organized into pre-established intact classes, making complete individual randomization infeasible.

The study involves two groups: an experimental group and a control group. The experimental group receives PAI instruction utilizing the Metaverse-Based Islamic Learning Environment, while the control group receives PAI instruction using the regular instructional approach typically employed by the teacher. Both groups undergo

an initial baseline measurement (pretest) prior to the intervention and a final measurement (posttest) after completing the full learning sequence. The research design is illustrated in Table 1.

**Table 1: Research Design**

| Group        | Pretest | Treatment | Posttest |
|--------------|---------|-----------|----------|
| Experimental | Q1      | X         | Q2       |
| Control      | Q3      | C         | Q4       |

*Note:*  $O_1$  represents the pretest score of the experimental group;  $O_2$  represents the posttest score of the experimental group;  $O_3$  represents the pretest score of the control group;  $O_4$  represents the posttest score of the control group; X represents the Metaverse-Based Islamic Learning Environment intervention; and C represents PAI instruction using the regular approach. The study is conducted at SMP Negeri 35 Medan during the sixth semester of the 2025/2026 academic year. The research stages comprise needs analysis, virtual learning environment development, instrument construction and validation, pilot testing, pretest administration, intervention delivery, posttest administration, data analysis, and interpretation of findings.

### Research Site, Time, Population, and Sample

The study is conducted at SMP Negeri 35 Medan. This location was selected due to the alignment of student characteristics with the research objectives, particularly the need to develop PAI instruction that adapts to digital technology advancements while strengthening students' religious digital literacy.

The target population consists of all students at SMP Negeri 35 Medan enrolled in Islamic Religious Education during the specified academic year. The sample is determined using cluster sampling or purposive sampling, considering class characteristics, grade level, student count, comparable academic ability, class schedules, PAI teacher recommendations, and technological infrastructure readiness.

Two classes with relatively equivalent characteristics are selected as the experimental group and the control group. Group assignments are established prior to the pretest administration. The sample composition is detailed in Table 2.

**Table 2: Sample Composition**

| Group | Grade | Number of Students |
|-------|-------|--------------------|
|-------|-------|--------------------|

|              |      |           |
|--------------|------|-----------|
| Experimental | VIII | 30        |
| Control      | VII  | 30        |
| <b>Total</b> |      | <b>60</b> |

Student inclusion criteria include: (1) actively enrolled students at SMP Negeri 35 Medan; (2) enrolled in the PAI course in the sampled classes; (3) granted consent to participate in the study; (4) complete participation in the pretest, all intervention sessions, and the posttest; and (5) possessing basic skills in operating the digital devices required to access the learning environment. Students who miss key stages of the research or produce incomplete primary data are excluded from the final analysis based on predetermined missing data criteria.

### **Development of the Metaverse-Based Islamic Learning Environment**

The Metaverse-Based Islamic Learning Environment is designed not merely as a visualization tool for learning content, but as an interactive space enabling students to explore, interact, collaborate, simulate scenarios, verify information, solve problems, and reflect. The development integrates principles of student-centered learning, experiential learning, collaborative learning, problem-based learning, and reflective learning. Under this paradigm, students act as active subjects in the learning process, while the teacher functions as a facilitator, guide, and mentor. The development follows six stages: needs analysis, instructional design, product development, expert validation, limited field testing, and product revision.

### **Needs Analysis**

Needs analysis is conducted through observations of PAI classes, interviews with PAI teachers, student profile identification, content analysis, and assessments of available school technology infrastructure. Aspects evaluated include students' digital usage habits, technology proficiency, learning difficulties in PAI, capacity to evaluate digital religious content, teacher readiness, device availability, internet connectivity, and the suitability of PAI topics for virtual environment integration. Results form the baseline for designing virtual space layouts, media formats, learning activities, evaluation tools, and reflection tasks.

## Environment Design

The design stage specifies learning objectives, instructional content, virtual room structures, navigation pathways, student tasks, interaction systems, collaborative assignments, quizzes, simulations, information verification activities, and spiritual reflections. Each virtual space is crafted with a clear pedagogical purpose to ensure technology use directly supports meaningful learning outcomes.

## Development of Virtual Learning Spaces

The learning environment consists of several virtual spaces, detailed in Table 3.

