Journal of Culture and Values in Education

https://cultureandvalues.org

E-ISSN: 2590-342X

Volume: 9 Issue: 1 2026

pp. 335-360

Symbolic and Epistemic Dimensions of Islamic Values Integration in Undergraduate Biology Education

Indayana Febriani Tanjung[a], Ibrohim Ibrohim*[a], Herawati Susilo[a] & Ira Suryani[b]

* Corresponding author:
Email: ibrohim.fmipa@um.ac.id
a. Department Biology, Universitas Negeri Malang, Malang, Indonesia
Biology Education, Universitas Islam Negeri Sumatera Utara, Medan, Indonesia.
b. Universitas Islam Negeri Sumatera Utara Medan, Indonesia

Article Info
Received: December 23, 2025
Accepted: March 13, 2026
Published: April 8, 2026

10.46303/jcve.2026.15

How to cite
Tanjung, I. F, Ibrohim, I., Susilo, H., & Suryani, I. (2026). Symbolic and Epistemic Dimensions of Islamic Values Integration in Undergraduate Biology Education. *Journal of Culture and Values in Education*, 9(1), 335-360. https://doi.org/10.46303/jcve.2026.15

ABSTRACT

Value-based higher education institutions face dual legitimacy pressures to maintain distinctive normative identities while demonstrating academic credibility. Within science education, however, the quality of values integration—beyond its symbolic presence—remains underexamined. This study examined (1) differences between symbolic and epistemic dimensions of Islamic values integration, (2) their structural associations with instructional practices, and (3) cross-institutional consistency in these patterns. Using a cross-sectional multi-source design, data were collected from 150 biology education students, 10 course syllabi, and five instructors across four Islamic higher education institutions in Indonesia. Nonparametric analyses indicated that Islamic values were highly visible in instructional practices, whereas engagement with scientific epistemic practices received substantially less emphasis, resulting in a large, statistically significant difference. Strong positive associations among instructional dimensions indicated that planning and assessment practices were structurally interconnected with opportunities for epistemic engagement. These patterns were consistent across institutions, suggesting systemic rather than institution-specific dynamics. Conceptually, the findings position values integration along a continuum from symbolic visibility to epistemic depth, indicating that current practices operate predominantly at the symbolic level. This study offers an empirically grounded analytical framework for evaluating the quality of values integration in value-based science education contexts.

KEYWORDS

Symbolic dimension; epistemic dimension; Islamic values integration; science education; biology education; Islamic higher education.

INTRODUCTION

Higher education institutions grounded in religious traditions face a persistent dual mandate: sustaining disciplinary rigor while affirming normative commitments. In scientific disciplines, where knowledge claims are justified through empirical evidence, methodological transparency, and disciplinary standards, this mandate generates structural tensions. Institutions are expected not only to transmit scientific knowledge but also to integrate religious or moral values that shape identity and ethical responsibility (Barnes et al., 2020; Paiva et al., 2022). The challenge is not whether values should be present in science education, but how they meaningfully intersect with epistemic practices that govern knowledge construction and justification.

Across diverse contexts, values integration has become a widely endorsed educational objective. Religious institutions incorporate faith-based principles, secular institutions emphasize sustainability and social justice, and culturally grounded universities foreground Indigenous or local knowledge systems (Druker-Ibáñez & Cáceres-Jensen, 2022; Zidny et al., 2020). However, despite strong normative endorsement, much of the existing literature conceptualizes integration primarily in terms of the presence of explicit value references, rather than examining how values function within disciplinary learning and scientific reasoning (Hudson et al., 2023; Tytler et al., 2025).

Scholarship on values integration has developed several theoretical approaches, including value clarification, moral reasoning, social learning, and direct instruction models (Chen et al., 2023; Raths et al., 1978). The Value Clarification Approach emphasizes students' reflection and articulation of their personal values (Raths et al., 1978), but it risks relativism when it lacks normative criteria (Arthur, 2024). The Moral Reasoning Approach, based on theories of moral development (Gilligan, 1982; Kohlberg, 1981), develops ethical reasoning through engagement with socio-scientific dilemmas (Atabey & Topçu, 2025; Zeidler, 2024), yet it requires careful scaffolding to be effective. The Social Learning Approach views values as socially acquired through modeling and interaction (Bandura, 1971), which shapes students' epistemic beliefs and disciplinary identities (Van Der Leij et al., 2024), although this process often remains implicit. The Direct Instruction Approach explicitly teaches core values within the curriculum (Hill et al., 2025), including Islamic values such as *Tawhid*, *Amanah*, and *Ihsan* (Latjompoh et al., 2025), but explicit articulation does not necessarily ensure internalization.

Although these frameworks differ in how values are formed and transmitted, they share a common limitation: values are primarily positioned as objects of moral formation rather than as epistemic resources shaping standards of knowledge construction and evaluation within disciplinary practice (Annala, 2022; Stroupe et al., 2024). Consequently, integration is frequently assessed in terms of value articulation or curricular visibility rather than functional depth within knowledge-building processes.

This limitation becomes particularly salient in undergraduate biology education, where learning quality is increasingly understood in terms of participation in epistemic practices. Epistemic practices include generating and justifying knowledge claims, evaluating evidence, critiquing arguments, and reflecting on methodological limitations (Berland et al., 2016; Kelly & Licona, 2018). From this perspective, meaningful integration cannot be assessed solely by the presence of value language in instructional discourse, but by whether such values influence how students interpret evidence and justify scientific claims.

Within Islamic higher education, values integration typically encompasses theological principles such as tawhid (unity of knowledge), khalifah (human stewardship), mizan (balance in creation), and maslahah (public benefit) (Bakar, 1999). Systematic reviews have documented the increasing incorporation of such principles into science curricula through ethical framing and theological contextualization (Amin et al., 2022; Sumarni et al., 2020). In this perspective, Islamic values function not only as moral teachings but also as normative–epistemic frames that shape how scientific knowledge is interpreted and evaluated within an Islamic worldview (Al-Faruqi, 1982; Attas, 1995; Nasr, 1996). These principles may influence how scientific problems are framed, how risks and benefits are evaluated, and how knowledge claims are justified in broader societal contexts (Alkouatli, 2024; Dev et al., 2025; Elmahjub, 2023; Raquib et al., 2022; Taşkın, 2014). However, despite growing curricular incorporation, empirical studies have primarily focused on documenting the incorporation of Islamic values in curricula without examining whether such integration substantively shapes students' engagement with scientific epistemic practices.

Across diverse educational systems, the integration of moral, cultural, or religious values into disciplinary learning has become an increasingly visible feature of higher education curricula (Sahin, 2018). Universities grounded in religious traditions, including Islamic higher education institutions, often institutionalize value integration as part of their educational identity and curriculum mandates (Firdaus et al., 2025; Syauqi et al., 2025). Within science education, this integration frequently appears through references to religious principles, ethical framing of scientific topics, or explicit statements linking scientific knowledge with broader moral commitments (Mansour, 2008, 2011). Empirical studies have documented the incorporation of Islamic values in science instruction through theological references, ethical contextualization of biological concepts, and identity-affirming discourse in classroom practices (Latjompoh et al., 2025; Mansour, 2010). However, these studies have primarily focused on documenting the presence of Islamic values, providing limited insight into how such values shape disciplinary reasoning or epistemic engagement in science learning.

