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ISLAMIC AI LITERACY AS RESPONSIBLE KNOWLEDGE PRACTICE: DEVELOPMENT AND VALIDATION OF AILS-IIUS IN INDONESIAN ISLAMIC HIGHER EDUCATION

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ABSTRACT
Artificial intelligence (AI) integration in higher education has increased the need for context-sensitive AI literacy frameworks aligned with ethical and educational values. This study aimed to develop and validate the Artificial Intelligence Literacy Scale for Indonesian Islamic University Students (AILS-IIUS) within the framework of Islamic AI literacy. Grounded in the principles of *adab, amanah, 'adl, maslahah*, and *tabayyun*, the study conceptualized AI literacy through four dimensions: Awareness, Usage, Evaluation, and Ethics. Using a quantitative scale-development design, data were collected from 361 undergraduate students enrolled at Islamic higher education institutions in Indonesia. Furthermore, the instrument development process involved expert validation, contextual refinement, exploratory factor analysis (EFA), confirmatory factor analysis (CFA), and regression analysis. Additionally, the findings produced a valid 15-item instrument explaining 72.38% of the total variance. The four-factor model demonstrated satisfactory model fit, reliability, convergent validity, and discriminant validity. Furthermore, the frequency of AI use significantly predicted all dimensions of AI literacy. Based on these results, the study concludes that AI literacy in Islamic higher education should incorporate conceptual understanding, evaluative judgment, ethical engagement, and responsible AI-supported learning. Ultimately, the AILS-IIUS provides an Islamically grounded framework to support ethical AI pedagogy and curriculum development in Islamic higher education.

Keywords: AI Literacy, Ethical AI Education, Islamic Educational Values, Islamic Higher Education, Responsible Knowledge Practice, Scale Development and Validation

INTRODUCTION
Artificial intelligence (AI) technologies such as ChatGPT, Gemini, and Claude are increasingly transforming higher education by reshaping how students access information, generate academic content, solve problems, and participate in knowledge production (Kong et al., 2023; Ng et al., 2021; Wang & Li, 2024). The rapid integration of AI into educational settings has created growing attention toward AI literacy as an important competency for university students. Contemporary studies conceptualize AI literacy as a multidimensional construct involving conceptual understanding, practical AI use, evaluative judgement, and ethical awareness (Long & Magerko, 2020; Ng et al., 2021; Wang et al., 2023; Zhou & Schofield, 2024). Beyond technical competence, AI literacy increasingly concerns students' ability to engage critically and responsibly with AI-generated information and AI-supported learning environments. Recent studies further indicate that AI literacy influences students' academic performance, confidence, and learning experiences, particularly in technology-mediated educational contexts (Singh et al., 2024; Wang & Chuang, 2023; Hargittai & Shafer, 2006; Atika et al., 2022). Despite the growing use of AI in higher education, concerns about misinformation, plagiarism, privacy, overreliance, and declining critical thinking continue to emerge across educational systems (Rafida et al., 2024).

These developments suggest that AI literacy should not be understood solely as technological familiarity but as a broader educational competence that requires ethical and responsible engagement with AI technologies.

Within Islamic higher education, the discussion of AI literacy requires a more specific educational and philosophical orientation. Islamic educational institutions are not only responsible for preparing students to adapt to technological transformation, but also for cultivating morally responsible learners whose knowledge practices reflect ethical conduct, trustworthiness, social responsibility, and critical verification of information. Islamic educational philosophy conceptualizes knowledge as inseparable from adab, moral development, and responsibility toward society (Al-Attas, 1979; Halstead, 2004; Sahin, 2018). In this perspective, educational success is measured not merely by cognitive achievement or technological proficiency, but also by the development of responsible and ethical engagement with knowledge. Recent discussions concerning digital transformation in Islamic education similarly emphasize that technological innovation should remain aligned with Islamic educational values and institutional identity (Firdaus et al., 2025). Accordingly, AI literacy within Islamic higher education should be interpreted as responsible knowledge practice in which students are expected not only to understand and utilize AI technologies effectively, but also to critically evaluate AI-generated information, engage honestly in AI-supported learning, protect fairness and privacy, and consider the broader social implications of AI use.

The framework of Islamic AI literacy as responsible knowledge practice adopted in the present study integrates Islamic educational philosophy with contemporary AI literacy theory. Drawing on the principles of *adab, amanah, 'adl, maslahah,* and *tabayyun,* the framework conceptualizes AI literacy through four interrelated dimensions: Awareness, Usage, Evaluation, and Ethics. Within this framework, Awareness reflects students' moral consciousness regarding the implications and limitations of AI technologies, while Usage represents *amanah* in responsible AI-supported learning practices. Evaluation reflects the principle of *tabayyun* through the verification and critical assessment of AI-generated information before acceptance or dissemination. Meanwhile, ethics represents *adab*, justice, accountability, privacy protection, and social responsibility in AI engagement. Unlike generic AI literacy frameworks emphasizing mainly operational competence and digital participation, the present framework positions AI literacy within the broader pedagogical mission of Islamic education involving moral formation, responsible knowledge production, and ethical social engagement.