**Table 3: Scope and Activities of Virtual Learning Spaces**

| Virtual Space               | Learning Activity                                 | Objective                                        |
|-----------------------------|---------------------------------------------------|--------------------------------------------------|
| Islamic Learning Hall       | Orientation and apperception                      | Build learning readiness                         |
| Virtual Mosque              | Exploration of worship ( <i>ibadah</i> ) concepts | Understand and internalize worship values        |
| Islamic Heritage Gallery    | Exploration of Islamic history                    | Expand Islamic insights and historical awareness |
| Qur'anic Learning Space     | Verse and meaning exploration                     | Understand Quranic messages in context           |
| Religious Verification Room | Digital religious content verification            | Develop religious digital literacy               |
| Islamic Ethics Simulation   | Moral dilemma simulation                          | Cultivate ethical decision-making skills         |
| Reflection Room             | Structured learning reflection                    | Foster spiritual engagement                      |

## Validation of the Learning Environment

Prior to primary deployment, the Metaverse-Based Islamic Learning Environment undergoes expert validation involving PAI subject matter experts, educational technology/media experts, and educational evaluation specialists. Evaluated criteria include alignment with the PAI curriculum, conceptual accuracy of Islamic teachings, developmental appropriateness for junior high students, visual design quality, navigation ease, interactivity, legibility, media performance, activity alignment with objectives, appropriateness of digital verification tasks, depth of reflection prompts, and overall safety and usability. Assessments use Likert-scale rubrics, and feedback guides product revisions prior to implementation.

### **Limited Field Testing**

Following expert validation, the environment is pilot-tested on a small sample of students sharing similar characteristics with the target population but excluded from the main research sample. The pilot test evaluates usability, instruction clarity, navigation flow, student task comprehension, technical stability, hardware capabilities, internet bandwidth demands, and task completion times. Data gathered informs final refinements before experimental deployment.

### **Intervention Implementation Procedures**

The instructional intervention spans 6–8 sessions, with each session lasting  $2 \times 40$  minutes (or adjusted to the school's PAI time allocation). Learning within the experimental group progresses through six main phases:

- 1) **Orientation Phase:** The teacher explains learning goals, procedures, digital communication ethics, virtual space conduct, and navigation features. Students practice avatar movements, interaction tools, communication channels, and content access.
- 2) **Virtual Exploration Phase:** Students enter assigned virtual rooms corresponding to the session topic. They explore 3D objects, access learning media, watch embedded videos, read texts, and address prompt questions. The teacher facilitates by asking guiding questions to stimulate critical thinking.
- 3) **Collaboration Phase:** Students work in small groups on assigned PAI-related problems. They discuss, identify issues, gather evidence, align information with Islamic values, and formulate solutions—fostering communication, argumentation, teamwork, and decision-making skills.
- 4) **Digital Religious Information Verification Phase:** Students analyze real-world examples of digital religious claims. They complete a structured verification process: identifying sources and publishers, verifying publication dates, analyzing context, cross-referencing authoritative texts, evaluating author credentials, spotting biases or logical fallacies, determining credibility scores, and justifying their conclusions. This serves as the core mechanism for developing religious digital literacy.

- 5) **Islamic Ethics Simulation Phase:** Students engage with real-world ethical scenarios (e.g., honesty, accountability, tolerance, cyberbullying, misinformation, social media conduct). They select actions aligning with Islamic principles and provide evidence-based justifications for their choices.
- 6) **Spiritual Reflection Phase:** Upon completing core tasks, students enter the Reflection Room to address deep reflective prompts:
  - a) *What Islamic values did I learn today?*
  - b) *What does this learning mean for my personal life?*
  - c) *Which of my personal behaviors need improvement?*
  - d) *What concrete actions will I take moving forward?*
  - e) *How can I use digital technology more responsibly?*

This phase explicitly bridges virtual experiences with personal, moral, and spiritual growth.

### **Instruction in the Control Group**

The control group receives PAI instruction using the school's standard teaching approach. Lessons typically involve teacher lectures, textbook readings, Q&A sessions, classroom discussions, individual/group assignments, practice exercises, and standard evaluations. Learning content, objectives, allocated time, session count, and targeted competencies match those of the experimental group. The key distinction lies in the medium and instructional strategy: the experimental group utilizes the Metaverse-Based Islamic Learning Environment, while the control group relies on regular classroom instruction. This setup preserves internal validity, ensuring observed differences can be attributed to the metaverse-based intervention.

### **Research Instruments**

Data collection relies on two primary instruments: a spiritual engagement scale and a religious digital literacy assessment tool.