Despite the growing visibility of Islamic values in science curricula, little empirical research has examined whether such integration functions symbolically or epistemically within disciplinary learning processes. Consequently, existing studies provide limited analytical tools for assessing the depth of values integration in science education (Rudolph, 2020). Most studies describe whether Islamic principles appear in curricular documents or instructional discourse but rarely investigate whether these values shape students' engagement with scientific reasoning, evidence evaluation, or methodological justification (Erduran et al., 2022; Park et al., 2022). Consequently, integration is often implicitly treated as a binary condition—values are either included or absent—without analytical tools for assessing the depth or quality of integration (Bowie et al., 2023). Addressing this limitation requires a conceptual framework capable of distinguishing between the visible articulation of values and their epistemic role in shaping disciplinary reasoning (Erduran et al., 2019). However, empirical studies applying such distinctions in Islamic science education remain limited.

The symbolic dimension refers to the ways values and principles are communicated through symbolic representations embedded in language, instructional discourse, and curriculum content (Filgona et al., 2024; Hasnah et al., 2025). In educational contexts, symbolic representations function as mediating tools that help learners interpret meanings, internalize norms, and connect abstract ideas with cultural and social values conveyed through teaching practices. Within instructional settings, this dimension is reflected in the use of language, conceptual terminology, and narrative forms that structure how values are communicated and understood in the learning process (Henríquez & Oñate, 2017). These symbolic forms enable teachers to integrate value-laden meanings into classroom discourse and learning materials, thereby shaping students' understanding of knowledge and ethical orientation. In Islamic education, symbolic representations often appear in the form of Qur'anic references, religious terminology, and ethical narratives that are incorporated into learning materials and instructional practices (Aqool, 2022; Isik & Akbari, 2024; Supriyadi et al., 2026). These symbolic elements function as carriers of Islamic values, allowing students to engage with moral teachings and religious meanings within the learning process.

In educational research, symbolic dimensions of values are therefore typically examined through the visibility of value representations within instructional discourse and learning materials. Accordingly, in this study the symbolic dimension of Islamic values is examined through Islamic Values Visibility, referring to the presence of Qur'anic references, religious terminology, and ethical narratives embedded in instructional discourse and learning materials.

The epistemic dimension refers to the extent to which learning engages students in understanding how knowledge is generated, evaluated, and justified through reasoning and evidence (Hofer, 2004; Krist, 2020). Rather than focusing solely on the transmission of factual knowledge, this dimension emphasizes students' participation in epistemic practices such as inquiry, evidence evaluation, and the construction of knowledge claims. In educational contexts, the epistemic dimension becomes visible in instructional practices that encourage scientific inquiry, argumentation, and the critical evaluation of explanations based on empirical evidence (Soysal, 2025). Through such practices, learners develop an understanding of the processes through which knowledge is constructed and validated within scientific disciplines. From an Islamic perspective, epistemic values are also reflected in the encouragement to seek knowledge, observe natural phenomena, and reflect upon creation. The Qur'an repeatedly invites believers to read, observe, and contemplate the signs of God in the universe, highlighting the importance of reasoning and inquiry in understanding truth (e.g., QS. Al-'Alaq 96:1–5; QS. Ali Imran 3:190–191).

To examine how epistemic values are enacted in classroom practice, this study employs scientific methodology emphasis as an analytical category to capture the epistemic dimension of learning. In this study, the term refers to the extent to which teaching practices foreground key features of scientific inquiry, including questioning, observation, evaluating evidence, and justifying knowledge claims through systematic investigation. This conceptualization is informed by literature on epistemic knowledge and epistemic practices, which highlights that science learning involves not only procedural engagement but also reasoning about how knowledge is constructed, evaluated, and justified (Agustian, 2023; Zetterqvist & Bach, 2023). From this perspective, distinguishing between symbolic and epistemic dimensions provides an analytical basis for understanding how knowledge is both represented and constructed in educational practice. While the symbolic dimension concerns the communication of values and meanings through language, discourse, and instructional representations, the epistemic dimension concerns the generation and justification of knowledge through reasoning and evidence.

While prior studies on Islamic values integration in science education have primarily focused on curricular presence or moral framing, the present study introduces a symbolic–epistemic analytical framework for evaluating the depth of integration. By distinguishing between the symbolic articulation of values and the epistemic engagement of students in scientific reasoning practices, this framework enables a more precise assessment of whether values integration functions primarily as institutional identity signaling or as a substantive component of disciplinary knowledge construction within biology education. Despite this emerging conceptual distinction, prior studies still primarily document the curricular presence and visibility of Islamic values in science education.

Although prior studies document the curricular presence and visibility of Islamic values in science education (Amin et al., 2022; Latjompoh et al., 2025), considerably less attention has been given to how deeply such integration functions within disciplinary knowledge construction. Existing research has not systematically differentiated between symbolic articulation and epistemic engagement when examining Islamic values integration in science education (Agustian, 2023). Recent scholarship in science education emphasizes the centrality of epistemic practices such as evidence evaluation, justification of claims, and methodological reasoning as defining features of disciplinary learning (Duschl, 2008; Jiménez-Aleixandre & Crujeiras, 2017). Without analytically distinguishing between symbolic visibility and epistemic functioning, the quality of integration cannot be systematically evaluated, particularly when epistemic practices are considered foundational to disciplinary competence (Kelly & Licona, 2018; Stroupe et al., 2024).

These limitations point to an empirical gap regarding the depth of integration. To date, few studies have systematically tested whether visible integration of Islamic values is matched by substantive engagement in epistemic practices within undergraduate science instruction. As calls increase for greater epistemic quality in science education (Hudson et al., 2023; Tytler et al., 2025), empirical examination of integration depth becomes necessary to determine whether values integration reshapes disciplinary reasoning or primarily signals institutional identity.

This study constitutes an evaluative investigation of how Islamic values and scientific epistemic practices are positioned within undergraduate biology instruction in Islamic higher education contexts. Rather than proposing a pedagogical model, the study examines existing instructional structures to assess the relative emphasis and alignment of symbolic visibility and epistemic engagement. The focus is therefore on analyzing enacted instructional patterns rather than designing or testing an intervention model.

The following research questions guide the study:

RQ1: To what extent do the symbolic and epistemic dimensions differ in their respective emphases within undergraduate biology instruction?

RQ2: To what extent are the symbolic and epistemic dimensions related to instructional planning, implementation, and assessment practices?

RQ3: Do patterns in the symbolic and epistemic dimensions vary significantly across institutional contexts?

METHODS

Research Design

This study employed a cross-sectional design, in which data were collected from participants at one point in time to examine differences and structural relationships among key instructional dimensions in undergraduate biology education (Leavy, 2017). The study drew on three sources of evidence—student questionnaires, lecturer surveys with open-ended responses, and syllabus documents—allowing triangulation across data sources (Heale & Forbes, 2013). The symbolic dimension was operationalized through Islamic Values Visibility, referring to the visibility of symbolic representations of Islamic values within instructional discourse and learning materials. The epistemic dimension was operationalized through Scientific Methodology Emphasis, which is used in this study as an analytical category to capture the extent to which instruction emphasizes hypothesis testing, evidence evaluation, and methodological reasoning. In addition, three instructional quality dimensions—instructional planning, instructional implementation, and assessment practices—were included to examine how these dimensions are reflected in teaching practices.

The unit of analysis was instructional practice at the course level as represented in institutional documents and reflected in student and instructor reports. Findings are therefore interpreted as patterns of instructional emphasis and structural alignment among symbolic and epistemic dimensions within undergraduate biology instruction. The multi-source design enables triangulation among student perceptions, instructional planning documents, and instructors’ perspectives, allowing a systematic examination of convergence and divergence at the pedagogical and institutional levels (Creswell & Plano Clark, 2018).

