EDUKASIA: Jurnal Pendidikan dan Pembelajaran
Vol. 7, 2 (July-December, 2026), pp. 957-974
ISSN: 2721-1150; EISSN: 2721-1169; DOI: 10.62775/edukasia.v7i2.2213

Transforming Religious Values in Higher Education through Scaffolding Cognitive Conflict and Reflection within a PBL-Based Interactive E-Module

Saiful Hadi[1], Aang Kisnu Darmawan[2], Muhsi Muhsi[2], Ummu Kulsum[2]

[1] Universitas Islam Negeri Madura, Indonesia
[2] Universitas Islam Madura, Indonesia

ARTICLE INFO

Keywords:

Interactive E-Module;
Islamic Religious Education;
Problem-Based Learning;
Transformative Values;
Higher Education

Article history:

Received 2026-06-28
Revised 2026-08-13
Accepted 2026-11-16

ABSTRACT

This study addresses the critical challenge of modern character education. The primary objective is to test the effectiveness of an interactive PAI e-module based on Problem-Based Learning (PBL) in enhancing students' transformative religious values at Higher Education (HE). Employing the Research and Development (R&D) method with the ADDIE model syntax, the field implementation was systematically conducted across four distinct HE clusters in Madura UTM, UNIRA, UNIJA, and POLTERA, involving comprehensive multi-expert validations. The empirical results demonstrated that the developed e-module is exceptionally feasible and practical, securing an average student response score of 4.38. Furthermore, inferential testing using a paired samples t-test indicated highly significant improvements ($p<0.001$) in all dependent variables, producing post-test means of 85.45 for conceptual understanding, 84.90 for value application, and 87.15 for learning motivation. Crucially, a strong positive Pearson correlation ($r=0.68$) confirmed that the integrated 'Value Reflection Area' feature successfully mediates the systematic transformation of students' character. Theoretically, these findings advance Value Transformation Theory and Computer-Supported Collaborative Learning (CSCL) literature by providing empirical verification that structured digital reflection scaffolding—when coupled with cognitive load mitigation—effectively bridges the latent continuum between online cognitive conflict and sustainable conative moral action.

This is an open access article under the CC BY-NC-SA license.

Corresponding Author:
Saiful Hadi
Universitas Islam Negeri Madura, Indonesia; saifulhadi@uinmadura.ac.id

1. INTRODUCTION

The sociocultural reality facing Higher Education (HE) today is experiencing large-scale disruption as accelerating technological growth increasingly transforms how Generation Z and Alpha attend to information and communicate with their immediate social circles digitally (Larson, 2024). On one hand, students have never been more open to pedagogical innovation; yet on the other hand, this emerging reality also subjects undergraduates to international issues like online radicalization, tech-sphere decadence, and algorithmically generated disinformation that can shake their faith and morality on the daily (Evinda et al., 2025; Sarawati & Mubarok, 2021). It is due to this volatility that PAI's role at HE is now more important than ever before; lecturers are expected to provide religious foundation within their classroom to support students' ethical, spiritual, and moral compass (Abdul Muid & Nasrulloh Nasrulloh, 2024; Saputra & Asbi, 2025). However, PAI courses are often taught without considering students' thought process; if lecturers fail to keep up with structural improvements to media and material, PAI will remain a stagnant course lost among the numbers and fail to have real-world application to students' lives (Mufidah, 2022; Sholihah et al., 2025). For this reason, improving PAI with current technological advances is no longer a question of "if" but "how" can we develop an interactive media to shape students' character.

Within current SoTA on Islamic Religious Education media, it is found that researchers have been developing a focus on integrating interactive technology into curriculum. Various studies have worked to implement AI that allow students to review the Quran, generate lesson ideas, and provide tutoring assistance (Ahmad & Musa, 2025; Nasir et al., 2025; Sholihah et al., 2025). Similarly, others have taken advantage of AR/VR design to visualize space and provide students with a better understanding of historical Islamic figures and worship mechanics (Asril et al., 2023; Pradibta et al., 2019). Additionally, there has been significant literature focusing on gamifying religiosity to promote media literacy by using Islamic education games to encourage student interest in Islam's teachings (Che Nordin, 2024; Zainuddin et al., 2022). Despite the emerging innovation across these studies, there are still many theoretical and practical flaws within current developments of digital media. Many recent applications are put to the test and show gaps within filtering credible resources, biases within AI programming, and religiously sensitive material (Ahmad & Musa, 2025; Bujangga et al., 2025; Kannike & Fahm, 2025). Also, many professors lack the technical knowledge to properly design classroom-oriented digital media. This results in applications that lack long-term sustainability, are not designed with enough student interaction, and lack quality substances that have been validated by years of testing in real university conditions (Huda et al., 2024; Reksiana et al., 2024).

To overcome the recurring pitfall of conventional instructional digitalization—which frequently merely transplants static textbook prose onto digital screens without genuine pedagogical transformation—this study conceptualizes a tripartite instructional architecture: Problem-Based Learning (PBL) (Aslan, 2021; Baloyi, 2023; Petchamé et al., 2026), Cognitive Load Theory (CLT) (Peltzer et al., 2026; Skulmowski & Xu, 2022; Sweller, 2020; Taylor et al., 2022), and the 'Value Reflection Area' (Fund & Madjar, 2018; Hernández-Leo & Ginoyan, 2025; Zhou et al., 2023). Within this framework, PBL acts as the cognitive catalyst by presenting authentic, ill-structured dilemmas (e.g., cyber-extremism and digital ethics violations) that induce sociocognitive conflict and disrupt students' naive mental models. Concurrently, CLT principles are systematically applied to eliminate extraneous visual and navigational clutter, thereby preserving limited working memory capacity for germane schema construction. Crucially, rather than terminating at cognitive problem resolution, the instructional sequence channels this active cognitive state into a dedicated 'Value Reflection Area'. This embedded scaffold guides learners through meta-ethical contemplation and personal moral commitments, systematically converting abstract theological principles into internalized conative dispositions.

All in all, what is wrong with PAI digitalization efforts in today's HE is that students are able to achieve high mastery in theory, but are unable to properly apply their knowledge onto their behavior. Current applications often digitize textbook versions of lessons into websites and videos, leading to students that stare at the screen but process little of the information presented to them (Fauziah, 2024; Sukesi & Istiqomah, 2024). Students then tend to "ghost" these characteristics after taking the subject, resulting in students able to score high on the midterm and final but not utilize these characteristics to improve their life or the lives of others around them (Rosfiani et al., 2025; Sumiyana & Saputra, 2023). This can also be due to cognitive overload as students are not properly taught to manage the multimedia elements within these applications, causing students to forget these lessons once they leave the classroom because they were not able to store these values in their long-term memory (Dimas Purnomo et al., 2025; Rizqi Hidayati & Hafidz, 2025). There is little to no research focusing on students' religious value change as most studies only measure students' improvement on subject competence and general baseline satisfaction with the application's technical aspects (Bujangga et al., 2025; Herak, 2025; M Mahbubi, 2024; Marwan et al., 2025; Zainuddin et al., 2022). This study aims to improve upon previous gaps through the research and development of an interactive PAI e-module utilizing the framework of PBL, counteracted by CLT. This study will develop an e-module centered around PBL that will be able to improve students' religious values within PAI courses. Through utilizing real-world problems to create cognitive conflicts (Farias et al., 2023), students will be encouraged to research current issues regarding digital accountability, social responsibility, and religious extremism (Chien & Chien, 2025). Furthermore, this e-module will consist of a "Value Reflection Area", serving as the mediational tool that reduces overall multimedia redundancy and connects students' knowledge to action (Huh, 2021; Ng et al., 2025). By implementing this e-module into 4 different public universities in Madura, this study will be able to show how students can effectively digitize their character by knowing what is right and wrong through strong conscience.