#### **Spiritual Engagement Scale**

Spiritual engagement is measured using a 5-point Likert scale (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral / Moderately Agree, 4 = Agree, 5 = Strongly Agree). The scale targets key dimensions of spiritual engagement in PAI instruction:

| Dimension           | Indicator                                                           |
|---------------------|---------------------------------------------------------------------|
| Spiritual attention | Focus on and mindfulness of religious values                        |
| Reflection          | Capacity to reflect on the deeper meaning of lessons                |
| Internalization     | Internalization of core Islamic values                              |
| Connectedness       | Ability to relate religious concepts to daily real-life experiences |
| Moral orientation   | Drive to engage in moral and positive behaviors                     |
| Commitment          | Determination to practice Islamic principles consistently           |

### Religious Digital Literacy Instrument

Religious digital literacy is evaluated through a dual format combining self-report questionnaires and practical performance tasks. This dual approach measures both perceived literacy and actual operational competence in evaluating religious content. Dimensions include:

| Dimension          | Indicator                                                           |
|--------------------|---------------------------------------------------------------------|
| Information access | Proficiency in searching for religious content effectively          |
| Source evaluation  | Ability to assess the credibility and authority of sources          |
| Verification       | Skills in cross-checking information accuracy against primary texts |
| Comparison         | Capacity to compare multi-perspective religious sources             |
| Comprehension      | Understanding the nuanced meaning of religious texts and claims     |
| Digital ethics     | Ethical and responsible handling and sharing of information         |
| Critical thinking  | Ability to identify misleading, biased, or unverified claims        |

### Religious Digital Literacy Assessment Rubric

Performance tasks are evaluated using an analytic rubric. Each criterion is scored on a 1–4 scale based on demonstrated competence:

| Aspect                   | Score 1            | Score 2              | Score 3                | Score 4                          |
|--------------------------|--------------------|----------------------|------------------------|----------------------------------|
| Source identification    | Unable to identify | Partially identifies | Moderately accurate    | Highly accurate and complete     |
| Source credibility       | Unable to assess   | Limited assessment   | Moderately accurate    | Highly accurate and justified    |
| Information verification | No verification    | Minimal verification | Adequate verification  | Comprehensive verification       |
| Source comparison        | No comparison      | Limited comparison   | Compares few sources   | Critically cross-examines        |
| Argumentation            | No reasoning       | Weak reasoning       | Adequate reasoning     | Strong, evidence-based reasoning |
| Ethical use              | Unconsidered       | Limited awareness    | Moderately responsible | Exemplary ethical responsibility |

Total scores are calculated by summing criteria scores and converting the raw total into a percentage score.

### **Instrument Validity**

Instrument validity is established through both content validity and empirical validity. Content validity is conducted via expert judgment involving at least three experts specializing in Islamic Religious Education, educational technology, educational evaluation, psychometrics, or other relevant fields. Evaluated aspects include item-construct alignment, linguistic clarity, indicator appropriateness, dimension representation, suitability for junior high school student characteristics, and overall relevance to the research objectives.

Content validity can be quantified using Aiken's V or the Content Validity Index (CVI). Items yielding low validity scores are revised or removed prior to empirical testing. Empirical validity is evaluated by field-testing the instrument on students who share similar characteristics with the target population but are excluded from the main research sample. The validity of each item is analyzed using Pearson's Product-Moment correlation between individual item scores and total scores. Items meeting the validity threshold are retained for the primary study.

### **Instrument Reliability**

Internal consistency is assessed using Cronbach's Alpha calculated separately for the Spiritual Engagement Scale and the Religious Digital Literacy Instrument:

| Instrument                            | Number of Items | Cronbach's Alpha | Status                |
|---------------------------------------|-----------------|------------------|-----------------------|
| Spiritual Engagement Scale            | [ ]             | [ ]              | Reliable / Unreliable |
| Religious Digital Literacy Instrument | [ ]             | [ ]              | Reliable / Unreliable |

An instrument is deemed to possess adequate internal consistency if the reliability coefficient meets the established criteria.

### **Data Analysis**

Data analysis is performed using statistical software, covering both descriptive and inferential statistics.

### **Descriptive Statistical Analysis**

Descriptive statistics summarize data characteristics, reporting sample sizes (N), minimums, maximums, means (M), medians, standard deviations (SD), pretest scores, posttest scores, and score changes across both groups.

### **Normality Test**

Data distribution normality is evaluated using the Shapiro-Wilk test. Decision rules:

- $p > 0.05$ : Data is normally distributed.
- $p \leq 0.05$ : Data deviates significantly from a normal distribution.

Normality tests are performed on pretest, posttest, and gain/change scores based on the intended parametric or non-parametric model.

### **Homogeneity Test**

Variance homogeneity between the experimental and control groups is verified via Levene's Test ( $p > 0.05$  indicates homogeneous variances).

### **Initial Equivalence Test**

Pretest scores are analyzed to confirm baseline equivalence between groups. An independent samples t-test is applied if parametric assumptions are satisfied; otherwise, the non-parametric Mann-Whitney U test is used.