Context and Participants

The study was conducted across four Islamic higher education institutions in Indonesia with explicit institutional mandates to integrate Islamic values into science curricula. The participating institutions, all of which offer undergraduate biology education programs, were purposively selected to capture variation in institutional context rather than to support statistical generalization (Patton, 2002).

Participants consisted of 150 undergraduate students enrolled in biology education programs at four Islamic higher education institutions in Indonesia: (1) Universitas Islam Negeri Sumatera Utara Medan (n = 75, 50.0%); (2) Universitas Islam Negeri Sulthan Thaha Saifuddin Jambi (n = 44, 29.3%); (3) Universitas Islam Negeri Syekh Ali Hasan Ahmad Addary Padangsidimpuan (n = 7, 4.7%); and (4) Universitas Islam Sumatera Utara (n = 24, 16.0%). Participants were drawn from Semesters II (28.7%), IV (32.7%), and VI (38.7%). The majority of participants were female (91.3%). This gender distribution reflects the demographic composition of biology education programs in Indonesian higher education, where female enrollment substantially exceeds male enrollment, particularly within teacher education tracks (Saadat et al., 2022; UNESCO, 2021). Therefore, the observed gender imbalance represents the structural characteristics of the program population rather than a sampling distortion. Given the unequal distribution of participants across institutions, cross-institutional comparisons are interpreted with caution, emphasizing structural patterns rather than definitive group-level conclusions. Therefore, cross-institutional analysis focuses on pattern consistency rather than institutional ranking.

All four institutions carry formal mandates from the Ministry of Religious Affairs of Indonesia to integrate Islamic values into their science curricula. Within each institution, participants were recruited through course coordinators responsible for undergraduate biology education courses. These coordinators distributed the online survey link to students enrolled in the relevant courses, resulting in participation from four institutions. Purposive criteria restricted participation to students actively enrolled in a biology education program within an Islamic institutional context. A non-probability sampling strategy was employed, specifically purposive sampling combined with convenience procedures, which are common in cross-sectional educational research where probability sampling is logistically constrained and where contextual specificity is analytically prioritized (Andrade, 2021; Etikan, 2016; Memon et al., 2025).

The sample size of 150 was adequate for detecting moderate effects and examining associative patterns in cross-sectional survey research (Hair et al., 2022). Given the study's focus on examining differences and structural associations within a defined institutional context, this sample size was sufficient for the planned non-parametric inferential analyses. As a non-probability sample drawn from a specific institutional and regional context, the findings should be interpreted as analytically generalizable rather than statistically generalizable to all biology education programs. The study aims to provide contextualized insight into instructional patterns within Islamic higher education settings, and conclusions are therefore bounded to comparable institutional contexts. Although the empirical setting of this study is Islamic higher education, the analytical focus on value integration as a pedagogical and epistemic phenomenon allows the findings to be interpreted in relation to other science education contexts that operate within explicitly value-based institutional frameworks.

Data Sources and Instruments

Three complementary data sources were used to capture instructional practices related to the integration of Islamic values and the emphasis on epistemic dimensions in biology education: a student survey, a course syllabi analysis, and an instructor survey.

Student Survey Instrument

Student perceptions of instructional practices were collected using a structured survey instrument comprising 79 items across six dimensions: Instructional Characteristics (27 items), Instructional Planning (18 items), Instructional Implementation (9 items), Assessment Practices (14 items), Islamic Values Visibility (6 items), and Scientific Methodology Emphasis (5 items). These six dimensions correspond to the analytical framework of the study. Islamic Values Visibility captures the degree to which Islamic principles are articulated within instructional practice. Scientific Methodology Emphasis reflects engagement in epistemic practices such as hypothesis testing, evidence evaluation, and methodological reasoning. In the present study, this dimension represents the epistemic context of instruction within which values may shape how evidence is interpreted and knowledge claims are justified, and is therefore conceptualized broadly to include critical appraisal of scientific claims and evidence-based reasoning rather than merely procedural laboratory activities. The remaining three dimensions represent key components of instructional quality (planning, implementation, and assessment). All 79 items across the six dimensions underwent expert content validity review simultaneously in a single validation process. Instrument development involved a systematic literature review, theoretical mapping of constructs, and cross-disciplinary expert consultation (DeVellis, 2017).

Content validity was established through expert review by five experts: two in Biology Education and Science Teaching Methods (Universitas Negeri Medan), one in Islamic Education and Curriculum Development (UIN Sumatera Utara Medan), one in Islamic Education and Values Integration (UIN Sumatera Utara Medan), and one in Psychometrics, Measurement, and Assessment (UIN Sumatera Utara Medan). All items achieved excellent content validity, with Item Content Validity Index (I-CVI) values of 1.00 and a Scale Content Validity Index (S-CVI/Ave) of 1.00, exceeding recommended thresholds (Polit & Beck, 2006).

Internal consistency reliability was first established through pilot testing with 87 undergraduate biology education students enrolled at Universitas Islam Negeri Mahmud Yunus Batusangkar, an Islamic higher education institution not included in the main study sample. Cronbach's alpha indicated excellent reliability for the full scale (α = .93) and acceptable to excellent reliability across subscales (α = .78–.91). Construct validity was examined using exploratory factor analysis (EFA), which demonstrated adequate sampling adequacy (KMO =

.86) and a significant Bartlett's test of sphericity ($p < .001$), indicating that the data were suitable for examining the instrument's multidimensional structure in line with the theoretical framework. In the main study sample ($N = 150$) drawn from four Indonesian Islamic universities, internal consistency reliability was re-examined to confirm measurement stability. Cronbach's alpha indicated excellent reliability for the full scale ($\alpha = .94$) and acceptable to excellent reliability across subscales ($\alpha = .65$–$.92$), with the lowest subscale reliability remaining within acceptable bounds for exploratory educational research. Construct validity was further examined using exploratory factor analysis, which demonstrated adequate sampling adequacy (KMO = .82) and a significant Bartlett's test of sphericity ($p < .001$), confirming the suitability of the data for factor analysis and providing additional evidence of structural consistency across samples.

Syllabi Analysis Instrument

Course syllabi (Rencana Pembelajaran Semester, RPS) were analyzed as institutional artifacts that represent formal instructional planning and expectations. A total of 10 syllabi were collected from biology education programs across four institutions, covering courses such as General Biology, Cell Biology, Genetics, Ecology, and Evolution.

The six indicators were designed to parallel the dimensions assessed in the student survey to ensure cross-source comparability. All six indicators were systematically evaluated in each syllabus during the coding process. A directed coding scheme was developed with six indicators aligned with the analytical framework of the study. (1) Learning outcomes clarity assessed the degree to which syllabi specify measurable learning outcomes (instructional planning quality). (2) Teaching methods clarity examined the specificity of instructional strategies described in syllabi (instructional implementation quality). (3) Symbolic dimension (Islamic Values Visibility) assessed the frequency and explicitness of Islamic values references in syllabi content, ethical framing, and learning objectives, without specifying how these values shape scientific reasoning or knowledge evaluation. (4) Islamic values–science epistemic linkage assessed the extent to which Islamic principles were explicitly linked to scientific reasoning processes (e.g., evidence evaluation, justification of claims, interpretation of uncertainty) within course descriptions and learning activities. (5) Assessment clarity examined whether syllabi specify evaluation criteria aligned with course objectives (assessment quality). (6) Epistemic dimension (Scientific Methodology Emphasis) assessed the extent to which syllabi explicitly require students to engage in hypothesis testing, evidence evaluation, and methodological reasoning. Each indicator was rated on a 3-point scale (1 = not present, 2 = partially present, 3 = clearly present). Two independent coders conducted the analysis, yielding high inter-rater reliability (percentage agreement = 88%; Cohen's kappa = 0.82). Discrepancies were resolved through consensus discussion.