Although previous studies have developed important conceptualizations and measurements of AI literacy, most existing frameworks were designed for technologically broad or secular educational contexts (Brennan& Resnick, 2012; Long & Magerko, 2020; Kuhlman et al., 2020; Ng et al., 2021; Wang et al., 2023). Recent studies have validated AI literacy scales among college students and non-expert users across different educational settings (Laupichler et al., 2023; Ma & Chen, 2024; Nong et al., 2024). These studies consistently demonstrate that AI literacy is measurable through dimensions related to AI knowledge, practical use, evaluation, and ethics. However, existing instruments generally conceptualize ethical AI literacy through universal concerns such as transparency, accountability, privacy, bias, and risk management, while giving limited attention to how AI literacy may be interpreted within value-based educational systems. In particular, current literature has not sufficiently explained how Islamic educational philosophy may reshape the meaning and practice of AI literacy in contexts where knowledge is closely connected to morality, academic integrity, and social responsibility. Furthermore, empirical studies examining AI literacy within Islamic higher education remain limited despite the rapid expansion of AI use among Muslim university students and the increasing need for ethical AI pedagogy in Islamic educational institutions.

Based on these considerations, the present study adopts the framework of Islamic AI literacy as a responsible knowledge practice to develop and validate the Artificial Intelligence Literacy Scale for Indonesian Islamic University Students (AILS-IIUS). The study conceptualizes AI literacy through four dimensions consisting of Awareness, Usage, Evaluation, and Ethics grounded in the principles of *adab, amanah, 'adl, maslahah,* and *tabayyun*. Using a quantitative scale-development design involving theoretical review, expert validation, student-based contextual refinement, exploratory factor analysis, confirmatory factor analysis, and regression analysis, the study seeks to establish a valid and reliable instrument to assess students' responsible engagement with AI technologies in Islamic higher education. By doing so, the study contributes not only to AI literacy research and educational measurement but also to the development of ethical AI pedagogy, curriculum integration, and responsible digital transformation within Islamic higher education institutions.

METHOD

This study employed a quantitative scale-development design to develop and validate the Artificial Intelligence Literacy Scale for Indonesian Islamic University Students (AILS-IIUS). The study adopted the framework of Islamic AI literacy as responsible knowledge practice by integrating Islamic educational philosophy with contemporary AI literacy theory (Al-Attas, 1979; Long & Magerko, 2020; Ng et al., 2021). Within this framework, AI literacy was conceptualized through four dimensions consisting of Awareness, Usage, Evaluation, and Ethics grounded in the principles of *adab, amanah, 'adl, maslahah,* and *tabayyun*. Initial indicators were generated through a review of AI literacy and digital literacy literature (Laupichler et al., 2023; Wang et al., 2023; Du & Wang, 2023; Hwang et al., 2023; Mansoor et al., 2024) and subsequently contextualized for Islamic higher education settings. To strengthen construct development, the study employed triangulated procedures involving theoretical review, expert validation, and student-based contextual refinement. The preliminary instrument was carefully evaluated by a panel of experts specializing in education, artificial intelligence, and psychometrics to ensure its conceptual relevance and clear dimensional structure. Additionally, a cognitive review was conducted with undergraduate students from Islamic universities to assess the instrument's readability, suitability within the cultural context, and clarity of individual items. This preliminary instrument consisted of 32 items, each rated on a five-point Likert scale ranging from strongly disagree to strongly agree, designed to capture the respondents' attitudes or perceptions accurately.

Data were collected through a nationwide online survey involving undergraduate students from Universitas Islam Negeri (UIN), Institut Agama Islam Negeri (IAIN), and Sekolah Tinggi Agama Islam Negeri (STAIN) across Indonesia. Participation was voluntary and conducted with informed consent, ensuring that all participants agreed freely after understanding the purpose of the study. A total of 372 responses were initially obtained; however, after screening for incomplete and inconsistent responses, 361 valid questionnaires were retained for analysis. The participants represented a diverse range of institutional backgrounds, academic levels, and frequencies of AI use. This diversity allowed for a broader and more comprehensive representation of AI engagement within Indonesian Islamic higher education institutions. To support cross-validation and strengthen analytical rigor, the dataset was randomly divided into two subsamples consisting of Sample A (n = 180) for Exploratory Factor Analysis (EFA) and Sample B (n = 181) for Confirmatory Factor Analysis (CFA). As presented in Table 1, the participants demonstrated relatively balanced gender distribution and varying levels of AI engagement, with most students reporting AI use between one and four times per week.

Table 1. Demographic Profile of Participants

Variable	n	%
Gender		
Male	171	47.4
Female	190	52.6
Academic Level		
Freshman	81	22.4
Junior	165	45.7
Senior	115	31.9
Institution Type		
UIN	193	53.5
IAIN	107	29.6
STAIN	61	16.9
Frequency of AI Use per Week		
Never	51	14.1
1–2 times	175	48.5
3–4 times	135	37.4

Table 1 provides a detailed overview of the participants, emphasizing a relatively balanced gender distribution that ensures diverse perspectives within the study. It also highlights a wide range of AI engagement levels among the students, illustrating varying degrees of familiarity and comfort with the technology. Most students reported using AI tools between one and four times per week, which indicates different patterns of interaction and competence. The group comprises individuals from various institutional backgrounds, including different universities and colleges, as well as students at multiple academic stages, from undergraduate to postgraduate levels. Additionally, the frequency of AI use varies significantly among participants, reflecting diverse attitudes and adoption rates. This heterogeneous composition offers a more comprehensive and nuanced understanding of how AI is integrated and utilized across different contexts, levels of study, and cultural settings within Indonesian Islamic higher education. Recognizing this diversity helps to shed light on the multifaceted ways in which AI influences teaching, learning, and research practices across institutions.