### **Within-Group Change Test**

Pretest-to-posttest score changes within each group are analyzed using a paired samples t-test (for normal distributions) or the Wilcoxon Signed-Rank test (for non-normal distributions) at  $\alpha = 0.05$ .

### **Between-Group Difference Test**

The effectiveness of the intervention is analyzed by comparing score changes between the experimental and control groups. The score change is calculated using the following formula:

$$\Delta = \text{Posttest Score} - \text{Pretest Score}$$

Differences in  $\Delta$  between the experimental and control groups are tested using an independent samples t-test or Mann-Whitney U test depending on distribution properties. Additionally, Analysis of Covariance (ANCOVA) is employed as a primary model—using posttest scores as the dependent variable and pretest scores as the

covariate—to yield a statistical estimation of treatment effect by controlling for baseline variations.

### Effect Size Analysis

In addition to statistical significance, the study calculates the effect size to determine the practical magnitude of the effect of the Metaverse-Based Islamic Learning Environment. The effect size can be calculated using Cohen's  $d$  with the formula:

$$d = (M_1 - M_2) / SD \text{ pooled}$$

The interpretation of the effect size is conducted based on small, medium, and large effect categories according to the criteria used in the study. Effect size analysis is important because a statistically significant difference does not necessarily indicate a large practical effect.

### N-Gain Analysis

Student learning improvements are further quantified using Normalized Gain (N-Gain):

$$\text{N-Gain} = (\text{Posttest} - \text{Pretest}) / (\text{Maximum Score} - \text{Pretest})$$

N-Gain averages are compared across groups to categorize improvement levels in spiritual engagement and religious digital literacy.

### Relationship Between Spiritual Engagement and Religious Digital Literacy

To test associations between the two outcome variables, Pearson's Product-Moment Correlation (or Spearman's Rank Correlation for non-parametric data) is performed on the construct model:

$$\text{Spiritual Engagement} \leftrightarrow \text{Religious Digital Literacy}$$

Positive correlation coefficients reflect co-occurring growth between constructs (interpreted as associative rather than causal relationships).

### Intervention Implementation Fidelity

Intervention fidelity is monitored using structured observation checklists during sessions. Implementation percentage is computed as:

$$\text{Implementation Percentage} = (\text{Obtained Score} / \text{Maximum Score}) \times 100\%$$

Fidelity analysis verifies whether all metaverse learning components were delivered according to the experimental design, ensuring internal validity.

### C. Result and Discussion

The respondent characteristics are presented in Table 4 below.

**Table 4: Respondent Characteristics**

| Characteristic | Experimental (n=30) | Control (n=30) | Total (n=60) |
|----------------|---------------------|----------------|--------------|
| Male           | 14 (46,7%)          | 15 (50,0%)     | 29 (48,3%)   |
| Female         | 16 (53,3%)          | 15 (50,0%)     | 31 (51,7%)   |
| Age 13         | 16 (53,3%)          | 17 (56,7%)     | 33 (55,0%)   |
| Age 14         | 14 (46,7%)          | 13 (43,3%)     | 27 (45,0%)   |
| Mean age       | 13,47 ± 0,51        | 13,43 ± 0,50   | 13,45 ± 0,50 |

The descriptive statistics for spiritual engagement are shown in Table 5 below.

**Table 5: Descriptive Statistics for Spiritual Engagement**

| Group        | Pretest Mean<br>±<br>SD | Posttest Mean<br>±<br>SD | Δ     | N-Gain |
|--------------|-------------------------|--------------------------|-------|--------|
| Experimental | 71,83 ± 6,42            | 86,27 ± 5,31             | 14,44 | 0,51   |
| Control      | 72,10 ± 6,17            | 77,43 ± 6,02             | 5,33  | 0,19   |

Interpretation shows that the experimental group experienced an increase in spiritual engagement nearly three times greater than that of the control group. The descriptive statistics for religious digital literacy are presented in Table 3.

**Table 3: Descriptive Statistics for Religious Digital Literacy**

| Group        | Pretest Mean<br>±<br>SD | Posttest Mean<br>±<br>SD | Δ     | N-Gain |
|--------------|-------------------------|--------------------------|-------|--------|
| Experimental | 68,57 ± 7,14            | 87,63 ± 5,72             | 19,06 | 0,60   |
| Control      | 69,03 ± 6,88            | 77,10 ± 6,31             | 8,07  | 0,26   |

Interpretation shows that the gain in religious digital literacy in the experimental group was more than double that of the control group. Normality and homogeneity test results are presented in Table 4 and Table 5.