Instructor Survey

An instructor survey was administered to five biology instructors whose students participated in the study. The instrument consisted of two parts: (1) Closed-ended items (10 items) using a

4-point Likert-type agreement scale (1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree), assessing (a) Islamic Values Visibility (5 items), and (b) Scientific Methodology Emphasis (5 items); and (2) Open-ended questions (3 items) exploring instructional strategies, perceived challenges in integration, and assessments of student readiness. The instructor survey was conceptually aligned with the symbolic and epistemic dimensions assessed in the student instrument. Specifically, items measuring Islamic Values Visibility practices correspond to the Islamic Values Visibility dimension in the student survey, while items measuring scientific reasoning emphasis correspond to the Scientific Methodology Emphasis dimension. This alignment enables cross-source comparison of instructional emphasis across student perceptions and instructor perspectives. Instructor responses were analysed descriptively to support triangulation and interpretation of student- and document-based findings, rather than as independent confirmatory tests of the study's analytical framework. Although instructor sample size was limited, responses provided contextual insight into pedagogical enactment across institutions.

Data Collection Procedures

Data collection involved three separate and independent data sources with distinct units of analysis: student survey responses (N = 150 students), course syllabi documents (N = 10), and instructor survey responses (N = 5 instructors). First, 150 undergraduate students completed an online survey administered via Google Forms. Survey links were distributed by course coordinators at each of the four institutions over a three-week period. Second, 10 course syllabi (Rencana Pembelajaran Semester, RPS) were collected directly from instructors and program administrators, with two to three syllabi obtained from each institution. These syllabi covered courses such as General Biology, Cell Biology, Genetics, Ecology, and Evolution. Third, five instructors whose students participated in the survey completed a structured instructor questionnaire administered either in person or via email.

The student survey, syllabi collection, and instructor survey were conducted sequentially over a six-week period to maintain functional independence across data sources. Student surveys were administered first via an online questionnaire, followed by collection of course syllabi as representations of institutional instructional planning, and finally the administration of instructor surveys to elicit pedagogical rationales and perceived constraints influencing instructional practices.

This temporal and functional separation enabled systematic examination of convergence and divergence across data sources and strengthened interpretation of findings as multilayered pedagogical and institutional practice patterns.

Data Analysis

Data analysis followed a research question–driven non-parametric inferential approach aligned with the study's three research questions. Prior to inferential testing, normality of composite scores for each instructional dimension was assessed using the Shapiro–Wilk test, which is recommended for small to moderate sample sizes (Razali & Wah, 2011). The results indicated statistically significant departures from normality across all six dimensions ($W = 0.811–0.979$, $p < .05$). Given the statistically significant departures from normality and the ordinal nature of Likert-type data, non-parametric statistical techniques were employed for inferential analyses (Field, 2018; Jamieson, 2004; Mishra et al., 2019). For descriptive purposes and interpretive clarity, mean scores and standard deviations are also reported to facilitate comparison across instructional dimensions. Comparative analyses examined differences across instructional dimensions using Cliff's delta, a non-parametric, distribution-free effect size measure suitable for ordinal data (Cliff, 1993; Romano et al., 2006). Effect sizes were interpreted following contemporary reporting guidelines (Lakens, 2013), and Spearman's rank-order correlation was employed to examine relationships among instructional planning, implementation, assessment, Islamic Values Visibility, and Scientific Methodology Emphasis. Analyses were conducted sequentially to correspond with the study's research questions. Research Question 1 was addressed using Wilcoxon signed-rank tests and Cliff's delta to examine differences between symbolic and epistemic dimensions. Research Question 2 was examined using Spearman's rank-order correlations to evaluate structural associations among symbolic, epistemic, and instructional dimensions. Research Question 3 was examined using Kruskal–Wallis tests to assess cross-institutional differences in structural alignment.

Syllabi (Rencana Pembelajaran Semester, RPS) data were analyzed using descriptive statistics (mean ratings across six indicators) as part of the study's multi-source design. Mean syllabi ratings were compared across institutions and interpreted alongside student survey data to examine convergence between planned instruction (syllabi) and enacted instruction (student perceptions). Instructor survey data were analyzed using descriptive statistics for closed-ended items and thematic synthesis for open-ended responses. Findings across data sources were compared to assess convergence and divergence across student perceptions, instructional planning documents, and instructor perspectives.

Ethical Considerations

Ethical approval for this study was obtained from the Research Ethics Committee of Universitas Negeri Malang (No: 02/10.11/UN32.14.2.8/LT/2025). All participants provided informed consent after receiving information about the study's purpose, the voluntary nature of participation, and assurances of confidentiality and anonymity.

RESULTS

Comparison of Islamic Values Visibility and Scientific Methodology Emphasis

A comparison was conducted between the symbolic dimension, operationalized as Islamic Values Visibility, and the epistemic dimension, operationalized as Scientific Methodology Emphasis. As shown in Table 1, Islamic Values Visibility demonstrated a higher mean score ($M = 3.58$, $SD = 0.46$) than Scientific Methodology Emphasis ($M = 2.64$, $SD = 0.52$), indicating a descriptive disparity between the symbolic and epistemic dimensions.

Table 1.

Mean Scores of Instructional Dimensions

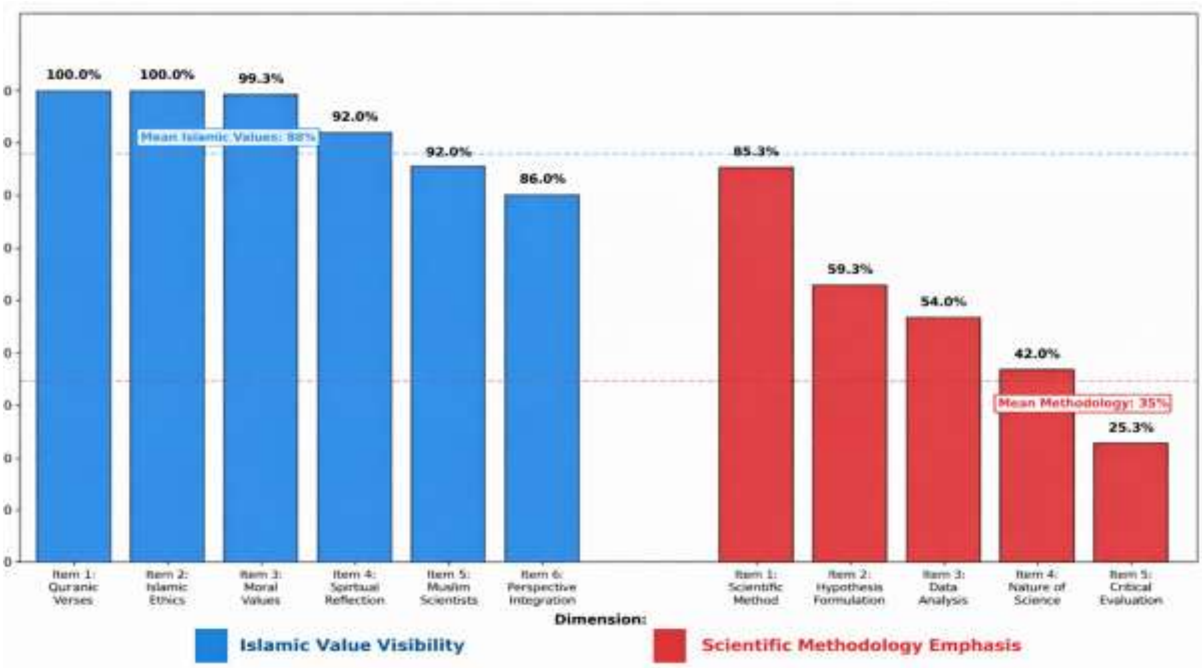
Dimension	Mean	SD	Category
Instructional Characteristics	3.14	0.39	High
Instructional Planning	3.15	0.44	High
Instructional Implementation	2.96	0.40	Moderate
Assessment	2.99	0.39	Moderate
Islamic Values Visibility	3.58	0.46	High
Scientific Methodology Emphasis	2.64	0.52	Moderate