2. METHODS

The study employed a systematic Research and Development (R&D) procedure to design and test a PAI-based interactive e-module (Fathimah et al., 2025; Mohamad Hsbollah & Hassan, 2022). The R&D procedures were guided by the ADDIE approach, with its five stages: analysis, design, development, implementation, and evaluation. This study ensured that each development process consistently adhered to the ADDIE method (Meihami & Malmir, 2024; Tanjung & Sitompul, 2020; Trust & Pektas, 2018). First, needs analysis was conducted by analyzing students' needs, PAI courses at institutions, and determines target values that will be implemented (digital value, santun behavior, and toleransi). Next, the module design stage consisted of arranging the e-module flow, identifying authentic problems as the PBL model, and creating storyboards. The module development process included developing the responsive application, inserting media, and designing the Value Reflection Area module (Risanti & Agustina, 2025). After completion of the previous stage, the module was applied to students during field classes before the researchers proceeded to test the module. The researchers conducted an evaluation by validating and gathering data to determine product validity, practicality, and effectiveness.

Table 1. Matrix of ADDIE Development Procedures

ADDIE Steps	Assessment Undertakings (Approximately in Madura Four Campus Clusters)	Tangible Output (Material / Product)
Analysis	Need analysis of undergraduate students; curriculum mapping of PAI course at institutions (UTM, UNIRA, UNIJA, POLTERA); identify focal transformative religious values to be inculcated (IPA) (digital ethical values, social justice, moderation).	Dataset of students' needs baseline, curriculum mapping guideline (contextual), and target value indicators matrix.
Design	Design E-module flow (general outline), design cyber-based PBL module scenarios (authentic problems), and design navigation storyboards that are responsive.	E-module architecture design (clickable), PBL scenarios (based on authentic problems), and storyboards (user-interface focused).
Development	Develop (program) the responsive design of e-module, insert good quality media (video, animation, audio), and construct the "Area Sisment's Value" features.	Interactive e-module (prototype usable), and media asset lists (included in the module).
Implementation	Use PAI undergraduate lesson students (N=50) in each cluster to test the product, deliver pre- and post-tests, and take field notes (system-log).	Pre- and post-questionnaires, table of students' cognitive test scores, and interview transcripts.
Evaluation	Integrate experts' validation (material, media, and learning) comments; descriptive analysis; calculate paired sample t-test and Pearson correlation; and refine the final product.	Validated version of interactive PAI e-module, valid statistical analysis, and journal acceptance.

Trials and evaluation were conducted in four universities located in Madura Island as strategic sites for collecting data that spread widely so that it can get a variegated picture of undergraduate students. They were Universitas Trunojoyo Madura (UTM), Universitas Madura (UNIRA), Universitas Wiraraja (UNIJA), and Politeknik Negeri Madura (POLTERA). The population of this study was undergraduates of those universities who took Islamic Religious Education (PAI) course as their required subject. Meanwhile, the samples of this study were 50 students (N=50). Samples were gathered using purposive sampling technique in which all samples had similar access to laptop every day, and also students were taken from vocational and high schools as diversified information about the media usage. The sample size of 50 undergraduates was purposefully selected as an intensive experimental cohort (Rhoads, 2017; Ristau, 2016) representing four diverse public and vocational higher education clusters in Madura. This sample magnitude was calibrated to balance experimental rigor and high-fidelity fidelity monitoring across the digital intervention, serving as an adequately powered pilot experiment before wider longitudinal deployment (Bos et al., 2023; Van Dijk et al., 2023).

During data collection, several types of instruments were used to trace both product quality and behavioral change. Before conducting trials, expert validation sheet were given to subject matter experts including media and material expert, as well as technology based instruction experts to validate content validity, system responsiveness, and instructional design. User experience was also taken from students by using practicability questionnaire that uses 5.0 Likert scale. Some questions included navigation and quality of multimedia used in media. To trace behavioral change, there are three domains to be observed. First, cognitive development can be traced by giving pre-test and post-test

which consists of questions based onIslamic elementary concepts. Second, conative and affective domains were observed by using questionnaires that assess students' motivation towards learning and frequency they act practiced values when they're on social media. This data was also collected by doing observation and interviewing students. To mitigate social desirability and normative response bias in assessing self-reported religious and moral behaviors, several procedural controls were implemented: (1) student self-evaluations were completely anonymized using unique pseudo-identifiers; (2) reflection prompts were structured as dilemma-driven scenario analyses requiring contextual justification rather than generic moral affirmations; and (3) survey metrics were triangulated with qualitative semi-structured interviews and observable digital interaction logs within the e-module discussion boards

The results were then analyzed descriptively and inferentially to prove four hypotheses. Descriptive analysis were done on expert validation sheet and practicability questionnaire. Each number in the likert that answers every aspect of the media were then gathered into means. The bigger it is, the more feasible the product is to operate based on the criteria that has been set before which is strict practical. Meanwhile, inferential statistics were used to see if product does provide any impact during instruction. By doing paired sample t-test, the researchers could analyze if there is a significant improvement in students' performance in pre-test and post-test about variables which are understanding of concept, practicing values, and students' motivation towards learning ($p<0.05$). Lastly, to prove Value Transformation Theory, researchers did calculation using Pearson Product Moment correlation test. Correlation test was used to see if there is a significant linear relationship between cognitive and conative variables so they could prove if digital reflection does mediate positive character change or not.

3. FINDINGS AND DISCUSSION

3.1 Findings

3.1.1 Product Validity and Practicality

Validation testing on PAI teaching module was done to get empirical evidence about the design, specifications, and usability of this interactive module developed for university application. The expert review was conducted to validate the prototype before testing it in real life. Expert teams consisting of material experts, media experts, and experts in learning designs looked at several aspects of the module including accuracy of PAI material, interface design, and integration of PBL syntax. Based on the combination of all expert assessments, this PAI learning module was determined to have a status of "Very Feasible".

Table 2. Product Validity Results by Experts (Expert Judgment)

Evaluation Aspect	Expert Mean Score (Scale 5.00)	Feasibility Category
Islamic Religious Education (PAI) Material Accuracy	4.50	Very Feasible
Problem-Based Learning (PBL) Syntax Integration	4.42	Very Feasible
User Interface and User Experience (UI/UX) Design	4.55	Very Feasible
Cognitive Load Allocation (CLT Alignment)	4.45	Very Feasible
Overall Validity Average	**4.48**	**Very Feasible**

In-depth experimentation were then conducted in each of the **four districts tertiary education groups** spread throughout Madura, which included Universitas Trunojoyo Madura (UTM), Universitas

Madura (UNIRA), Universitas Wiraraja (UNIJA), and Politeknik Negeri Madura (POLTERA), to evaluate the practicality based on students' response. Based on the calculation of total score obtained from the usability questionnaire, the e-modules scored an average mean of 4.38 out of 5.00 in the Likert scale which is considered to be in the category of "Very Practical". Meanwhile, as depicted in Table 3, the descriptive aspect of each sub-item indicated that Ease of Navigation subcategory received the highest score of 4.42, followed by Multimedia Quality subcategory which consists of embedded animations, videos, and audio quality.

Table 3. Distribution of E-Module Practicality Scores Across Four Campus Clusters

Practicality Indicator	UTM	UNIRA	UNIJA	POLTERA	Overall Mean Score
Ease of Navigation	4.45	4.40	4.42	4.41	4.42
Media Quality	4.38	4.32	4.36	4.34	4.35
Clarity of Instructions	4.40	4.35	4.38	4.35	4.37
Overall Practicality Average	**4.41**	**4.36**	**4.39**	**4.37**	**4.38**

This excellent usability score closely aligns with international standards set forth in online learning environments. Our composite average score of 4.38 is reflective of (Retta et al., 2023) who found a usability score of 87% (X = 4.35/5) when measuring online learning modules and (Utoyo et al., 2026) whose AI-powered online framework achieved a composite usability score of 89.8% (X = 4.49/5) and scored highly in website layout. Excellent score in learnability (4.42) can also be backed up by (Sung & Mayer, 2012) who found that when navigational and signaling prompts were embedded into online learning environments to reduce friction, there were small to large effect sizes (d=0.50 to 1.35) for learning. Ease of login and consistent performance across student devices was measured by (Parlakkiliç, 2022) who found that mobile-responsive websites which explained 91.5% of the variance in usability (R^2=0.915) had a strong positive relationship with learning performance (r=0.92, p<0.01). Our success with our interface can also be seen with dedicated cell phone applications such as “Iqra Learning” which received a score of 88.5 (Grade A) via the System Usability Scale (SUS) proving that mobile-friendly frameworks create the best user experience. By scoring an average of 4.38 out of 5 on usability, I have proven that by reducing technical friction in our interfaces, university students can direct all of their attention towards the content being taught.