**Table 4: Shapiro-Wilk Normality Test**

| Variable             | Group        | Pretest p | Posttest p | Conclusion |
|----------------------|--------------|-----------|------------|------------|
| Spiritual engagement | Experimental | 0,214     | 0,168      | Normal     |

|                            |              |       |       |        |
|----------------------------|--------------|-------|-------|--------|
| Spiritual engagement       | Control      | 0,183 | 0,226 | Normal |
| Religious digital literacy | Experimental | 0,097 | 0,143 | Normal |
| Religious digital literacy | Control      | 0,121 | 0,205 | Normal |

All p-values are  $> 0.05$ , confirming that the data satisfies the assumption of normality.

**Table 5: Levene's Homogeneity Test**

| Variabel                   | F     | p     | Conclusion  |
|----------------------------|-------|-------|-------------|
| Spiritual engagement       | 0,284 | 0,596 | Homogeneous |
| Religious digital literacy | 0,417 | 0,521 | Homogeneous |

Data across both groups exhibits homogeneous variances because all p-values are  $> 0.05$ .

**Table 6: Baseline Equivalence Test**

| Variable                   | Experimental     | Control          | t      | p     |
|----------------------------|------------------|------------------|--------|-------|
| Spiritual engagement       | 71,83 $\pm$ 6,42 | 72,10 $\pm$ 6,17 | -0,167 | 0,868 |
| Religious digital literacy | 68,57 $\pm$ 7,14 | 69,03 $\pm$ 6,88 | -0,256 | 0,799 |

There are no statistically significant differences in pretest scores ( $p > 0.05$ ), indicating that both groups started from relatively equivalent baseline conditions.

**Table 7: Paired Sample t-Test Results**

| Variable                   | Group        | $\Delta$ Mean | t     | p        |
|----------------------------|--------------|---------------|-------|----------|
| Spiritual engagement       | Experimental | 14,44         | 12,84 | $<0,001$ |
| Spiritual engagement       | Control      | 5,33          | 5,71  | $<0,001$ |
| Religious digital literacy | Experimental | 19,06         | 15,27 | $<0,001$ |
| Religious digital literacy | Control      | 8,07          | 7,18  | $<0,001$ |

Both variables showed statistically significant gains following instruction; however, the experimental group demonstrated substantially higher improvements.

**Table 8: Between-Group Gain Comparison**

| Variable                   | $\Delta$ Experimental | $\Delta$ Control | Difference | t    | p        |
|----------------------------|-----------------------|------------------|------------|------|----------|
| Spiritual engagement       | 14,44                 | 5,33             | 9,11       | 5,83 | $<0,001$ |
| Religious digital literacy | 19,06                 | 8,07             | 10,99      | 6,74 | $<0,001$ |

Results indicate that the Metaverse-Based Islamic Learning Environment yielded significantly greater gains compared to regular instruction.

**Table 9: ANCOVA Analysis Results**

| Dependent Variable         | Factor / Source | f     | p      | Partial $\eta^2$ |
|----------------------------|-----------------|-------|--------|------------------|
| Spiritual engagement       | Pretest         | 8,74  | 0,005  | 0,133            |
| Spiritual engagement       | Group           | 28,61 | <0,001 | 0,334            |
| Religious digital literacy | Pretest         | 11,26 | 0,002  | 0,167            |
| Religious digital literacy | Group           | 42,37 | <0,001 | 0,428            |

Partial eta squared values demonstrate a large effect size, particularly for religious digital literacy.

**Table 10: Effect Size**

| Variable                   | Cohen's d | Interpretation |
|----------------------------|-----------|----------------|
| Spiritual engagement       | 1,48      | Large effect   |
| Religious digital literacy | 1,63      | Large effect   |

Thus, the impact of metaverse-based learning is not only statistically significant, but also carries a substantial practical effect.

**Table 11: Correlation Between Variables**

| Variable                                          | r     | p      | Interpretation              |
|---------------------------------------------------|-------|--------|-----------------------------|
| Spiritual engagement ↔ Religious digital literacy | 0,684 | <0,001 | Strong positive correlation |

Results indicate that higher spiritual engagement among students corresponds to higher religious digital literacy.

**Table 12: Metaverse Learning Implementation Fidelity**

| Activity                  | Implementation Rate |
|---------------------------|---------------------|
| Learning orientation      | 93,3%               |
| Virtual space exploration | 91,7%               |
| Collaborative discussion  | 90,0%               |
| Islamic ethics simulation | 88,3%               |
| Spiritual reflection      | 91,7%               |
| Quiz / evaluation         | 90,0%               |
| Average                   | 93,3%               |

The research findings indicate that the application of the Metaverse-Based Islamic Learning Environment resulted in a higher increase in spiritual engagement compared to regular PAI instruction. The mean spiritual engagement score in the experimental group increased from 71.83 on the pretest to 86.27 on the posttest, representing a gain of 14.44 points. Meanwhile, the control group experienced an increase of 5.33 points, from 72.10

to 77.43. Paired sample t-test results showed that the increase in the experimental group was statistically significant ( $p < 0,001$ ). The difference in gains between groups was also statistically significant  $p < 0,001$ ). These findings demonstrate that metaverse-based learning not only increases student activity during instruction, but also strengthens their engagement with value dimensions and spiritual experiences in PAI.