Note. Scale: 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Always. N = 150.

A direct comparison between Islamic Values Visibility and Scientific Methodology Emphasis was conducted using a Wilcoxon signed-rank test. Results indicated a statistically significant difference between the two dimensions ($Z = -10.52$, $p < .001$), with a large effect size (Cliff's $\delta = 0.80$), indicating a very large practical difference in instructional emphasis. This effect size indicates a substantial difference in instructional emphasis between the symbolic and epistemic dimensions.

Figure 1.

Distribution of Islamic Values Visibility and Scientific Methodology Emphasis Scores



Note. Data based on student survey responses (N = 150). Islamic Values Visibility items assessed explicit references to Islamic principles within course content, whereas Scientific Methodology Emphasis items assessed emphasis on hypothesis testing, evidence evaluation, and methodological reasoning. Percentages represent the proportion of students with mean scores ≥3.0 (Sometimes/Always). Scale: 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Always.

To contextualize the magnitude of this statistically significant difference, distributional patterns were examined. Specifically, 88.0% of students achieved mean scores ≥3.0 for Islamic

Values Visibility, whereas only 35.3% achieved similar scores for Scientific Methodology Emphasis (Figure 1). This distributional contrast further illustrates the magnitude of the observed difference.

To examine the consistency of findings across data sources, student survey results were compared with syllabi analysis and instructor survey responses (Table 2). Comparable patterns were observed across student, syllabi, and instructor data, providing contextual support for the inferential results reported above.

Student survey results indicated high levels of Islamic Values Visibility (M = 3.58, SD = 0.46), whereas Scientific Methodology Emphasis was reported at a moderate level (M = 2.64, SD = 0.52). Syllabi analysis showed that Islamic values were highly visible in instructional planning documents, appearing in 90% of analyzed course syllabi with explicit learning outcomes referencing Islamic principles. However, explicit epistemic expectations were less frequently specified. Only 40% of syllabi contained clear indicators of scientific methodology emphasis or Islamic values–science epistemic linkage, such as hypothesis testing, evidence evaluation, or methodological critique.

Instructor survey responses indicated that 80% routinely integrate Islamic values into their teaching, and 60% provide inquiry-oriented learning opportunities. Notably, only 20% of instructors reported regularly assessing students' ability to critically evaluate scientific claims—a pattern consistent with the levels reported in the student survey.

Table 2.

Summary of Findings Across Data Sources

Dimension	Students	Syllabi (RPS)	Instructors
Islamic Values Visibility	M = 3.58 (SD = 0.46); 88% consistent practice	Most visible curricular indicator	80% report routine integration
Scientific Methodology Emphasis	M = 2.64 (SD = 0.52); 35% consistent practice	Limited epistemic indicators (methodology emphasis / values–science linkage)	60% report inquiry opportunities
Critical Evaluation of Claims	25.3% consistent practice	Rarely specified	Limited assessment emphasis

Note. Student percentages represent the proportion of students with mean dimension scores ≥ 3.0 (Sometimes/Always).

Symbolic and Epistemic Dimensions Across Instructional Practices

Relationships between the symbolic and epistemic dimensions and instructional planning, implementation, and assessment practices were examined using Spearman rank-order correlations (Table 3). Strong positive correlations were observed between instructional planning and assessment ($\rho = .70$, $p < .001$) and between instructional planning and Scientific Methodology Emphasis ($\rho = .76$, $p < .001$). Islamic Values Visibility also demonstrated a strong positive correlation with Scientific Methodology Emphasis ($\rho = .84$, $p < .001$).

Table 3.

Spearman Correlation Matrix of Instructional Dimensions

Dimension	Characteristics	Planning	Implementation	Assessment	Islamic Values Visibility	Scientific Methodology Emphasis
Instructional Characteristics	—	.73***	.59***	.68***	.73***	.72***
Instructional Planning		—	.59***	.70***	.68***	.76***
Instructional Implementation			—	.50***	.60***	.64***
Assessment				—	.63***	.78***
Islamic Values Visibility					—	.84***
Scientific Methodology Emphasis						—

*Note. ***p < .001 with Bonferroni correction (α = .003). N = 150.*

A strong positive correlation was observed between Islamic Values Visibility and Scientific Methodology Emphasis ($\rho = .84$, $p < .001$). Although strongly correlated, the substantial mean difference between these dimensions ($M = 3.58$ vs. $M = 2.64$) indicates unequal levels of emphasis. Instructional planning was strongly correlated with assessment ($\rho = .70$, $p < .001$) and scientific methodology emphasis ($\rho = .76$, $p < .001$). Assessment also demonstrated a strong association with scientific methodology emphasis ($\rho = .78$, $p < .001$). These results indicate substantial structural associations among instructional dimensions.

Cross-Institutional Differences in Instructional Alignment

Cross-institutional differences in the symbolic and epistemic dimensions were examined using Kruskal–Wallis tests (Table 4). The results indicated no statistically significant differences across institutions for Islamic Values Visibility ($H = 1.338$, $p = .720$), Scientific Methodology Emphasis ($H = 0.901$, $p = .825$), or the integration gap between the two dimensions ($H = 0.335$, $p = .953$).

Table 4.

Cross-Institutional Consistency Analysis

Dimension	H	df	p	ε²	Result
Islamic Values Visibility	1.338	3	.720	≈0	ns
Scientific Methodology Emphasis	0.901	3	.825	≈0	ns
Integration Gap	0.335	3	.953	≈0	ns

Note. ns = not significant. The "Integration Gap" row represents the disparity between Islamic Values Visibility and Scientific Methodology Emphasis scores.

Effect sizes were negligible ($\varepsilon^2 \approx 0$), indicating minimal variation across institutional contexts. These findings suggest that the relative emphasis between symbolic and epistemic dimensions was broadly consistent across the four participating institutions.

DISCUSSION

The results reveal three key patterns corresponding to the study's research questions. First, Islamic Values Visibility was reported at significantly higher levels than Scientific Methodology Emphasis, indicating a disparity between symbolic and epistemic dimensions. Second, strong structural associations were observed among instructional planning, assessment, and epistemic dimensions. Third, no significant cross-institutional differences were detected. The following sections discuss these findings in relation to the study's analytical framework and institutional theory, highlighting implications for value-based science education.