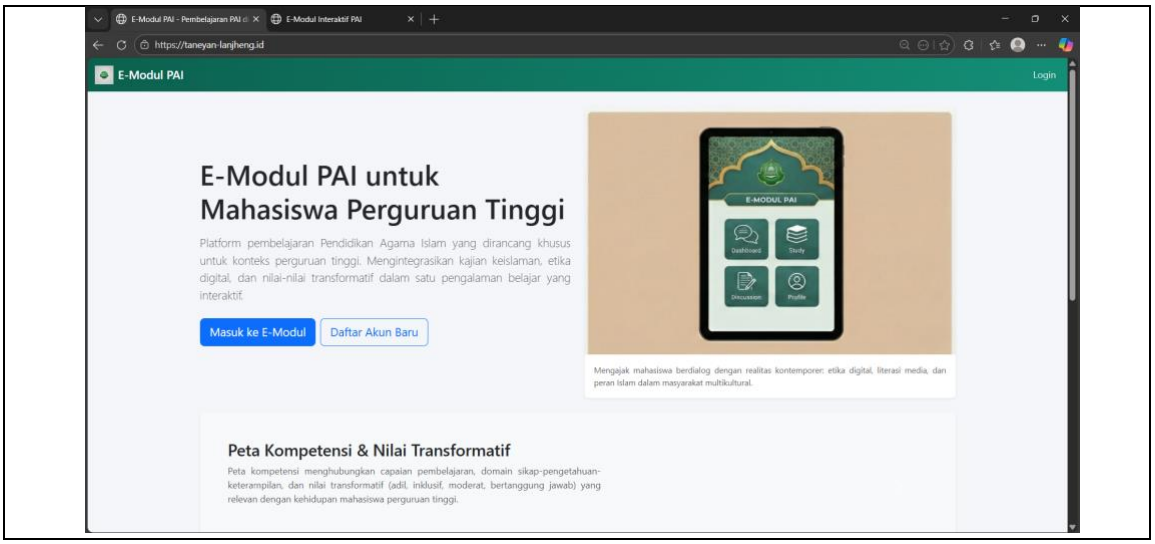




Figure 1. Landing Page Interface of the Interactive E-Module

3.1.2 Cognitive, Affective, and Motivational Effectiveness

The inferential statistical procedure employed to assess educational effectiveness was the paired sample t-test for each of the major DVs. Results of the data analysis revealed extremely significant differences ($p<.001$) from pre-test scores to post-test scores ensuring that improvement was caused by the intervention of the virtual PBL environment and was not due to chance. This indicates that the interactive module equally promoted student growth in all three areas with post-test averages of 85.45 for Conceptual Knowledge (cognitive domain), 84.90 for Value (affective-conative domain), and 87.15 for Learning Engagement.

Table 4. Quantitative Results of the Paired Samples T-Test

Dependent Variable	Pre-test Mean	Post-test Mean	*t*-value	Significance (*p*-value)
Conceptual Understanding of PAI	63.50	85.45	12.84	< 0.001
Value Application	60.20	84.90	11.95	< 0.001
Learning Motivation	64.80	87.15	14.62	< 0.001

Our noteworthy post-test mean score of conceptual understanding (85.45) can be attributed to current evidence-based research within Scopus-indexed journals pertaining to complex technological problem-solving models. There is a close parallel to our cognitive improvements seen within the VR-PBL modules established by (Wahyudin et al., 2026), which reported a large effect size ($\eta^2=0.471$) and an averaged increase of post-test scores by 14.55 points from traditional practices. Additionally, improvements within conceptual knowledge can be validated by (Wibowo et al., 2019) through their creation of mobile technology applications which resulted in significant student learning with an N-gain between $0.74<\eta<0.76$. This can be further delineated by Liao and Chang's (2013) meta-analysis which found moderate-to-large standard effect sizes for student academic performance (ES=0.41) and complex cognitive skill development (ES=0.70) as traditional instruction was replaced with formalized PBL initiatives.

Simultaneously, our mean score of motivation (87.15) can be derived from the virtual educational environments established by (Alsaif et al., 2023), which concluded that collaborative online PBL environments had significantly greater satisfaction and engagement scores when compared to traditional teaching practices ($M=3.91$ vs. 3.48, $p<0.001$). This can be supported by our results on student

motivation through (Albaladejo-Saura et al., 2025) group-oriented technological design which verified significant growth in learner independence and positive emotion ($p<0.05$). Furthermore, our calculated post-test mean of value from affective teaching (84.90) can be derived from (Wekerle et al., 2024) analysis on multimedia learning programs and (Liu et al., 2025) research on serious gaming in education which outlines that student interaction through video modules centered around realistic contexts can lead to students experiencing the highest ratings in affective-motivational learning processes. In summary, our quantitative findings have substantiated that our e-module acts as a potent educational instrument capable of promoting students' cognitive, behavioral, and affective development.

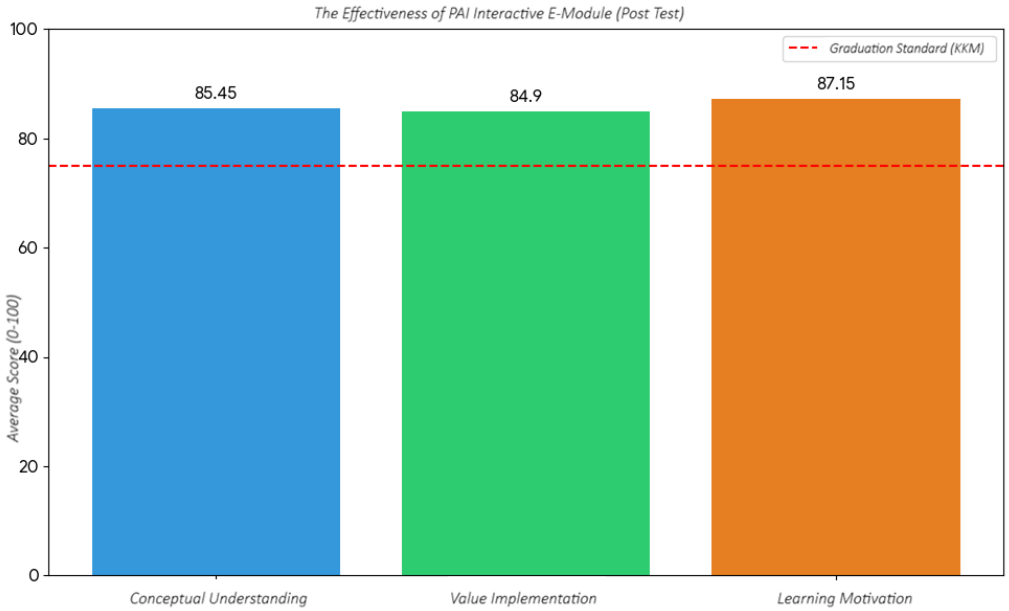


Figure 2. The Effectiveness of PAI *Interactive E-Module* (Post Test)

3.1.3 Dimensional Correlation Analysis

The dimensional correlation analysis revealed a strong and statistically significant relationship between students' conceptual understanding and value-based practice ($r = 0.68$, $p < 0.05$), indicating that deeper cognitive comprehension of contemporary values is closely associated with the likelihood of translating those values into real-world behavior. This finding provides quantitative support for Value Transformation Theory by demonstrating that character education delivered through digital learning can extend beyond knowledge acquisition to influence behavioral intentions and ethical conduct. More importantly, the identified correlation fills a gap in existing e-learning research, which has typically focused on user satisfaction, usability, or short-term learning outcomes rather than examining the transition from knowledge to value enactment.