Data analysis was conducted in several stages. First, EFA using principal axis factoring with oblimin rotation was performed to identify the latent structure of the instrument because the dimensions of AI literacy were theoretically expected to be interrelated (Hair et al., 2019). Sampling adequacy was evaluated using the Kaiser–Meyer–Olkin (KMO) measure and Bartlett's test of sphericity. Factor retention decisions were guided through triangulated analytical procedures involving eigenvalues, scree plot analysis, parallel analysis, and theoretical interpretability of the emerging dimensions. Second, CFA using maximum likelihood estimation

was conducted to validate the four-factor measurement model identified through EFA. Model fit and construct validity were assessed using multiple indicators, including Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), Composite Reliability (CR), Average Variance Extracted (AVE), and discriminant validity (Fornell & Larcker, 1981; Kline, 2016; Schermelleh-Engel et al., 2003). Finally, regression analysis was conducted to examine the relationship between demographic variables and students' AI literacy dimensions, particularly the influence of AI use frequency on Awareness, Usage, Evaluation, and Ethics.

RESULTS AND DISCUSSION

Development of Islamic AI Literacy Dimensions

The development of the Artificial Intelligence Literacy Scale for Indonesian Islamic University Students (AILS-IIUS) was rooted in the framework of Islamic AI literacy as a form of responsible knowledge practice. This approach emphasizes the importance of understanding and applying AI in a manner that aligns with Islamic values and ethical considerations. Drawing on contemporary AI literacy literature that highlights key components such as conceptual understanding, practical AI use, evaluative judgement, and ethical engagement (Long & Magerko, 2020; Ng et al., 2021; Wang et al., 2023), the study adapted the concept of AI literacy specifically within the context of Islamic higher education. To do so, it proposed four interconnected dimensions, Awareness, Usage, Evaluation, and Ethics, that collectively aim to comprehensively measure students' AI literacy in a manner consistent with both technological competency and Islamic ethical principles.

The development process employed triangulated procedures involving theoretical review, expert validation, and student-based contextual refinement. Initial indicators related to AI knowledge, AI-supported learning, critical evaluation, and ethical AI engagement were identified from previous AI literacy studies (Laupichler et al., 2023; Ma & Chen, 2024; Wang et al., 2023). The preliminary indicators were subsequently reviewed by experts in education, artificial intelligence, and psychometrics to examine conceptual relevance and dimensional clarity. In addition, cognitive review involving undergraduate students from Islamic universities was conducted to assess readability, contextual interpretation, and response clarity. Meanwhile, the consistency across theoretical review, expert evaluation, and student refinement strengthened the conceptual coherence and contextual suitability of the proposed dimensions for Islamic higher education settings.

Particularly important, the retained indicators clustered into four interrelated but conceptually distinct dimensions. Awareness reflected students' understanding of AI concepts, limitations, and implications for learning and society. Usage represented students' practical engagement with AI technologies for academic tasks and problem-solving. On the one hand, the evaluation reflected students' ability to critically assess AI-generated information, including issues related to transparency, reliability, and verification. Then, the ethics represented responsible AI engagement involving privacy protection, fairness, accountability, and misuse prevention. Together, the dimensions demonstrated that AI literacy within Islamic higher education extends beyond operational AI skills toward broader forms of critical and ethical educational engagement.

The findings further indicated that Islamic educational values provided important conceptual grounding for the retained dimensions. The principle of *amanah* informed responsible AI-supported learning practices within the Usage dimension, while *tabayyun* guided the Evaluation dimension through verification and critical assessment of AI-generated information. Similarly, *adab, 'adl,* and *maslahah* informed the Ethics dimension by emphasizing ethical conduct, fairness, privacy protection, social responsibility, and harm prevention in AI engagement. These findings suggest that AI literacy in Islamic higher education should be understood not merely as technological competence, but as responsible knowledge practice aligned with the broader moral

and pedagogical mission of Islamic education. Table 2 presents the final dimensions and indicators of AILS-IIUS.

Table 2. Final Dimensions and Indicators of AILS-IIUS

Dimension	Islamic Educational Grounding	Educational Meaning	Retained Indicators
Awareness	*Maslahah, 'adl*	Moral understanding of AI implications	AI understanding, AI functions, privacy awareness, AI learning awareness
Usage	*Amanah*	Responsible AI-supported learning	AI problem-solving, collaborative learning, academic support
Evaluation	*Tabayyun*	Verification and critical assessment	AI transparency, output verification, AI limitations, critical evaluation
Ethics	*Adab, 'adl, maslahah*	Ethical and responsible AI engagement	Ethical AI use, privacy protection, social reflection, misuse awareness

As presented in Table 2, the four dimensions collectively demonstrate that AI literacy in Islamic higher education represents a multidimensional form of responsible knowledge practice integrating conceptual understanding, practical AI use, critical evaluation, and ethical engagement. Although Awareness, Usage, Evaluation, and Ethics emerged as distinct dimensions, the findings indicate that responsible AI engagement requires students not only to understand and utilize AI technologies, but also to critically evaluate AI-generated information and engage with AI in ethically accountable ways. The retained dimensions, therefore, reflect the integration of technological competence with the moral and pedagogical orientation of Islamic education.