Disparity Between Symbolic and Epistemic Dimensions

The observed pattern—high visibility of Islamic values alongside comparatively limited epistemic engagement with Scientific Methodology Emphasis—reflects what institutional theory describes as decoupling between symbolic commitments and core technical practices (Karbhari et al., 2020; Melin et al., 2020; Meyer & Rowan, 2012). From the perspective of contemporary science education research, epistemic practices are central to disciplinary learning because they structure how knowledge claims are evaluated and justified. When value integration does not explicitly engage these epistemic processes, the integration may remain symbolically visible without shaping the epistemic core of scientific learning. Value-based higher education institutions operate under dual legitimacy pressures: sustaining distinctive normative identities while demonstrating disciplinary credibility. Under such conditions, organizations may adopt practices that visibly affirm institutional values without fundamentally transforming underlying pedagogical routines.

The symbolic–epistemic distinction proposed in this study helps clarify whether values integration functions primarily as symbolic identity signaling or as an epistemically substantive component of disciplinary learning. Such patterns have also been observed in other contexts of value-based science education. Research in science education shows that cultural or moral elements are often incorporated symbolically without corresponding shifts in epistemic practice (Erduran, Dagher, et al., 2019). Meaningful integration, however, requires engagement with the processes through which knowledge claims are generated, evaluated, and legitimized (Duschl, 2008), underscoring that visibility alone does not guarantee epistemic depth.

The findings align with scholarship documenting how institutional mandates—while well-intentioned—can produce surface-level compliance rather than deep pedagogical transformation. In their analysis of socioscientific issues teaching, Ozcan-Ermis & Hervé (2023) found that teachers often adopt neutral stances to avoid controversy, prioritizing procedural adherence over epistemic depth. This pattern parallels our observation that instructors make

Islamic values visible without necessarily engaging students in examining how religious principles inform or constrain scientific reasoning.

Critically, the strong correlation between Islamic Values Visibility and Scientific Methodology Emphasis indicates these dimensions are not oppositional but rather co-occur systematically. This finding challenges assumptions that value integration necessarily undermines scientific reasoning. Instead, it suggests instructional capacity: when Scientific Methodology Emphasis increases, Islamic Values Visibility also tends to increase. However, these dimensions co-occur at different average intensities, consistent with the broader descriptive pattern in which Islamic values are positioned more prominently than Scientific Methodology Emphasis. This pattern suggests a form of compartmentalized integration in which Islamic values remain visible but are only weakly connected to processes of scientific knowledge evaluation. These conditions suggest the potential for epistemic integration if value articulation becomes more explicitly linked to scientific reasoning practices. These findings suggest the importance of integration approaches that connect value articulation with explicit engagement in scientific reasoning practices.

Beyond the specific context of Islamic higher education, the symbolic–epistemic distinction proposed in this study offers a broader analytical framework for examining value integration in science education. The framework allows researchers to move beyond binary evaluations of whether values are present, toward assessing the depth at which values interact with disciplinary knowledge practices.

Structural Associations Among Instructional Dimensions

Strong associations among instructional planning, assessment, and Scientific Methodology Emphasis suggest that planning and assessment may function as leverage points for epistemic integration. Contemporary frameworks in science education emphasize that epistemic practices must be deliberately designed into instruction rather than assumed to emerge spontaneously. Agustian (2023) demonstrated that epistemic dimensions in higher science education are often left implicit, leading students to engage superficially with scientific reasoning despite exposure to inquiry activities. This finding aligns with the present results, which indicate that even when inquiry-oriented approaches are formally referenced in curricular documents, explicit articulation of scientific reasoning processes remains limited. Curricula may therefore obscure the dynamic relationships among explanatory models, empirical evidence, and data—precisely the epistemic alignment necessary for deep scientific understanding.

The limited emphasis on the critical evaluation of claims further illustrates the restricted development of epistemic engagement observed in the results. Claim evaluation is widely recognized as central to scientific literacy and epistemic practice (Berland et al., 2016). When assessment practices do not systematically require students to critique knowledge claims—including those framed through religious values—opportunities for epistemic engagement may remain underdeveloped. In such contexts, integration is therefore more likely to operate symbolically than epistemically.

The strong associations observed among planning, assessment, and Scientific Methodology Emphasis suggest that epistemic emphasis is structurally embedded within formal instructional architecture. When methodological reasoning is explicitly articulated in learning outcomes and assessed systematically, epistemic engagement may become institutionally reinforced rather than solely dependent on individual instructional decisions. This structural coupling between planning and assessment may therefore represent a key mechanism through which symbolic articulation can transition toward epistemic integration.

Cross-Institutional Consistency of Instructional Patterns

The absence of statistically significant differences across institutions suggests that the symbolic–epistemic imbalance observed in this study is not institution-specific but structurally patterned across contexts. Rather than reflecting isolated pedagogical preferences, the findings point to shared organizational logics shaping how Islamic Values Visibility is enacted within undergraduate biology instruction. This pattern aligns with institutional theory, which identifies how organizations operating within the same field tend to develop structurally similar responses to shared environmental pressures (DiMaggio & Powell, 1983).

From an institutional theory perspective, such cross-institutional uniformity is consistent with processes of normative and coercive isomorphism, whereby institutions operating under similar legitimacy mandates adopt comparable practices (Kezar & Bernstein-Sierra, 2019). In value-based higher education contexts, visible incorporation of Islamic principles may satisfy identity and accountability expectations, even when deeper epistemic transformation remains limited. This dynamic reflects what J. Meyer & Rowan (1977) describe as decoupling, where formal structures serve ceremonial functions to secure legitimacy rather than driving substantive organizational change. Institutions may therefore display symbolic conformity to Islamic identity mandates while leaving core epistemic practices largely unchanged (Bromley & Powell, 2012; Kodeih & Greenwood, 2014). The consistency across institutions therefore strengthens the interpretation that symbolic prominence of values is structurally embedded rather than locally contingent.

At the same time, the absence of institutional variation should be interpreted within the study's sampling boundaries. The institutions examined share regulatory frameworks and ministerial mandates, which may contribute to patterned similarity consistent with coercive isomorphic pressures. Nevertheless, the cross-institutional convergence reinforces the argument that efforts to strengthen epistemic integration must operate at systemic levels. This requires coordinated action across curriculum design, assessment policy, and faculty development, rather than relying solely on individual instructor initiative (Brundiers et al., 2021; Henderson et al., 2011).

Implications for Value-Based Science Education

The findings of this study have implications for value-based science education in contexts where cultural, moral, or religious values are integrated into disciplinary teaching. The results indicate that the integration of values in undergraduate biology instruction tends to occur more strongly at the symbolic level than at the epistemic level. While Islamic values were visibly represented in instructional discourse and learning materials, opportunities for students to engage in scientific reasoning through hypothesis testing, evidence evaluation, and methodological justification were less consistently emphasized. This pattern suggests that value integration may remain representational unless it is intentionally connected to the epistemic practices through which scientific knowledge is constructed and justified.

At the pedagogical level, the findings highlight the importance of aligning instructional planning, teaching activities, and assessment practices with epistemic goals. The observed associations among planning, assessment, and Scientific Methodology Emphasis suggest that epistemic engagement is more likely to occur when it is explicitly embedded in curricular design rather than left implicit in classroom interaction. In this regard, meaningful integration requires more than the inclusion of value language in instructional materials; it requires learning opportunities that engage students in examining how values relate to evidence, reasoning, and the evaluation of scientific claims.