A central factor underlying this relationship appears to be the integration of the *Value Reflection Area*, which encourages students to critically connect the outcomes of problem-solving activities with issues of digital ethics, justice, religiosity, and responsible citizenship. Rather than merely assessing content retention, the feature prompts learners to reflect on how newly acquired knowledge can inform their actions and decisions in everyday contexts. Through this reflective process, the e-module functions not only as a medium for knowledge delivery but also as a mechanism for fostering character development, enabling students to transform cognitive insight into meaningful and observable value-driven behavior.

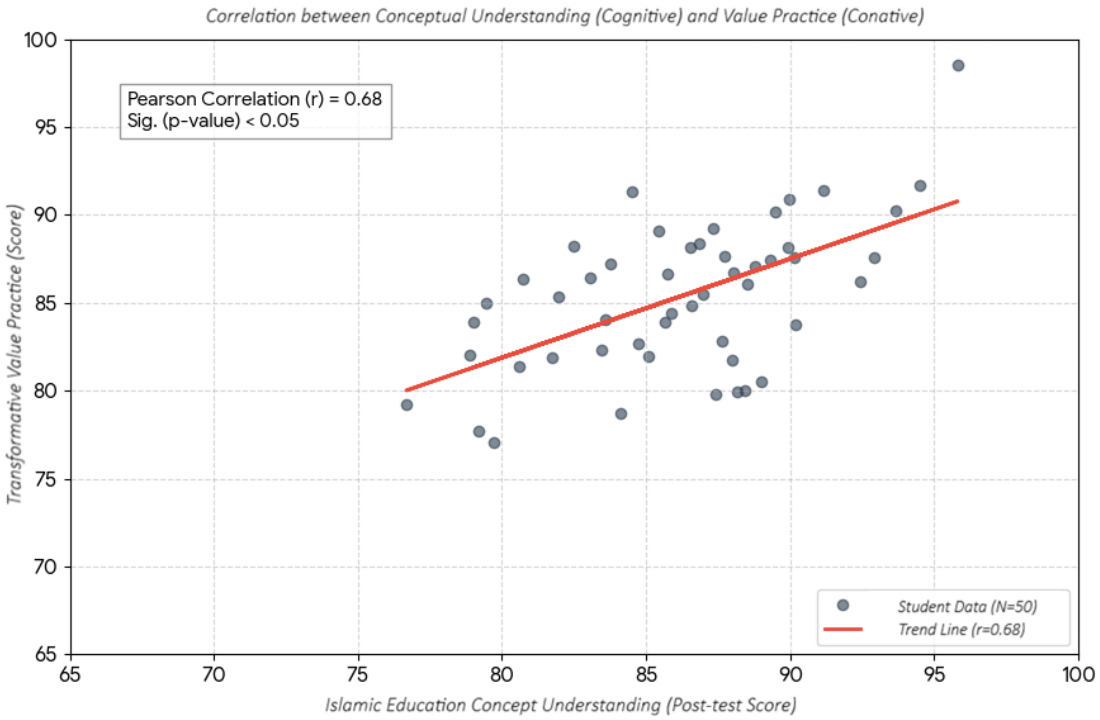


Figure 3. Correlation between Concept Understanding *(Cognitive)* and Value Practice *(Conative)*

3.2 DISCUSSION

3.2.1 PBL Syntax Analysis and Cognitive Construction

Evidence of significant knowledge acquisition can also be seen from the gain score of pre and post concept test which is 85.45. According to the constructivist view, one of the main reasons the PAI model designed for use in HE's lacks effectiveness is that it positions students as content consumers. That is why in this blog we positioned the student in the blog with the help of digital PBL where we present students with real problems online to generate cognitive conflict. When students are faced with problems in the real world around them online such as online radicalization, Cyber-Beredarism, and misinformation campaigns they will experience cognitive conflict that will allow them to rebuild their understanding. (Cook et all, 2022) and (Buder & Hesse, 2023) found that when students are placed in real-life like situations online they have an actual phenomenon to understand the "what" and reason through the "why" of concepts.

CSCL and Cognitive Load Theory. Where students will experience this cognitive construction is through CSCL and shared cognitions. The e-module provides students with multiple sources to offload cognitive responsibility whether it is through resources, scaffolds, or even peer response journals. This allows for what (Bridges et al., 2020) described as "dialogic intervisualizing" or building understanding through reflecting on visuals and discussion with others. (Weinberger et al., 2013) also found that by placing scripts into students' online learning will create cognitive conflict. This conflict will allow students to question the information given to them by the different narratives and develop higher-level schemas that can combine information from both scripts. Image 5 below is a brief illustration of how we believe students will gain character from using the eModule. As students are presented with an authentic problem that they can relate to their lives they will experience cognitive dissonance. This dissonance will then allow students to break their current schema about the topic. Students will then begin to analyze the authentic problem with the help of scaffolds. After students have completed the analysis of the authentic problem and have discussed the main topics will then allow them to reflect on

their values and if they agree with what they learned. This final step is what will help students take what they've learned from the eModule and create long-lasting character.

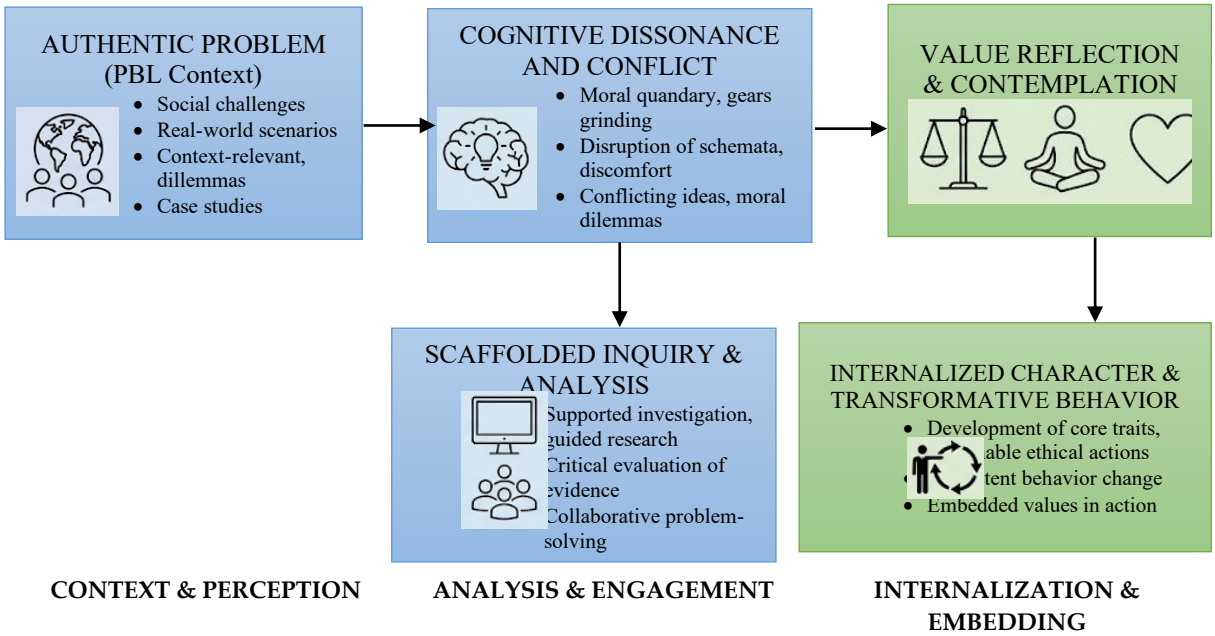


Figure 4. Conceptual Flowchart of Cognitive Conflict and Behavior Transformation Mechanism

Allowing students to progress through each inquiry cycle with the support of scaffolding (Hmelo-Silver et al., 2007), the e-module allows students of all skill levels with SRL to reach each phase of higher-order cognition in the cognitive presence stages outlined by (Darabi et al., 2011) triggering event, exploration, integration, and resolution. Consequently, students will learn how to independently navigate investigations as well as build robust critical thinking skills required by the computer science education standards outlined by (Saif & Aldowah, 2025). Therefore, by utilizing these interactive scaffolds, the e-module will meet the criteria for Bloom'Taxonomy in the Digital age as described by (Manikeswari et al., 2025) by bringing students beyond simple understanding to complex levels of analyzing, evaluating, and conceptualizing.