Exploratory Factor Analysis of AILS-IIUS

Exploratory Factor Analysis (EFA) was conducted to examine the latent structure of the Artificial Intelligence Literacy Scale for Indonesian Islamic University Students (AILS-IIUS) and refine the retained indicators across the four proposed dimensions. The analysis was performed using Sample A (n = 180), which was randomly separated from the full dataset to support cross-validation in the subsequent confirmatory analysis stage. Prior to factor extraction, sampling adequacy was examined using the Kaiser–Meyer–Olkin (KMO) measure and Bartlett's test of sphericity. The KMO value of 0.873 and significant Bartlett's test ($p < .001$) indicated that the dataset was suitable for factor analysis and that the retained items shared sufficient common variance for latent structure identification (Hair et al., 2019; Kline, 2016).

Furthermore, factor retention decisions were guided through triangulated analytical procedures involving scree plot inspection, parallel analysis, eigenvalue examination, and theoretical interpretability of the emerging dimensions. During the refinement process, items demonstrating low factor loadings, conceptual overlap, or unstable cross-loadings were iteratively removed to improve construct clarity and dimensional distinctiveness. The analysis ultimately retained 15 items distributed across four interrelated dimensions consisting of Evaluation, Ethics, Awareness, and Usage.

The final four-factor solution explained 72.38% of the total variance, indicating that the retained dimensions accounted for a substantial proportion of students' AI literacy variation. The retained factor structure demonstrated strong conceptual coherence with the proposed framework of Islamic AI literacy as responsible knowledge practice. Evaluation emerged as the strongest factor, followed by Ethics, Awareness, and Usage. The findings indicate that students' AI literacy involved not only conceptual understanding and practical AI use, but also critical verification of AI-generated information and responsible AI engagement within academic contexts. Table 3 presents the results of the exploratory factor analysis from the study.

Table 3. Exploratory Factor Analysis Results

Items	Evaluation	Ethics	Awareness	Usage
EV3	.781			
EV1	.773			
EV2	.748			
EV4	.730			
ET4		.845		
ET2		.833		
ET3		.789		
ET1		.667		
AW2			.871	
AW3			.842	
AW4			.688	
AW1			.662	
US2				.880
US3				.835
US1				.790

Note. EV = Evaluation; ET = Ethics; AW = Awareness; US = Usage. Principal axis factoring with oblimin rotation was applied. Only factor loadings ≥ .50 are displayed.

As presented in Table 3, all retained items demonstrated satisfactory factor loadings above the recommended threshold of .50, indicating strong empirical relationships between the observed indicators and their respective latent dimensions. The factor structure also showed clear conceptual separation among Evaluation, Ethics, Awareness, and Usage while remaining theoretically interconnected within the broader framework of Islamic AI literacy. These findings support the multidimensional structure of AILS-IIUS and indicate that AI literacy within Islamic higher education encompasses conceptual, evaluative, practical, and ethical forms of engagement with AI technologies.

Confirmatory Factor Analysis and Construct Validation

Confirmatory Factor Analysis (CFA) was conducted using Sample B (n = 181) to validate the four-factor structure identified through the exploratory factor analysis stage. The use of separate subsamples for EFA and CFA constituted an analytical triangulation strategy intended to strengthen construct validation and reduce the risk of overfitting the measurement model to a single dataset. The CFA specified a correlated four-factor model consisting of Awareness, Usage, Evaluation, and Ethics, with each retained item loading on its intended latent

construct. As presented in Table 4, the model demonstrated acceptable fit across all reported indices, including CMIN/df = 2.241, RMSEA = 0.068, CFI = 0.950, and NFI = 0.915, indicating that the proposed four-factor structure adequately represented the observed data. The fit indices for the four-factor CFA model are summarized in Table 4.

Table 4. Model Fit Indices for the Four-Factor CFA Model

Measure	Reference Guideline	Estimate
CMIN/df	Between 1 and 3	2.241
RMSEA	< 0.08	0.068
CFI	> 0.90	0.950
NFI	> 0.90	0.915

As presented in Table 4, the four-factor CFA model demonstrated satisfactory overall fit, supporting the structural coherence of Awareness, Usage, Evaluation, and Ethics as dimensions of AI literacy among Indonesian Islamic university students. Once the model fit was confirmed, construct reliability and convergent validity were assessed through standardized factor loadings, Composite Reliability (CR), and Average Variance Extracted (AVE), as detailed in Table 5.

Table 5. CFA Results, Composite Reliability, and AVE

Dimension	Item	Loading	CR	AVE
Awareness	AW1	0.85	0.849	0.720
	AW2	0.88		
	AW3	0.84		
	AW4	0.82		
Usage	US1	0.82	0.862	0.676
	US2	0.80		
	US3	0.78		
Evaluation	EV1	0.88	0.868	0.622
	EV2	0.85		
	EV3	0.83		
	EV4	0.81		
Ethics	ET1	0.78	0.890	0.669
	ET2	0.83		
	ET3	0.81		
	ET4	0.80		

Table 5 shows the CFA results on the standardized factor loadings ranged from 0.78 to 0.88, reflecting strong relationships between the observed indicators and their respective latent constructs. All Composite Reliability (CR) values exceeded the recommended threshold of 0.70, and all Average Variance Extracted (AVE) values were above 0.50, indicating satisfactory internal consistency and convergent validity across the four retained dimensions.