At the institutional level, the absence of significant cross-institutional differences suggests that the symbolic–epistemic imbalance identified in this study may reflect broader structural tendencies rather than institution-specific conditions. Institutional mandates may successfully encourage the visible inclusion of values in curricula, but such mandates do not automatically ensure epistemically substantive integration. These findings imply that curriculum review processes, faculty development initiatives, and assessment policies should support not only the formal presence of values but also the cultivation of students' epistemic engagement in disciplinary learning.

Limitations and Future Directions

Several limitations should be acknowledged. First, the cross-sectional design does not allow causal conclusions about how instructional practices influence students' epistemic engagement. Future studies could strengthen this line of inquiry by using longitudinal designs to examine how opportunities for epistemic engagement develop across courses and over time.

Second, the study relied on student perceptions, instructor self-reports, and syllabus documents. Although these sources allowed triangulation across different forms of evidence, they do not fully capture enacted classroom practice. Future research could improve the methodology by incorporating classroom observations, analysis of teaching materials and assessment tasks, and performance-based measures of students' scientific reasoning.

Third, the study focused on undergraduate biology education within Islamic higher education institutions in Indonesia. Replication in other disciplinary, institutional, and sociocultural contexts would help determine whether the symbolic–epistemic gap identified here is specific to this setting or reflects a broader pattern in value-based science education. Comparative studies across disciplines or across institutions with different value frameworks may be especially useful for testing the wider applicability of the present findings.

Finally, although this study identified a symbolic–epistemic gap, it did not examine interventions to reduce it. Future research should therefore move beyond descriptive analysis to intervention-based studies that test curriculum modules, assessment designs, or professional development models to strengthen epistemic integration. Such studies should also consider contextual factors affecting implementation, including instructor preparedness, institutional support, student readiness, and the cultural appropriateness of specific pedagogical strategies.

Taken together, these limitations indicate that the findings should be interpreted as evidence of a patterned symbolic–epistemic imbalance rather than as a complete account of enacted classroom practice. Nevertheless, the study contributes a novel analytical distinction between symbolic visibility and epistemic engagement, which may guide future research in developing more robust methodological approaches to evaluating values integration in science education.

CONCLUSION

This study examined differences, structural associations, and cross-institutional patterns in the integration of Islamic values within undergraduate biology instruction. Three main conclusions can be drawn. First, Islamic Values Visibility was consistently more prominent than Scientific Methodology Emphasis, indicating a gap between symbolic visibility and epistemic engagement. Second, strong associations among instructional planning, assessment, and Scientific Methodology Emphasis suggest that epistemic engagement is shaped by interconnected instructional structures rather than by isolated teaching practices. Third, the absence of significant cross-institutional differences indicates that this symbolic–epistemic imbalance may reflect shared organizational conditions rather than institution-specific characteristics.

The study contributes a novel analytical perspective by distinguishing between symbolic visibility and epistemic engagement as two different dimensions of values integration in science education. This distinction shows that the presence of values in instructional discourse does not necessarily ensure students' engagement in scientific reasoning practices. In this sense, the key issue in value-based science education is not simply whether values are integrated, but how they function within disciplinary learning.

Based on these findings, several recommendations can be made. For instructors, value integration should be supported through learning activities and assessments that explicitly engage students in evaluating evidence, reasoning methodologically, and justifying scientific claims. For institutions, curriculum review, faculty development, and assessment policies should promote not only the visible inclusion of values but also their epistemic integration within teaching and learning processes. For future researchers, the present study should be replicated and extended through longitudinal, observational, comparative, and intervention-based designs to strengthen methodological robustness and broaden contextual understanding.

REFERENCES

Agustian, H. Y. (2023). The Critical Role of Understanding Epistemic Practices in Science Teaching Using Wicked Problems. *Science & Education*, *34*(1), 485–510. https://doi.org/10.1007/s11191-023-00471-2

Al-Faruqi, I. R. (1982). *Islamization of knowledge: General principles and work plan* (2nd ed., rev.expanded). International Institute of Islamic Thought.

Alkouatli, C. (2024). Illuminating data beyond the tangible: Exploring a conceptually-relevant paradigmatic frame for empirical inquiry with Muslim educators. *International Journal of Qualitative Studies in Education*, *37*(8), 2466–2484. https://doi.org/10.1080/09518398.2024.2318301

Amin, A. M., Ahmad, S. H., & Adiansyah, R. (2022). RQANI: A Learning Model that Integrates Science Concepts and Islamic Values in Biology Learning. *International Journal of Instruction*, *15*(3), 695–718. Scopus. https://doi.org/10.29333/iji.2022.15338a

Andrade, C. (2021). The Inconvenient Truth About Convenience and Purposive Samples. *Indian Journal of Psychological Medicine*, *43*(1), 86–88. https://doi.org/10.1177/0253717620977000

Annala, J. (2022). Disciplinary knowledge practices and powerful knowledge: A study on knowledge and curriculum structures in regions. *Teaching in Higher Education*, *27*(8), 1084–1102. https://doi.org/10.1080/13562517.2022.2114340

Aqool, R. H. (2022). Stylistics of Quranic Stories in Subject of Islamic education in (Iraqi schools) An Analytical Study. *Res Militaris*, *12*(2), 5566–5583. Scopus. https://www.scopus.com/inward/record.uri?eid=2-s2.0-85142056687&partnerID=40&md5=3a999a265fdcc0f06e7406af5ec67b19

Arthur, J. (2024). Character education in universities. *Church, Communication and Culture*, *9*(2), 329–344. https://doi.org/10.1080/23753234.2024.2390128

Atabey, N., & Topçu, M. S. (2025). Analyzing socioscientific issues-based instruction studies focusing on character and value development: A systematic review. *Journal of Moral Education*, *54*(3), 485–503. https://doi.org/10.1080/03057240.2024.2324781

Attas, M. N. al-. (1995). *Prolegomena to the metaphysics of Islam: An exposition of the fundamental elements of the worldview of Islām* (2. ed). International Institute of Islamic Thought and Civilization.

Bakar, O. (1999). *The history and philosophy of Islamic science*. Islamic Texts Society.

Bandura, A. (1971). *Social Learning Theory*. Prentice Hall.

Barnes, M. E., Werner, R., & Brownell, S. E. (2020). Differential Impacts of Religious Cultural Competence on Students' Perceived Conflict with Evolution at an Evangelical University. *The American Biology Teacher*, *82*(2), 93–101. https://doi.org/10.1525/abt.2020.82.2.93

Berland, L. K., Schwarz, C. V., Krist, C., Kenyon, L., Lo, A. S., & Reiser, B. J. (2016). Epistemologies in practice: Making scientific practices meaningful for students. *Journal of Research in Science Teaching*, *53*(7), 1082–1112. https://doi.org/10.1002/tea.21257

Bowie, R. A., Aantjes, R., Woolley, M., Hulbert, S., Thomas, C., Revell, L., & Riordan, J.-P. (2023). Science religion encounters, epistemic trespass, neighbourliness and overlapping domains: Theorisation and quantitative evidence of extent. *Journal of Religious Education*, *71*(3), 279–295. https://doi.org/10.1007/s40839-023-00209-w

Bromley, P., & Powell, W. W. (2012). From Smoke and Mirrors to Walking the Talk: Decoupling in the Contemporary World. *Academy of Management Annals*, *6*(1), 483–530. https://doi.org/10.5465/19416520.2012.684462

Brundiers, K., Barth, M., Cebrián, G., Cohen, M., Diaz, L., Doucette-Remington, S., Dripps, W., Habron, G., Harré, N., Jarchow, M., Losch, K., Michel, J., Mochizuki, Y., Rieckmann, M., Parnell, R., Walker, P., & Zint, M. (2021). Key competencies in sustainability in higher education—Toward an agreed-upon reference framework. *Sustainability Science*, *16*(1), 13–29. https://doi.org/10.1007/s11625-020-00838-2

Chen, J., Liu, Y., Dai, J., & Wang, C. (2023). Development and status of moral education research: Visual analysis based on knowledge graph. *Frontiers in Psychology*, *13*, 1079955. https://doi.org/10.3389/fpsyg.2022.1079955

Cliff, N. (1993). Dominance statistics: Ordinal analyses to answer ordinal questions. *Psychological Bulletin*, *114*(3), 494–509. https://doi.org/10.1037/0033-2909.114.3.494

Creswell, J. W., & Plano Clark, V. L. (2018). *Designing and conducting mixed methods research* (3rd ed.). SAGE.