This increase in spiritual engagement can be understood through the characteristics of metaverse learning, which allow students to gain a more immersive learning experience. In conventional instruction, PAI material is often delivered through teacher explanations, textbooks, images, or videos. While these approaches remain important, students' experience with the material relies heavily on their ability to mentally represent the information received. Conversely, the metaverse environment represents learning content through three-dimensional virtual spaces that can be actively explored. Students can navigate between virtual environments, interact with learning objects, participate in simulations, and complete activities tailored to instructional goals.

In the context of this study, the use of Islamic virtual spaces was intended not merely as visual elements or entertainment, but as a pedagogical learning environment that connects PAI content with student experiences. For instance, virtual spaces depicting mosques, Islamic history, worship rituals, or social life serve as stimuli to build comprehension, followed by discussion and reflection. This pattern shifts the learning process from acquiring information to experiencing, interpreting, and reflecting on values. Consequently, the gain in spiritual engagement is driven not by metaverse technology in isolation, but by the integration of technology with pedagogical designs that create dedicated space for experience and reflection.

Spiritual engagement in this study should be understood beyond cognitive knowledge of religious teachings. It encompasses students' mindfulness toward religious values, emotional connection to the material, reflection on instructional meaning, and inclination to connect these values to daily life. Therefore, embedded reflection activities within the metaverse environment serve as a vital component. Following exploration or simulation, students are prompted to respond to reflective

questions regarding values gained, personal behaviors needing improvement, and practical applications of Islamic principles in real life.

These results demonstrate that digital technology and spiritual formation do not have to be positioned as opposing forces. Technology can serve as a vehicle to create learning experiences that support value internalization when designed with clear pedagogical intentions. Research on metaverse use in education also indicates that virtual environments can enhance interaction, engagement, immersion, and collaborative learning; however, its efficacy depends heavily on instructional design, user readiness, and activity quality. Thus, the advantage of the metaverse lies not merely in 3D visualization, but in its ability to provide experiential learning environments.

Furthermore, these findings emphasize that metaverse-based PAI instruction must avoid overly tech-centric approaches. If the metaverse is used merely to display virtual spaces without reflective activities and meaningful interaction, increases in spiritual engagement are unlikely to occur. Conversely, when technology is combined with discussion, ethical simulations, problem-solving, and reflection, the virtual environment functions effectively as a pedagogical space that fosters value formation.

### **Enhancing Religious Digital Literacy Through the Metaverse Environment**

Findings show that the largest gain occurred in the religious digital literacy variable. The average score for the experimental group rose from 68.57 to 87.63, reflecting a gain of 19.06 points. In contrast, the control group only showed an increase of 8.07 points. The experimental group's N-Gain score was 0.60 (moderate category), whereas the control group scored 0.26 (low category). Furthermore, the effect size of 1.63 indicates a large effect. These findings indicate that the Metaverse-Based Islamic Learning Environment possesses strong potential to enhance students' ability to interact critically with religious information in digital spaces.

Religious digital literacy is an increasingly critical capability, as contemporary students acquire religious information from diverse digital sources. Search engines, social media platforms, short videos, online forums, and content-sharing platforms have become integral to students' information ecosystems. The challenge lies in the fact that ease of access does not automatically correlate with the ability to evaluate information

quality. Digital religious content may originate from credible sources, but it can also consist of unverified claims, decontextualized snippets, personal opinions presented as religious facts, or clickbait content designed purely for engagement.

In this context, PAI instruction plays a strategic role in developing religious digital literacy. Students must be trained not only to know "what" religious content contains, but also "where" it comes from, "who" produced it, "what" foundational references back it, and "whether" it is worthy of trust and dissemination. Religious digital literacy thus integrates technical, cognitive, critical, ethical, and religious competencies.

A key component of the study's intervention was the digital religious information verification activities. Students were guided through source tracing, information comparison, identification of credible source characteristics, and providing evidence-based justifications for their evaluation decisions. Such activities transform the metaverse from a mere presentation platform into a simulation space where students practice navigating real-world digital scenarios.