To assess discriminant validity, the analysis examined whether Awareness, Usage, Evaluation, and Ethics were empirically distinct dimensions of AI literacy. This was done by

comparing the square root of AVE for each construct with the correlations among them. As shown in Table 6, all diagonal values exceeded the inter-construct correlations, confirming adequate discriminant validity among the four dimensions.

Table 6. Discriminant Validity Matrix

	Awareness	Usage	Evaluation	Ethics
Awareness	0.766			
Usage	0.405	0.822		
Evaluation	0.383	0.526	0.789	
Ethics	0.152	0.489	0.416	0.818

From Table 6, it can be seen that although Usage and Evaluation demonstrated the strongest correlation, the value remained below the square root of AVE for both constructs, indicating that the dimensions were related yet empirically distinguishable. Overall, the CFA findings demonstrated satisfactory construct validity, reliability, and dimensional distinctiveness for the AILS-IIUS across Awareness, Usage, Evaluation, and Ethics.

Demographic Influences on Islamic AI Literacy

Regression analysis was conducted using Sample B (n = 181) to examine whether demographic variables were associated with students' scores across the four dimensions of Islamic AI literacy. The analysis included gender, academic level, and frequency of AI use as predictors of Awareness, Usage, Evaluation, and Ethics. The use of separate subsamples for exploratory and confirmatory analyses, combined with multiple validation procedures throughout instrument development, strengthened the consistency and interpretability of the findings.

The regression results, presented in Table 7, demonstrated that the frequency of AI use was the strongest and most consistent predictor across all four dimensions of AI literacy. As presented in Table 7, students who engaged more frequently with AI technologies tended to report higher levels of Awareness, Usage, Evaluation, and Ethics. The strongest association was observed for the Evaluation dimension, indicating that repeated AI engagement was closely related to students' ability to critically assess AI-generated information, verify AI outputs, and recognize AI limitations. AI use frequency also demonstrated strong associations with Awareness and Usage, suggesting that repeated interaction with AI technologies contributed to both conceptual understanding and practical AI-supported learning abilities.

Table 7. Regression Analysis of Demographic Influences on AI Literacy Dimensions

Outcome	Predictor	β	p
Awareness	Gender	.125	.028
	Grade level	−.048	.311
	AI use frequency	.542	< .001
Usage	Gender	.112	.042
	Grade level	−.030	.600
	AI use frequency	.548	< .001
Evaluation	Gender	.198	< .001
	Grade level	.042	.441
	AI use frequency	.562	< .001

Outcome	Predictor	β	p
Ethics	Gender	.105	.088
	Grade level	.051	.386
	AI use frequency	.430	< .001

The findings in Table 7 further demonstrated that gender was significantly associated with Awareness, Usage, and Evaluation of AI, although the observed effects were comparatively smaller than those related to the frequency of AI use. This suggests that gender differences may influence familiarity and confidence with AI technologies, but to a lesser extent than how often individuals engage with AI in practical contexts. In contrast, academic level did not significantly predict any of the four dimensions examined, indicating that students' progression through university study alone does not necessarily correlate with higher levels of AI literacy. This could imply that simply advancing academically does not automatically improve one's understanding or skills related to AI. Overall, these findings suggest that the development of AI literacy may depend more heavily on direct, hands-on engagement with AI technologies rather than on academic seniority or progression, emphasizing the importance of practical experience and active learning in acquiring AI-related competencies.

The comparatively weaker predictive relationship observed for the Ethics dimension suggests that ethical engagement with artificial intelligence may not naturally develop solely through exposure to technological tools and applications. While frequent use of AI was positively associated with improved conceptual understanding, practical application skills, and evaluative judgment, the engagement with ethical considerations in AI appeared to necessitate additional targeted educational interventions. This finding underscores the critical importance of intentionally integrating comprehensive ethical AI education and responsible AI pedagogical strategies within the curriculum of Islamic higher education institutions. Such integration is essential to foster a deeper, more consistent ethical awareness and responsible behavior among students as they interact with AI technologies.

The findings of the present study support the interpretation that AI literacy within Islamic higher education should be understood as responsible knowledge practice integrating conceptual understanding, practical AI use, critical evaluation, and ethical engagement. The validated four-dimensional structure, comprising Awareness, Usage, Evaluation, and Ethics, demonstrates that AI literacy among Indonesian Islamic university students extends beyond operational technological competence to encompass broader forms of educational and moral engagement. This finding aligns with contemporary AI literacy frameworks that emphasize multidimensional competencies for understanding, applying, evaluating, and ethically engaging with AI technologies (Long & Magerko, 2020; Ng et al., 2021; Wang et al., 2023). However, the present study further demonstrates that within Islamic higher education, these competencies are closely connected to moral responsibility, educational ethics, and socially accountable knowledge practices.

The emergence of Awareness as a distinct dimension indicates that students' AI literacy involves recognition of AI concepts, limitations, privacy implications, and societal impact. Previous studies similarly suggest that AI literacy requires awareness of both the opportunities and risks associated with AI technologies (Laupichler et al., 2023; Wang et al., 2023). Within the present framework, however, Awareness also reflects moral consciousness regarding the implications of AI use in educational and social contexts. This interpretation resonates with Islamic educational philosophy, which emphasizes that knowledge acquisition should involve ethical awareness and responsible understanding rather than mere cognitive mastery (Al-Attas, 1979; Halstead, 2004). Consequently, awareness of AI-related risks and implications becomes

part of responsible educational engagement within Islamic higher education.