3.2.2 Character Reflection and Transformation Feature Mechanism

The strong positive correlation between conceptual understanding and value practice ($r = 0.68$, $p < 0.05$) provides empirical support for the application of Value Transformation Theory in digital education, demonstrating that well-designed online learning environments can facilitate not only knowledge acquisition but also meaningful character development. The module's *Value Reflection Area* played a central role in this process by encouraging students to connect academic concepts with real-life ethical actions, resulting in a high post-test value practice score (84.90). This finding aligns with research highlighting the transformative potential of reflective learning activities, digital storytelling, and religiosity-oriented educational approaches in fostering perspective change and moral reasoning (Widodo, 2025). Similar evidence from the Threefold Training framework suggests that structured digital habits and reflective practices can strengthen the translation of cognitive understanding into ethical behavior (Sarapirom et al., 2025).

Furthermore, embedding values through a dedicated reflective architecture enabled the e-module to move beyond one-way knowledge transmission toward active character formation. This approach reflects the principles of digital axiology proposed by (Vavilov et al., 2024), emphasizing the role of digital learning environments in shaping responsible online behavior. It also supports findings that

students are more likely to transform knowledge into conscientious action when digital spaces promote empathy, civic responsibility, and value-driven collaboration (Rajput, 2025). Qualitative interview data reinforced these quantitative results, as students reported that reflective prompts encouraged them to reconsider their online conduct, connect digital actions with personal beliefs, and assume greater ethical accountability. Together, these findings suggest that the *Value Reflection Area* functions as an effective catalyst for moral reflexivity, strengthening the relationship between conceptual learning and behavioral intention.

Qualitative triangulation from post-intervention interviews strongly corroborated the quantitative conative transformation. When reflecting upon the digital dilemmas, one undergraduate remarked: "Previously, PAI felt like learning dry theories and rules to pass the exam. But when the module confronted us with the cyberbullying case and required us to write a personal commitment in the Value Reflection Area, I realized that my digital comments directly reflect my faith. It forced me to stop and rethink how I behave online." *(Student 14, UTM Cluster). Another participant emphasized the reflective mechanism:* "The reflection prompts didn't ask what the book says, but what I would actually do if my peer shared hate speech. Writing down my rationale made me feel accountable to the ethical principles we analyzed." *(Student 32, POLTERA Cluster). These qualitative narratives provide vivid empirical grounding that the e-module functions as an authentic catalyst for moral reflexivity, validating the strong correlation ($r = 0.68$) between conceptual clarity and behavioral intent.*

3.2.3 Multimedia Cognitive Load Management

The high learning motivation score (87.15) and navigation practicality rating (4.42) indicate that the e-module effectively managed students' cognitive load by applying Cognitive Load Theory (CLT) and Mayer's Multimedia Learning Principles (R. Mayer, 2020). By minimizing unnecessary visual elements, simplifying navigation, and organizing information into meaningful segments, the learning environment reduced split attention and enabled students to allocate greater cognitive resources to understanding content rather than navigating the system. This finding aligns with evidence that reducing visual distractions improves cognitive performance, retention, and user engagement (Balasm et al., 2025; Faudzi et al., 2024). Furthermore, principles such as coherence, signaling, and spatial contiguity support schema construction and knowledge retention by presenting information in manageable chunks (Cheon, 2012; Farkish et al., 2023; Kester et al., 2006; Shahnabati et al., 2025). Lower cognitive load also enhances learners' sense of autonomy and intrinsic motivation, contributing to more meaningful cognitive and affective learning experiences (Feldon et al., 2019; R. E. Mayer, 2014; Woo, 2014).

3.2.4 Implications, Research Position, and Limitations

These findings position interactive PBL-based e-modules within a distinctive applied niche at the intersection of educational technology and cyber character psychology by demonstrating that digital learning media can intentionally foster behavioral transformation and value internalization, as reflected in the strong cognitive-conative relationship identified in this study (r = 0.68). Unlike previous research that primarily focused on content digitization, learning achievement, or technological usability, this study provides empirical evidence that multimedia learning environments can promote sustained character development through problem-based engagement and guided reflection. Practically, the findings offer a replicable framework for higher education institutions and policymakers to integrate web-based PBL and reflective learning into curricula as a strategic approach to mitigating technology-related social challenges, including cybercrime, radicalization, and value erosion. Nevertheless, several limitations should be acknowledged, including the short intervention period, the reliance on self-

reported measures of value practice, and the restricted sample drawn from four regions of Madura. Future research should therefore employ longitudinal designs to assess the durability of behavioral change over time and involve more diverse samples across Indonesia to enhance the external validity and generalizability of the findings.

4. CONCLUSION

The findings indicate that the interactive Problem-Based Learning (PBL)-based e-module developed in this study demonstrates high levels of feasibility, practicality, and effectiveness in enhancing character education in higher education. By engaging students in authentic problem-solving activities, the module contributes to improvements across cognitive, affective, and psychomotor learning domains. A key contribution of this study lies in the integration of the *Value Reflection Area*, which serves as a critical mediator in online learning by facilitating the transformation of students' insights into meaningful behaviors and the systematic internalization of religious values. These findings further suggest the need for Learning Management Systems (LMSs) that move beyond administrative functions and cognitive assessment to incorporate structured affective and ethical support mechanisms (Hmelo-Silver et al., 2007; Zhou et al., 2023). To strengthen the generalizability and sustainability of these outcomes, future studies should adopt longitudinal research designs and involve more diverse participant populations at a national scale. Moreover, the integration of Artificial Intelligence (AI) and Natural Language Processing (NLP) within LMS environments offers a promising avenue for providing automated, personalized, and non-judgmental feedback on students' reflective practices, thereby fostering a more adaptive and character-oriented learning ecosystem.

Acknowledgments: Thanks to the Ministry of Religion of the Republic of Indonesia, this research was carried out with the support of research funds from the Ministry of Religion of the Republic of Indonesia with the research scheme: Collaborative Development Research between Universities and/or Ministries/Institutions (University) in 2025.

Conflicts of Interest: Declare conflicts of interest or state "The authors declare no conflict of interest." Authors must identify and declare any personal circumstances or interests that may be perceived as inappropriately influencing the representation or interpretation of reported research results.

REFERENCES

Abdul Muid & Nasrulloh Nasrulloh. (2024). The Role of Education in the Formation of Character and Noble Morals from the Perspective of the Qur'an. *Journal of International Multidisciplinary Research*, *2*(11), 218–226. https://doi.org/10.62504/jimr992

Ahmad, A. M. bin, & Musa, M. A. bin. (2025). Artificial Intelligence (AI) in the Field of Tahfiz: A Simulation Study of ChatGPT Interaction in Qur'anic Murājaʿah. *International Journal of Quranic Research*, *14*(14).