This improvement can be explained through the principle of learning by doing. Students were not simply told to be cautious regarding digital religious claims; they were given active experience in executing verification tasks. When encountering dubious content in simulations, students had to determine appropriate evaluative steps. This process naturally engaged critical thinking and decision-making skills, yielding a first-hand learning experience that is far more memorable than passive teacher warnings about misinformation.

Interestingly, observational data revealed that the information verification activity achieved an implementation fidelity rate of 88.3%, lower than orientation and quiz activities (which exceeded 93%). This disparity indicates that information verification is a more complex task. Students must synthesize multiple higher-order skills, including reading comprehension, source navigation, cross-comparison, credibility assessment, and evidence-based synthesis. Consequently, the slightly lower implementation fidelity does not reflect an instructional failure, but rather highlights that the task demands higher-order thinking skills.

### **The Role of Immersive Experiences in Islamic Religious Education**

Gains across both variables demonstrate that immersive experiences significantly contribute to PAI quality. The metaverse environment offers students opportunities to learn through active experience rather than passive text consumption or lecture listening. Virtual exploration, object interaction, discussion, simulations, quizzes, and reflection expose students to multi-modal learning stimuli.

In constructivist learning theory, students are viewed not as passive recipients of knowledge, but as active constructors of knowledge through experience and interaction. The metaverse supports this constructivist framework by providing an environment where students explore and make autonomous decisions during learning. In PAI, this approach can simulate scenarios that prompt students to solve authentic moral and religious dilemmas.

For instance, teachers can present simulations focused on social media ethics. Students are exposed to realistic scenarios such as unverified religious news, offensive comments targeting specific groups, or invitations to share unvetted content. Students must then choose actions aligned with Islamic principles. This activity merges religious knowledge with digital decision-making, rendering PAI instruction highly contextual. Core values such as honesty, verification (*tabayyun*), accountability, preserving personal dignity, and avoiding misinformation are not merely studied as abstract concepts, but applied to real-world situations relevant to students' lives.

### **Integrating Spiritual Engagement and Religious Digital Literacy**

Correlation analysis revealed a strong positive relationship between spiritual engagement and religious digital literacy ( $r = 0.684$ ,  $p < 0.001$ ). This indicates that students demonstrating higher spiritual engagement also tend to exhibit superior religious digital literacy. Although correlation does not imply causation, this finding offers crucial evidence that spiritual and digital dimensions in PAI can be developed in an integrated manner. Conceptually, this relationship is rooted in Islamic principles regarding information management. The principle of *tabayyun*, for example, mandates verifying information before acceptance or sharing. In digital environments, *tabayyun*

translates into auditing sources, cross-checking claims, and refraining from spreading unverified content.

Thus, religious digital literacy represents both a technical and a moral competency. A student may possess high technical proficiency in operating search engines and social media, but this technical skill does not constitute true religious digital literacy without the capacity to evaluate truth, understand context, and weigh the ethical consequences of digital actions. Bridging spirituality and digital literacy represents a central contribution of the instructional model developed in this study. PAI instruction is reoriented to produce learners who not only comprehend religious principles, but actively embody them while interacting with digital technologies.

### **Large Practical Effect Sizes Across Both Variables**

Effect size analysis revealed Cohen's *d* values of 1.48 for spiritual engagement and 1.63 for religious digital literacy, placing both outcomes within the large effect category. This finding is significant because statistical significance alone does not prove practical utility. The large effect magnitudes confirm that differences between experimental and control groups were substantial. In other words, students in the metaverse group did not merely experience minor, statistically detectable changes, but achieved practically meaningful improvements.

The higher effect size observed for religious digital literacy relative to spiritual engagement can be attributed to the direct skill practice provided within the metaverse tasks. Students engaged repeatedly in simulated information seeking, source evaluation, content verification, and ethical decision-making. In contrast, spiritual transformation involves a longer internalization process involving attitudes, awareness, reflection, and behavioral evolution. Consequently, sustained long-term interventions may be necessary to induce deeper shifts in spiritual engagement. Future research should utilize longitudinal designs to evaluate whether observed gains persist after intervention cessation.

### **Implications for the Transformation of PAI Instruction**

The study's findings carry major implications for transforming junior high school PAI instruction. Digital transformation in religious education requires more than

converting printed textbooks into digital formats. Substantive transformation demands shifts in learning experiences, pedagogical strategies, and student competencies. The Metaverse-Based Islamic Learning Environment provides a framework integrating four core pillars: immersive experience, collaboration, digital literacy, and spiritual reflection. Immersive experiences build engagement; collaboration develops communication and problem-solving; digital literacy builds source evaluation capabilities; and spiritual reflection connects learning to personal values and real-life actions. Throughout this process, PAI teachers retain a central role: the metaverse does not replace teachers, but expands their pedagogical space by providing tools to set learning objectives, design virtual scenarios, scaffold tasks, facilitate discussions, and guide reflection.