The findings related to the Usage dimension further indicate that AI literacy involves practical engagement with AI technologies for learning, collaboration, and academic problem-solving. This finding is consistent with previous research demonstrating that university students increasingly use AI technologies to support academic tasks and learning processes (Ng et al., 2021; Singh et al., 2024). However, the present study extends existing literature by interpreting AI-supported learning through the principle of *amanah*, emphasizing trustworthiness and responsibility in the use of AI-generated content. Within Islamic higher education, AI-supported learning cannot be separated from academic integrity and ethical responsibility. Therefore, effective AI use should involve not only technological efficiency but also honesty, accountability, and responsible engagement with digital knowledge production.

The strong emergence of the Evaluation dimension highlights the importance of critical judgment in students' interaction with AI-generated information. The retained indicators of verification, transparency, reliability, and recognition of AI limitations suggest that students perceived AI-generated information as requiring active scrutiny rather than passive acceptance. This finding supports previous studies identifying evaluative judgment as a central component of AI literacy (Long & Magerko, 2020; Wang et al., 2023). Within the Islamic educational framework, this evaluative orientation reflects the principle of *tabayyun*, which emphasizes careful verification of information before acceptance or dissemination. The findings, therefore, suggest that AI literacy within Islamic higher education should involve epistemic responsibility and critical examination of AI-generated outputs, particularly in contexts where AI technologies may generate misinformation, biased content, or inaccurate academic information.

The Ethics dimension also emerged as a coherent component of AI literacy involving privacy protection, fairness, accountability, social reflection, and awareness of misuse. These findings align with contemporary discussions concerning responsible AI engagement, digital ethics, and algorithmic accountability (Alamäki et al., 2024; Kong et al., 2023). Nevertheless, the present study demonstrates that ethical AI literacy within Islamic higher education is not limited to general digital ethics concerns. Instead, ethical AI engagement is interpreted through the principles of *adab, 'adl,* and *maslahah,* emphasizing responsible conduct, fairness, harm prevention, and social responsibility. This finding suggests that Islamic educational philosophy provides a substantive ethical framework for AI engagement by positioning technological competence within broader concerns of morality and educational responsibility.

The EFA and CFA findings further demonstrated that Awareness, Usage, Evaluation, and Ethics were empirically distinct yet theoretically interconnected dimensions. The strongest relationship between Usage and Evaluation indicates that frequent practical interaction with AI technologies may strengthen students' evaluative judgement and familiarity with AI limitations. Similar findings have been reported in studies suggesting that repeated engagement with AI may improve users' ability to critically assess AI-generated outputs (Ma & Chen, 2024; Nong et al., 2024). However, the multidimensional structure identified in the present study also indicates that practical AI competence alone does not automatically guarantee ethical or critical AI engagement.

The regression findings provide additional insight into the development of Islamic AI literacy. Frequency of AI use emerged as the strongest predictor across Awareness, Usage, Evaluation, and Ethics, indicating that repeated AI engagement contributed significantly to students' conceptual understanding, practical AI use, and evaluative judgement. This finding is consistent with previous studies suggesting that technological familiarity and repeated AI exposure contribute positively to AI literacy development (Gokce et al., 2024; Wang & Chuang, 2023). The weak link between AI use frequency and Ethics indicates ethical AI engagement needs more educational efforts beyond exposure.

This finding carries significant pedagogical implications for Islamic higher education institutions. While repeated AI use may enhance operational competence and evaluative awareness among students, fostering ethical AI behavior appears to necessitate more deliberate pedagogical guidance and reflective educational practices. This approach aligns closely with Islamic educational philosophy, which emphasizes that education should integrate the acquisition of knowledge with the development of moral character and ethical values (Al-Attas, 1979; Halstead, 2004; Sahin, 2018). Therefore, AI literacy education within Islamic universities should extend beyond merely teaching technical AI skills. It should also focus on nurturing ethical awareness, promoting responsible conduct, and encouraging reflective engagement with AI technologies. Such comprehensive education aims to prepare students not only to be proficient users of AI but also morally responsible individuals who deeply consider the broader societal and ethical implications of AI deployment. This holistic approach ensures that AI integration in Islamic higher education contributes meaningfully to both individual character development and the ethical advancement of society.

The findings, therefore, support the integration of ethical AI learning within curriculum design and digital pedagogy in Islamic higher education. Current AI adoption in educational settings often prioritizes technological efficiency, automation, and productivity without sufficiently addressing ethical reflection or responsible knowledge practices. However, the present findings indicate that responsible AI engagement requires educational support related to verification practices, academic honesty, privacy protection, fairness, and awareness of AI-generated misinformation. Integrating these concerns into curriculum and instructional practices may help students develop balanced AI literacy, combining technical competence with ethical and social responsibility.

From a pedagogical perspective, Islamic higher education institutions may incorporate AI literacy into classroom instruction through reflective and inquiry-based learning approaches. For example, students may be encouraged to critically evaluate AI-generated information, compare AI outputs with verified academic sources, identify misinformation and algorithmic bias, and reflect on the ethical implications of AI use in academic contexts. Such learning practices align closely with the principle of *tabayyun* through verification-oriented learning and critical examination of information sources. Similarly, discussions regarding responsible AI-supported writing, academic integrity, and ethical use of generative AI technologies may strengthen students' understanding of *amanah* and *adab* within digital learning environments.