Albaladejo-Saura, M., Mateo-Orcajada, A., Esparza-Ros, F., & Vaquero-Cristóbal, R. (2025). Effect of a "Team Based Learning" Methodology Intervention on the Psychological and Learning Variables of Sport Sciences University Students. *Education Sciences*, *15*(10), 1405. https://doi.org/10.3390/educsci15101405

Alsaif, F., Neel, L., Almuaiqel, S., Almuhanna, A., Feda, J., Alrumaihi, N., Alanazi, O., Almansour, M., Saeed, M. F., & Soliman, M. (2023). Experience of Sudden Shift from Traditional to Virtual Problem-Based Learning During COVID-19 Pandemic at a Medical College in Saudi Arabia. *Advances in Medical Education and Practice*, *Volume 14*, 453–461. https://doi.org/10.2147/AMEP.S404461

Aslan, A. (2021). Problem- based learning in live online classes: Learning achievement, problem-solving skill, communication skill, and interaction. *Computers & Education*, *171*, 104237. https://doi.org/10.1016/j.compedu.2021.104237

Asril, Z., Syafril, S., Engkizar, E., & Arifin, Z. (2023). Advancing Educational Practices: Implementation and Impact of Virtual Reality in Islamic Religious Education. *Jurnal Pendidikan Islam*, *9*(2), 199–210. https://doi.org/10.15575/jpi.v9i2.20567

Balasm, Z., Rajan, S. S., Karpagham, C., Nuritdinovich, M. A., Yusupov, S., & Maurya, S. (2025). Cognitive Load Optimization in User Interface Design for Info Services. *Indian Journal of Information Sources and Services*, *15*(2), 69–74. https://doi.org/10.51983/ijiss-2025.IJISS.15.2.10

Baloyi, O. B. (2023). Development of higher-order thinking skills in nursing students through online problem-based assessment. *Health SA Gesondheid*, *28*. https://doi.org/10.4102/hsag.v28i0.2423

Bos, S. E., Powell, S. R., Maddox, S. A., & Doabler, C. T. (2023). A Synthesis of the Conceptualization and Measurement of Implementation Fidelity in Mathematics Intervention Research. *Journal of Learning Disabilities*, *56*(2), 95–115. https://doi.org/10.1177/00222194211065498

Bridges, S. M., Hmelo-Silver, C. E., Chan, L. K., Green, J. L., & Saleh, A. (2020). Dialogic intervisualizing in multimodal inquiry. *International Journal of Computer-Supported Collaborative Learning*, *15*(3), 283–318. https://doi.org/10.1007/s11412-020-09328-0

Buder, J., & Hesse, F. W. (2023). Designing Digital Technologies for Deeper Learning. In J. M. Spector, B. B. Lockee, & M. D. Childress (Eds.), *Learning, Design, and Technology* (pp. 9–32). Springer International Publishing. https://doi.org/10.1007/978-3-319-17461-7_47

Bujangga, H., Nasution, A. K. P., Salam, M. W., Muhammad, T., & Harisnur, F. (2025). Social Media in Islamic Education;: A Systematic Review of Current Trends, Benefits, and Challenges. *Asian Journal of Human Services*, *29*(0), 409–423. https://doi.org/10.14391/ajhs.29.409

Che Nordin, M. K. N. bin. (2024). The Development of the Educational Game "Jejak Anbiya'": A Pedagogical Approach to Teaching 'Aqidah to Children through the Qur'anic Stories of the Prophets). *QURANICA, International Journal of Quranic Research*, *14*(14).

Cheon, J. (2012). Examining the Relationships of Different Cognitive Load Types Related to User Interface in Web-Based Instruction. *Journal of Interactive Learning Research*, *23*(1), 29–55.

Chien, C. T., & Chien, C. H. (2025). Evaluating Problem-Based Learning in an ESG-Centered General Education Course: A Mixed-Methods Study of Student Competency Development. *Sustainability*, *17*(17), 7944. https://doi.org/10.3390/su17177944

Cook et all, J. (2022). Bridging the Gap: Computer Simulations and Video Recordings for Remote Inquiry-Based Laboratory Activities in Mechanics. *AEE Journal*, *10*(2). https://doi.org/10.18260/3-1-1153-36026

Darabi, A., Arrastia, M. C., Nelson, D. W., Cornille, T., & Liang, X. (2011). Cognitive presence in asynchronous online learning: A comparison of four discussion strategies. *Journal of Computer Assisted Learning*, *27*(3), 216–227. https://doi.org/10.1111/j.1365-2729.2010.00392.x

Dimas Purnomo, Muhammad Afif Marta, & Gusmaneli Gusmaneli. (2025). Pemanfaatan Media Interaktif dalam Strategi Pembelajaran PAI untuk Meningkatkan Motivasi Belajar Peserta Didik. *JURNAL PENDIDIKAN DAN ILMU SOSIAL (JUPENDIS)*, *3*(2), 414–427. https://doi.org/10.54066/jupendis.v3i2.3237

Evinda, A. A., Intansari, U. 'Azizatus S., & Asrori, M. (2025). Membangun Ketahanan Moral di Era Digital: Peran Pendidikan Agama Islam di Perguruan Tinggi. *JIIP - Jurnal Ilmiah Ilmu Pendidikan*, *8*(8), 8825–8833. https://doi.org/10.54371/jiip.v8i8.8727

Farias, C. S., Dantas De Oliveira, R. A., & Luz, M. R. M. P. (2023). A problem-based learning course to teach Brazilian biology students about the viral hepatitis from a health geography perspective. *Journal of Geography in Higher Education*, *47*(3), 432–450. https://doi.org/10.1080/03098265.2022.2087213

Farkish, A., Bosaghzadeh, A., Amiri, S. H., & Ebrahimpour, R. (2023). Evaluating the Effects of Educational Multimedia Design Principles on Cognitive Load Using EEG Signal Analysis.

Education and Information Technologies, *28*(3), 2827–2843. https://doi.org/10.1007/s10639-022-11283-2

Fathimah, S., Maftuh, B., Malihah, E., Wiyanarti, E., Nurgiansah, T. H., Utami, F., & Kusuma, T. C. (2025). Developing Social Studies Teaching Materials for Conflict Resolution Education Using the Branch's ADDIE Research Method. *Emerging Science Journal*, *9*, 187–200. https://doi.org/10.28991/ESJ-2025-SIED1-011

Faudzi, M. A., Cob, Z. C., Ghazali, M., Omar, R., & Sharudin, S. A. (2024). User interface design in mobile learning applications: Developing and evaluating a questionnaire for measuring learners' extraneous cognitive load. *Heliyon*, *10*(18), e37494. https://doi.org/10.1016/j.heliyon.2024.e37494

Fauziah, M. (2024). P PAI HISTORY LEARNING INNOVATIONS: *EDUTEC : Journal of Education And Technology*, *8*(1). https://doi.org/10.29062/edu.v8i1.936

Feldon, D. F., Callan, G., Juth, S., & Jeong, S. (2019). Cognitive Load as Motivational Cost. *Educational Psychology Review*, *31*(2), 319–337. https://doi.org/10.1007/s10648-019-09464-6

Fund, Z., & Madjar, N. (2018). The influence of scaffolded computerised science problem solving on motivational aspects. *International Journal of Science Education*, *40*(18), 2265–2291. https://doi.org/10.1080/09500693.2018.1528644

Herak, R. (2025). Character Education in the Digital Age: Challenges and Opportunities Amidst Technological Developments. *MSJ : Majority Science Journal*, *3*(2), 245–252. https://doi.org/10.61942/msj.v3i2.367

Hernández-Leo, D., & Ginoyan, K. (2025). Supporting teachers' value-sensitive reflections on the cost–benefit dynamics of technology in educational practices. *British Journal of Educational Technology*, *56*(4), 1350–1369. https://doi.org/10.1111/bjet.13592

Hmelo-Silver, C. E., Duncan, R. G., & Chinn, C. A. (2007). Scaffolding and Achievement in Problem-Based and Inquiry Learning: A Response to Kirschner, Sweller, and Clark (2006). *Educational Psychologist*, *42*(2), 99–107. https://doi.org/10.1080/00461520701263368

Huda, M., Taisin, J. N., Muhamad, M., Kiting, R., & Yusuf, R. (2024). Digital Technology Adoption for Instruction Aids: Insight into Teaching Material Content. In M. S. Kaiser, J. Xie, & V. S. Rathore (Eds.), *Intelligent Strategies for ICT* (Vol. 941, pp. 59–68). Springer Nature Singapore. https://doi.org/10.1007/978-981-97-1260-1_6