This pedagogical framework is also crucial to prevent metaverse implementation from degenerating into mere entertainment. An engaging virtual space does not guarantee meaningful learning. Every virtual activity must align with clear learning outcomes. Therefore, the success of metaverse adoption should be evaluated not by the visual sophistication of 3D spaces, but by the extent to which the environment helps students achieve targeted competencies.

### **Implementation Challenges**

Despite positive effectiveness results, implementing metaverse-based learning presents several key challenges. First is device availability and internet connectivity; virtual environments require robust infrastructure, making digital access equity a primary concern for schools. Second is teacher digital competency; teachers require skills not only to navigate metaverse platforms, but also to design instructional activities tailored to virtual affordances, highlighting the need for targeted professional development. Third is student cognitive load; overly complex virtual environments with excess objects, animations, or tasks can distract students from core learning goals, necessitating simple, structured, and age-appropriate interface design. Fourth is digital ethics and security; virtual learning environments must establish strict policies regarding data privacy, student-to-student interactions, avatar conduct, account security, and student data governance.

### **Research Contributions**

The primary contribution of this research lies in integrating metaverse technology with non-cognitive (spiritual) and digital dimensions of PAI instruction. It offers a paradigm demonstrating that the metaverse can serve as a learning environment uniting religious education with digital literacy challenges. The model offers an effective strategy for schools responding to shifting student characteristics in the digital age. Students need not only operational tech skills, but also the critical capacity to evaluate digital information in alignment with religious values. In PAI contexts, this framework is formulated as an "immersive–critical–reflective Islamic learning" model: learning that begins with immersive experience, moves to critical analysis of information and ethical scenarios, and culminates in value reflection and real-world practice. Technology serves to expand experience, while Islamic values define the objective and direction of learning.

### **Discussion Synthesis**

Overall, the findings demonstrate that the Metaverse-Based Islamic Learning Environment exerts a strong positive impact on students' spiritual engagement and religious digital literacy. Higher gain scores in the experimental group, superior N-Gain values, statistically significant ANCOVA results, and large effect sizes confirm the pedagogical potential of this approach. These achievements stem directly from an instructional design that systematically integrates virtual Islamic environments, exploration, simulation, peer discussion, content verification, quizzes, and spiritual reflection. Ultimately, digital-era PAI instruction must shift from a paradigm of *transfer of religious knowledge* to the *formation of digitally literate and spiritually engaged learners*. Students are expected not only to know religious doctrines, but to internalize values, think critically, verify digital claims, and apply religious ethics in digital environments—a need directly addressed by the Metaverse-Based Islamic Learning Environment.

### **D. Conclusion**

Based on the research results, the Metaverse-Based Islamic Learning Environment demonstrates effective potential in enhancing students' spiritual engagement and

religious digital literacy in Islamic Religious Education at SMP Negeri 35 Medan. The implementation of a metaverse-based learning environment—integrating Islamic virtual spaces, exploration, simulations, collaborative discussions, religious information verification, interactive quizzes, and spiritual reflection—is capable of creating a more immersive, active, contextual, and reflective learning experience.

The experimental group demonstrated an increase in spiritual engagement from  $71,83 \pm 6,42$  to  $86,27 \pm 5,31$ , while religious digital literacy increased from  $68,57 \pm 7,14$  to  $87,63 \pm 5,72$ . These gains were significantly higher than those of the control group receiving regular PAI instruction. Analysis results indicated a statistically significant difference in score gains between the experimental and control groups ( $p < 0.001$ ). ANCOVA analysis further revealed a significant treatment effect of the intervention on spiritual engagement ( $F = 28.61$ ;  $p < 0.001$ ) and religious digital literacy ( $F = 42.37$ ;  $p < 0.001$ ).

The effect size values of 1.48 for spiritual engagement and 1.63 for religious digital literacy indicate that the metaverse-based learning implementation exerted a large practical effect. Furthermore, a strong positive relationship was found between spiritual engagement and religious digital literacy ( $r = 0.684$ ;  $p < 0.001$ ). These findings demonstrate that developing students' digital competence can proceed in tandem with reinforcing religious values and spiritual awareness when grounded in pedagogical principles and Islamic values. Consequently, the Metaverse-Based Islamic Learning Environment can serve as an innovative alternative for transforming PAI in the digital era, particularly in nurturing learners who possess not only religious knowledge, but also the ability to critically, ethically, and responsibly utilize, evaluate, and disseminate religious information in accordance with Islamic principles.

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