The findings also contribute to broader discussions concerning digital transformation within Islamic higher education institutions. As AI technologies increasingly influence learning, research, communication, and knowledge production, Islamic universities face the challenge of balancing technological adaptation with the preservation of educational values and institutional identity. The present study suggests that Islamic educational philosophy may provide an important ethical foundation for navigating these transformations. Rather than rejecting AI technologies or adopting them uncritically, Islamic higher education institutions may position AI literacy within a balanced pedagogical framework emphasizing responsibility, verification, fairness, and social benefit.

The validated AILS-IIUS framework also contributes theoretically to AI literacy research by demonstrating that AI literacy may be interpreted differently across educational and cultural contexts. Existing AI literacy frameworks are commonly developed within technologically oriented or secular educational environments emphasizing operational competence and general digital participation (Long & Magerko, 2020; Ng et al., 2021). In contrast, the present study demonstrates that Islamic educational philosophy reshapes the interpretation of AI literacy by positioning technological competence within broader concerns of morality, responsibility, and ethical educational engagement. This finding suggests that AI

literacy frameworks may benefit from greater contextual and philosophical sensitivity when applied across diverse educational traditions and value-based educational systems.

Overall, the findings support the conclusion that AI literacy in Islamic higher education should be understood as a responsible knowledge practice that integrates awareness, practical engagement, evaluative judgement, and ethical responsibility. The four-dimensional framework validated in the present study demonstrates that AI literacy is not solely concerned with technological proficiency, but also with the cultivation of morally responsible engagement with AI technologies. Accordingly, Islamic higher education institutions may play an important role in developing forms of AI literacy that balance digital competence with ethical reflection, social responsibility, and the broader pedagogical mission of Islamic education.

CONCLUSION

This study developed and validated the Artificial Intelligence Literacy Scale for Indonesian Islamic University Students (AILS-IIUS), grounded in the framework of Islamic AI literacy as responsible knowledge practice. The findings confirmed a valid four-dimensional structure comprising Awareness, Usage, Evaluation, and Ethics, demonstrating that AI literacy in Islamic higher education extends beyond technical competence to critical, ethical, and socially responsible engagement with AI technologies. The triangulated validation process involving theoretical grounding, expert review, student-based contextual refinement, exploratory factor analysis, confirmatory factor analysis, and regression analysis further supported the reliability and construct validity of the instrument. The results also revealed that frequent AI engagement strengthened students' conceptual understanding, practical AI use, and evaluative judgement, although ethical AI engagement appeared to require more intentional pedagogical guidance and value-based instruction. Accordingly, the study suggests that AI literacy within Islamic higher education should be integrated into curriculum design, ethical AI pedagogy, and digital learning practices that emphasize *adab, amanah, tabayyun, 'adl,* and *maslahah*. The AILS-IIUS therefore provides not only a context-sensitive measurement instrument but also a pedagogical framework to support responsible AI learning and ethical digital transformation in Islamic higher education institutions.

BIBLIOGRAPHY

Alamäki, A., Nyberg, C., Kimberley, A., & Salonen, A. O. (2024). Artificial intelligence literacy in sustainable development: A learning experiment in higher education. *Frontiers in Education, 9*, Article 1343406. https://doi.org/10.3389/feduc.2024.1343406

Al-Attas, S. M. N. (Ed.). (1979). *Aims and objectives of Islamic education*. London: Hodder and Stoughton.

Atika, Q., Najmul, H., Olusola, A. A., Hardaker, G., Ronny, S., Yeahia, S., Paul, S. K., & Zubairu, M. J. (2022). Gender differences in information and communication technology use & skills: a systematic review and meta-analysis. *Education and Information Technologies*, *27*(3), 4225-4258. https://doi.org/10.1007/s10639-021-10775-x

Brennan, K., & Resnick, M. (2012). New frameworks for studying and assessing the development of computational thinking. *Proceedings of the 2012 Annual Meeting of the American Educational Research Association*, 1-25. Retrieved from http://scratched.gse.harvard.edu/ct/files/AERA2012.pdf

Du, X., & Wang, X. (2023). Play by design: developing artificial intelligence literacy through game-based learning. *Journal of Computer Science Research*, *5*(4), 1-12. https://doi.org/10.30564/jcsr.v5i4.5999

Firdaus, S., Suwendi, S., Nafi'a, I., Gumiandari, S., Huriyah, H., & Juanda, A. (2025). Transforming Islamic higher education: Integrating Islamic values and digital technology at UIN Siber Cirebon. *Jurnal Ilmiah Peuradeun, 13*(3), 2337–2362. https://doi.org/10.26811/peuradeun.v13i3.2330

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18*(1), 39–50. https://doi.org/10.1177/002224378101800104

Gokce, A.T, Deveci Topal, A., Kolburan Geçer, A., & Dilek Eren, C. (2025). Investigating the level of artificial intelligence literacy of university students using decision trees. *Education and Information Technologies*, *30*(5), 6765-6784. https://doi.org/10.1007/s10639-024-13081-4

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate data analysis* (8th ed.). Boston: Cengage Learning.