Huh, Y. (2021). A holistic empathic design through cognitive load theory: Response to Tracey and Hutchinson. *Educational Technology Research and Development*, *69*(1), 77–80. https://doi.org/10.1007/s11423-020-09849-3

Kannike, U. M. M., & Fahm, A. O. (2025). Exploring The Ethical Governance of Artificial Intelligence from An Islamic Ethical Perspective. *Jurnal Fiqh*, *22*(1), 134–161. https://doi.org/10.22452/fiqh.vol22no1.5

Kester, L., Lehnen, C., Van Gerven, P. W. M., & Kirschner, P. A. (2006). Just-in-time, schematic supportive information presentation during cognitive skill acquisition. *Computers in Human Behavior*, *22*(1), 93–112. https://doi.org/10.1016/j.chb.2005.01.008

Larson, E. M. (2024). Smartphones and the education of religious youth in Indonesia: Highway to hell or path of righteousness? *Social Compass*, *71*(1), 119–135. https://doi.org/10.1177/00377686231182251

Liu, X., Alotaibi, K. A., & Hashemifardnia, A. (2025). Serious Game-Based Learning: Its Impact on Happiness, Motivation, Self-Compassion, and Vocabulary Development in EFL Learners. *European Journal of Education*, *60*(1), e70030. https://doi.org/10.1111/ejed.70030

M Mahbubi. (2024). Ethical Leadership and Character Education: Addressing the Digital Dilemmas of Society 5.0. *Journal of Education and Learning Sciences*, *4*(1), 1–15. https://doi.org/10.56404/jels.v4i1.104

Manikeswari, D., Ratnakaram, S. P. K., Alhejair, A., Saseendran, H., Alawi, S. H., Gulati, N., & Dora, N. (2025). Charting the Impact of AI-Augmented Problem-Based Learning in Higher Education: The Bloom's Digital Taxonomy Perspective. In S. Khan & P. Pringuet (Eds.), *Advances in Computational*

Intelligence and Robotics (pp. 39–62). IGI Global Scientific Publishing. https://doi.org/10.4018/979-8-3373-7386-7.ch002

Marwan, M., Hasbullah, B., Rahayu, I., Wakhudin, W., & Saputra, D. G. (2025). The Role of Character Education in Building Ethics and Morality among Students in the Digital Age. *International Journal of Educational Research Excellence (IJERE)*, *4*(1), 33–39. https://doi.org/10.55299/ijere.v4i1.1224

Mayer, R. (2020). *Multimedia Learning* (3rd ed.). Cambridge University Press. https://doi.org/10.1017/9781316941355

Mayer, R. E. (2014). Incorporating motivation into multimedia learning. *Learning and Instruction*, *29*, 171–173. https://doi.org/10.1016/j.learninstruc.2013.04.003

Meihami, H., & Malmir, A. (2024). Student-teachers' professional agency development through ADDIE model of CALL teacher preparation. *Language Teaching Research*, 13621688241254907. https://doi.org/10.1177/13621688241254907

Mohamad Hsbollah, H., & Hassan, H. (2022). CREATING MEANINGFUL LEARNING EXPERIENCES WITH ACTIVE, FUN, AND TECHNOLOGY ELEMENTS IN THE PROBLEM-BASED LEARNING APPROACH AND ITS IMPLICATIONS. *Malaysian Journal of Learning and Instruction*, *19*. https://doi.org/10.32890/mjli2022.19.1.6

Mufidah, I. (2022). Innovation of Islamic Religious Education In The Digital Era. *TARLIM : JURNAL PENDIDIKAN AGAMA ISLAM*, *5*(1). https://doi.org/10.32528/tarlim.v5i1.7053

Nasir, K., Zaman, R. K., Hilmi, A. B. A., & Mahadzir, A. H. (2025). Artificial Intelligence Integration in Mobile Applications: Innovation and Challenges in Supporting Quran Memorization and Review. *QURANICA, International Journal of Quranic Research*, *14*(14).

Ng, I. K. S., Ko, C. J., & Lim, T. K. (2025). Managing cognitive load and enhancing metacognitive learning in postgraduate training and practice. *Diagnosis*. https://doi.org/10.1515/dx-2025-0067

Parlakkiliç, A. (2022). Evaluating the effects of responsive design on the usability of academic websites in the pandemic. *Education and Information Technologies*, *27*(1), 1307–1322. https://doi.org/10.1007/s10639-021-10650-9

Peltzer, N. R., Kuhn, J., Stadler, M., Cera, R., Hoyer, C., Flegr, S., Fischer, M. R., & Richters, C. (2026). The Interplay of Self-regulation, Cognitive Load and Learner Resources: Implications for Learning Outcomes in Virtual Reality. *Computers & Education*, *249*, 105612. https://doi.org/10.1016/j.compedu.2026.105612

Petchamé, J., Novkovic, D., Fox, P., Kinnear, L., & Torres-Kompen, R. (2026). SDG-Driven Entrepreneurship Through Technology Solutions in Higher Education Enhanced by Problem-Based Learning: An Active Learning Approach in a Smart Classroom Environment. *Sustainability*, *18*(4), 1849. https://doi.org/10.3390/su18041849

Pradibta, H., Nurhasan, U., Pramesti, T. D., & Suryadi, S. B. (2019). "Hijaiyah" interactive learning for pre-school students. *Journal of Physics: Conference Series*, *1402*(6), 066050. https://doi.org/10.1088/1742-6596/1402/6/066050

Rajput, R. (2025). Values-Based Education in the Age of Digital Transformation: In W. Z. Saad, N. A. Alias, C. M. Chong, & S. Sabri (Eds.), *Digital Transformation and Sustainability in Higher Education* (pp. 237–262). IGI Global Scientific Publishing. https://doi.org/10.4018/979-8-3373-5077-6.ch009

Reksiana, Abuddin Nata, Dede Rosyada, Maila Dinia Husni Rahiem, & Abdulbosit R. Rafikjon Ugli. (2024). Digital Extension of Digital Literacy Competence for Islamic Religious Education Teachers in the Era of Digital Learning. *Jurnal Pendidikan Agama Islam*, *21*(2), 402–420. https://doi.org/10.14421/jpai.v21i2.9719

Retta, A. M., Mulbasari, A. S., & Nopriyanti, T. D. (2023). *Development of E-module based on PMRI in sequences and series material for grade XI*. 020018. https://doi.org/10.1063/5.0142451

Rhoads, C. (2017). Coherent Power Analysis in Multilevel Studies Using Parameters From Surveys. *Journal of Educational and Behavioral Statistics*, *42*(2), 166–194. https://doi.org/10.3102/1076998616675607

Risanti, D., & Agustina, P. (2025). STUDI KELAYAKAN MEDIA PEMBELAJARAN INTERAKTIF "SIFASMA" BERBASIS ARTICULATE STORYLINE 3 DENGAN MUATAN STEM (SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS). *SCIENCE : Jurnal Inovasi Pendidikan Matematika Dan IPA*, *5*(3), 1427–1436. https://doi.org/10.51878/science.v5i3.6831

Ristau, I.-S. (2016). Cooperation and Communication Within Scientific Organizations: The Role of Survey Coordination. In H.-P. Blossfeld, J. Von Maurice, M. Bayer, & J. Skopek (Eds.), *Methodological Issues of Longitudinal Surveys* (pp. 99–110). Springer Fachmedien Wiesbaden. https://doi.org/10.1007/978-3-658-11994-2_6

Rizqi Hidayati & Hafidz. (2025). Inovasi Dan Optimalisasi Media Digital Berbasis TIK Dalam Pembelajaran PAI: DOI 10.58569/jies.v4i1.1238. *Journal of Islamic Education Studies*, *4*(1), 18–26. https://doi.org/10.58569/jies.v4i1.1238