Halstead, J. M. (2004). An Islamic concept of education. *Comparative Education, 40*(4), 517–529. https://doi.org/10.1080/0305006042000284510

Hargittai, E., & Shafer, S. (2006). Differences in actual and perceived online skills: The role of gender. *Social Science Quarterly, 87*(2), 432–448. https://doi.org/10.1111/j.1540-6237.2006.00389.x

Hwang, H. S., Zhu, L. C., & Cui, Q. (2023). Development and validation of a digital literacy scale in the artificial intelligence era for college students. *KSII Transactions on Internet and Information Systems, 17*(8), 2241–2258. https://doi.org/10.3837/tiis.2023.08.016

Kline, R. B. (2016). *Principles and practice of structural equation modeling* (4th ed.). New York: Guilford Press.

Kong, S.-C., Cheung, W. M.-Y., & Zhang, G. (2023). Evaluating an Artificial Intelligence Literacy Programme for Developing University Students' Conceptual Understanding, Literacy, Empowerment and Ethical Awareness. *Educational Technology & Society, 26*(1), 16–30. Retrieved from https://www.jstor.org/stable/48707964

Kuhlman, C., Jackson, L., & Chunara, R. (2020). No computation without representation: Avoiding data and algorithm biases through diversity. *arXiv preprint arXiv:2002.11836*. Retrieved from https://arxiv.org/abs/2002.11836

Laupichler, D., Ng, D. T. K., & Pinski, F. (2023). Development of the scale for the assessment of non-experts' AI literacy: An empirical study. *Education and Information Technologies*. Advance online publication. https://doi.org/10.1007/s10639-023-11234-2

Long, D., & Magerko, B. (2020). What is AI literacy? Competencies and design considerations. *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems,* 1–16. https://doi.org/10.1145/3313831.3376727

Ma, S., & Chen, Z. (2024). The development and validation of the Artificial Intelligence Literacy Scale for Chinese College Students (AILS-CCS). *IEEE Access*, PP(99), 1-1. https://doi.org/10.1109/ACCESS.2024.3468378

Mansoor, H. M. H., Bawazir, A., Alsabri, M. A., Alharbi, A., & Okela, A. H. (2024). Artificial intelligence literacy among university students—a comparative transnational survey. *Frontiers in Communication, 9*, 1478476. https://doi.org/10.3389/fcomm.2024.1478476

Ng, D. T. K., Leung, J. K. L., Chu, S. K. W., & Qiao, M. S. (2021). Conceptualizing AI literacy: An exploratory review. *Computers and Education: Artificial Intelligence*, 2, 100041. https://doi.org/10.1016/j.caeai.2021.100041

Ng, D. T. K., Wu, W., Leung, J. K. L., & Chu, S. K. W. (2023). Artificial intelligence (AI) literacy questionnaire with confirmatory factor analysis. *Proceedings of the IEEE International Conference on Advanced Learning Technologies*, 233–235. https://doi.org/10.1109/ICALT58380.2023.00080

Ng, W. (2021). AI literacy: Enhancing students' abilities to critically understand and evaluate AI in their everyday lives. *Computers & Education, 168,* 104209. https://doi.org/10.1016/j.compedu.2021.104209

Nong, Y., Cui, J., He, Y., Zhang, P., & Zhang, T. (2024). Development and Validation of an AI Literacy Scale. *Journal of Artificial Intelligence Research*, *1*(1), 33-54. https://doi.org/10.70891/JAIR.2024.100029

Rafida, T., Suwandi, S., & Ananda, R. (2024). EFL students' perception in Indonesia and Taiwan on using artificial intelligence to enhance writing skills. *Jurnal Ilmiah Peuradeun, 12*(3), 987–1016. https://doi.org/10.26811/peuradeun.v12i3.1520

Sahin, A. (2018). Critical issues in Islamic education studies: Rethinking Islamic and Western liberal secular values of education. *Religions, 9*(11), 335. https://doi.org/10.3390/rel9110335

Schermelleh-Engel, K., Moosbrugger, H., & Müller, H. (2003). Evaluating the fit of structural equation models: Tests of significance and descriptive goodness-of-fit measures. *Methods of Psychological Research Online, 8*(2), 23–74. Retrieved from https://www.stats.ox.ac.uk/~snijders/mpr_Schermelleh.pdf

Singh, E., Vasishta, P., & Singla, A. (2024). AI-enhanced education: Exploring the impact of AI literacy on generation Z's academic performance in Northern India. *Quality Assurance in Education, 33*(2), 185–202. https://doi.org/10.1108/QAE-02-2024-0037

Wang, B., & Chuang, Y.-W. (2023). Artificial intelligence self-efficacy: Scale development and validation. *Education and Information Technologies, 29*, 4785–4808. https://doi.org/10.1007/s10639-023-12015-w

Wang, B., Rau, P.-L. P., & Yuan, T. (2023). Measuring user competence in using artificial intelligence: Validity and reliability of artificial intelligence literacy scale. *Behaviour & Information Technology, 42*(9), 1324–1337. https://doi.org/10.1080/0144929X.2022.2072768

Wang, L., & Li, W. (2024). The impact of AI usage on university students' willingness for autonomous learning. *Behavioral Sciences, 14*(10), 956. https://doi.org/10.3390/bs14100956

Wang, S., Chen, M., & Zhang, Q. (2023). The development and validation of an AI literacy scale for college students. *Educational Technology Research and Development, 71*(2), 215–233. https://doi.org/10.1007/s11423-022-10100-4

Zhou, Y., & Schofield, S. (2024). Developing a conceptual framework for artificial intelligence (AI) literacy in higher education. *Journal of Learning Development in Higher Education, 26*. https://doi.org/10.47408/jldhe.vi26.832