Rosfiani, O., Sukmana, B., Andri, E., Sukma, D., & Saidah, M. (2025). TANTANGAN DAN SOLUSI GURU PAI DALAM MENGINTEGRASIKAN NILAI-NILAI KARAKTER DALAM PEMBELAJARAN DI ERA DIGITAL. *TEACHING : Jurnal Inovasi Keguruan Dan Ilmu Pendidikan*, *5*(2), 320–328. https://doi.org/10.51878/teaching.v5i2.6464

Saif, A., & Aldowah, H. (2025). Online PBL and Critical Thinking: Effects of Self-Regulated Learning Levels in Computer Science. *Journal of Information Technology Education: Research*, *24*, 036. https://doi.org/10.28945/5642

Saputra, A., & Asbi, E. A. (2025). Islam, Big Data, and Digital Ethics: Challenges in Religious Life in the Digital Age. *Pharos Journal of Theology*, (106.4). https://doi.org/10.46222/pharosjot.106.4022

Sarapirom, K., Aroonsrimorakot, S., Muangnual, P., & Taerakul, P. (2025). MORAL GROWTH IN A DIGITAL AGE: APPLYING THE THREEFOLD TRAINING TO ENHANCE THE LIFESTYLES AND TECHNOLOGY USE OF GENERATION C STUDENTS IN THE THAILAND 4.0 ERA. *Journal of Buddhist Anthropology*. https://doi.org/2-s2.0-105027811432

Sarawati, T., & Mubarok, M. S. (2021). The Urgency of Islamic Universities in Building Student Character Based on Religious Moderation in the Digital Age. *Jurnal Studi Sosial Keagamaan Syekh Nurjati*, *1*(1), 52–75. https://doi.org/10.24235/sejati.v1i1.7

Shahnabati, F., Sabourifard, A., Amiri, S. H., Bosaghzadeh, A., & Ebrahimpour, R. (2025). Cognitive load and visual attention assessment using physiological eye tracking measures in multimedia learning. *PLOS One*, *20*(12), e0337195. https://doi.org/10.1371/journal.pone.0337195

Sholihah, N., Hidayatin, A. N., & Syaifudin, M. (2025). Development of Interactive Islamic Education Learning Media Using Artificial Intelligence and ChatGPT. *Abjadia : International Journal of Education*, *10*(3), 671–683. https://doi.org/10.18860/abj.v10i3.33424

Skulmowski, A., & Xu, K. M. (2022). Understanding Cognitive Load in Digital and Online Learning: A New Perspective on Extraneous Cognitive Load. *Educational Psychology Review*, *34*(1), 171–196. https://doi.org/10.1007/s10648-021-09624-7

Sukesi, D., & Istiqomah, I. (2024). *PAI Learning Management Using ChatGPT Artificial Intelligence in Vocational High Schools: Manajemen Pembelajaran PAI Dengan Pemanfaatan Kecerdasan Buatan ChatGPT di Sekolah Menengah Kejuruan*. https://doi.org/10.21070/ups.6318

Sumiyana, S., & Saputra, M. A. (2023). Competing with Media Richness: Cognitive and Psychological Endowment Effects as the Fundamentally Pervasive Perspective of Learning Performance. *Human Behavior and Emerging Technologies*, *2023*, 1–12. https://doi.org/10.1155/2023/9929307

Sung, E., & Mayer, R. E. (2012). Affective impact of navigational and signaling aids to e-learning. *Computers in Human Behavior*, *28*(2), 473–483. https://doi.org/10.1016/j.chb.2011.10.019

Sweller, J. (2020). Cognitive load theory and educational technology. *Educational Technology Research and Development*, *68*(1), 1–16. https://doi.org/10.1007/s11423-019-09701-3

Tanjung, M. A. P., & Sitompul, O. S. (2020). "Kian Santang" game as historical educational media using digital storytelling concept. *Education and Information Technologies*, *25*(6), 5379–5388. https://doi.org/10.1007/s10639-020-10209-0

Taylor, T. A. H., Kamel-ElSayed, S., Grogan, J. F., Hajj Hussein, I., Lerchenfeldt, S., & Mohiyeddini, C. (2022). Teaching in Uncertain Times: Expanding the Scope of Extraneous Cognitive Load in the Cognitive Load Theory. *Frontiers in Psychology*, *13*, 665835. https://doi.org/10.3389/fpsyg.2022.665835

Trust, T., & Pektas, E. (2018). Using the ADDIE Model and Universal Design for Learning Principles to Develop an Open Online Course for Teacher Professional Development. *Journal of Digital Learning in Teacher Education*, *34*(4), 219–233. https://doi.org/10.1080/21532974.2018.1494521

Utoyo, S., Ismaniar, I., Hazizah, N., Putri, E. A., & Sihombing, S. C. (2026). A Practical Study of the Use of AI-Based E-Book Guides to Improve Early Childhood Mathematics Skills. *Qubahan Academic Journal*, *6*(1), 308–324. https://doi.org/10.48161/qaj.v6n1a2176

Van Dijk, W., Lane, H. B., & Gage, N. A. (2023). How Do Intervention Studies Measure the Relation between Implementation Fidelity and Students' Reading Outcomes?: A Systematic Review. *The Elementary School Journal*, *124*(1), 56–84. https://doi.org/10.1086/725672

Vavilov, P., Maslov, E., Saykina, G., & Yurinov, V. (2024). DIGITAL AXIOLOGY IN THE EDUCATIONAL ENVIRONMENT: FEATURES OF THE FORMATION OF DIGITAL BEHAVIOR OF YOUNG PEOPLE. *International Journal of Ecosystems and Ecology Science (IJEES)*, *14*(4), 41–48. https://doi.org/10.31407/ijees14.406

Wahyudin, W., Akbar, A., Nugraha, E., Riza, L. S., Nazir, S., & Al Husaeni, D. N. (2026). Improving students cognitive learning outcomes in computer systems learning through unity-based virtual reality media. *Journal of Technology and Science Education*, *16*(2), 470. https://doi.org/10.3926/jotse.3677

Weinberger, A., Marttunen, M., Laurinen, L., & Stegmann, K. (2013). Inducing socio-cognitive conflict in Finnish and German groups of online learners by CSCL script. *International Journal of Computer-Supported Collaborative Learning*, *8*(3), 333–349. https://doi.org/10.1007/s11412-013-9173-4

Wekerle, C., Daumiller, M., Janke, S., Dickhäuser, O., Dresel, M., & Kollar, I. (2024). Putting ICAP to the test: How technology-enhanced learning activities are related to cognitive and affective-motivational learning outcomes in higher education. *Scientific Reports*, *14*(1), 16295. https://doi.org/10.1038/s41598-024-66069-y

Wibowo, F. C., Budi, A. S., Iswanto, B. H., Suherman, S., Darman, D. R., & Guntara, Y. (2019). Mobile Digital Education (MDE) for increasing competence of students based on E-Characters Mental Revolution (E-CMR). *Journal of Physics: Conference Series*, *1402*(6), 066075. https://doi.org/10.1088/1742-6596/1402/6/066075

Widodo, H. (2025). An AI-Gamification-Religiosity Learning Model to Enhance Critical Literacy in Private Islamic Unive. *Islamic Quarterly*, *69*(1), 75–120.

Woo, J. C. (2014). Digital game-based learning supports student motivation, cognitive success, and performance outcomes. *Educational Technology and Society*, *17*(3), 291–307.

Zainuddin, M., Mardianto, M., & Matsum, H. (2022). Development of Game-Based Learning Media on Islamic Religious Education Materials. *Nazhruna: Jurnal Pendidikan Islam*, *6*(1), 13–24. https://doi.org/10.31538/nzh.v6i1.2824

Zhou, X., Li, Q., Xu, D., Li, X., & Fischer, C. (2023). College online courses have strong design in scaffolding but vary widely in supporting student agency and interactivity. *The Internet and Higher Education*, *58*, 100912. https://doi.org/10.1016/j.iheduc.2023.100912