Dev, S., Lababidi, D., & Nidawi, I. A.-. (2025). Developing Culturally-Responsive Emotional Intelligence Programs for UAE Students: Examining Impacts on Self-Motivation, Empathetic Understanding, and Skills. *Journal of Culture and Values in Education, 8*(3), 259-283. https://doi.org/10.46303/jcve.2025.35

DeVellis, R. F. (2017). *Scale development: Theory and applications (4th ed.)*. SAGE Publications.

DiMaggio, P. J., & Powell, W. W. (1983). The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields. *American Sociological Review*, *48*(2), 147. https://doi.org/10.2307/2095101

Druker-Ibáñez, S., & Cáceres-Jensen, L. (2022). Integration of indigenous and local knowledge into sustainability education: A systematic literature review. *Environmental Education Research*, *28*(8), 1209–1236. https://doi.org/10.1080/13504622.2022.2083081

Duschl, R. (2008). Science Education in Three-Part Harmony: Balancing Conceptual, Epistemic, and Social Learning Goals. *Review of Research in Education*, *32*(1), 268–291. https://doi.org/10.3102/0091732X07309371

Elmahjub, E. (2023). Artificial Intelligence (AI) in Islamic Ethics: Towards Pluralist Ethical Benchmarking for AI. *Philosophy & Technology*, *36*(4), 73. https://doi.org/10.1007/s13347-023-00668-x

Erduran, S., Dagher, Z. R., & McDonald, C. V. (2019). Contributions of the Family Resemblance Approach to Nature of Science in Science Education: A Review of Emergent Research and Development. *Science & Education*, *28*(3–5), 311–328. https://doi.org/10.1007/s11191-019-00052-2

Erduran, S., Guilfoyle, L., & Park, W. (2022). Science and Religious Education Teachers' Views of Argumentation and Its Teaching. *Research in Science Education*, *52*(2), 655–673. https://doi.org/10.1007/s11165-020-09966-2

Erduran, S., Guilfoyle, L., Park, W., Chan, J., & Fancourt, N. (2019). Argumentation and interdisciplinarity: Reflections from the Oxford Argumentation in Religion and Science Project. *Disciplinary and Interdisciplinary Science Education Research*, *1*(1), 8. https://doi.org/10.1186/s43031-019-0006-9

Etikan, I. (2016). Comparison of Convenience Sampling and Purposive Sampling. *American Journal of Theoretical and Applied Statistics*, *5*(1), 1. https://doi.org/10.11648/j.ajtas.20160501.11

Field, A. (2018). *Discovering Statistics Using IBM SPSS Statistics (5th Ed.)*. SAGE.

Filgona, J., Mahmud, Z., & Babba, G. (2024). Curriculum design and innovation. In *Navigating Quality Assurance and Accreditation in Global Higher Education* (pp. 193–217). Scopus. https://doi.org/10.4018/979-8-3693-6915-9.ch008

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

Gilligan, C. (1982). *In a different voice: Psychological theory and women's development*. Harvard University Press.

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2022). *A primer on partial least squares structural equation modeling (PLS-SEM)* (Third edition). SAGE.

Hasnah, Y., Saragih, A., & Murni, S. M. (2025). Dissecting the Rise of Ideological Constructs in Educators' Pedagogical Discourse: A Critical Discourse Analysis. *Theory and Practice in Language Studies*, *15*(2), 557–565. Scopus. https://doi.org/10.17507/tpls.1502.26

Heale, R., & Forbes, D. (2013). Understanding triangulation in research. *Evidence Based Nursing*, *16*(4), 98–98. https://doi.org/10.1136/eb-2013-101494

Henderson, C., Beach, A., & Finkelstein, N. (2011). Facilitating change in undergraduate STEM instructional practices: An analytic review of the literature. *Journal of Research in Science Teaching*, *48*(8), 952–984. https://doi.org/10.1002/tea.20439

Henríquez, V. A. V., & Oñate, A. A. S. (2017). Dialogicity and narrativity in teachers of excellence and its relation to learning. *Psicologia Escolar e Educacional*, *21*(3), 457–466. Scopus. https://doi.org/10.1590/2175-3539/2017/021311175

Hill, J. L., Van Driel, J., Seah, W. T., & Kern, M. L. (2025). Students' values in science education: A scoping review. *Studies in Science Education*, *61*(2), 275–327. https://doi.org/10.1080/03057267.2024.2412456

Hofer, B. K. (2004). Exploring the dimensions of personal epistemology in differing classroom contexts: Student interpretations during the first year of college. *Contemporary Educational Psychology*, *29*(2), 129–163. Scopus. https://doi.org/10.1016/j.cedpsych.2004.01.002

Hudson, B., Gericke, N., Olin-Scheller, C., & Stolare, M. (2023). Trajectories of powerful knowledge and epistemic quality: Analysing the transformations from disciplines across school subjects. *Journal of Curriculum Studies*, *55*(2), 119–137. https://doi.org/10.1080/00220272.2023.2182164

Isik, T., & Akbari, R. (2024). A Narrative Approach to Character Cultivation in Islamic Religious Education: Using Rumi's Mathnawi as an Example for Storytelling. *Asia Pacific Journal of Educators and Education*, *39*(2), 97–115. Scopus. https://doi.org/10.21315/apjee2024.39.2.6

Jamieson, S. (2004). Likert scales: How to (ab)use them. *Medical Education*, *38*(12), 1217–1218. https://doi.org/10.1111/j.1365-2929.2004.02012.x

Jiménez-Aleixandre, M. P., & Crujeiras, B. (2017). Epistemic Practices and Scientific Practices in Science Education. In K. S. Taber & B. Akpan (Eds.), *Science Education* (pp. 69–80). SensePublishers. https://doi.org/10.1007/978-94-6300-749-8_5

Karbhari, Y., Alam, M. K., & Rahman, M. M. (2020). Relevance of the application of institutional theory in Shariah governance of Islamic banks. *PSU Research Review*, *5*(1), 1–15. Scopus. https://doi.org/10.1108/PRR-05-2020-0015

Kelly, G. J., & Licona, P. (2018). Epistemic Practices and Science Education. In M. R. Matthews (Ed.), *History, Philosophy and Science Teaching* (pp. 139–165). Springer International Publishing. https://doi.org/10.1007/978-3-319-62616-1_5

Kezar, A., & Bernstein-Sierra, S. (2019). Examining Processes of Normative Isomorphism and Influence in Scaled Change Among Higher Education Intermediary Organizations. *AERA Open*, *5*(4), 2332858419884905. https://doi.org/10.1177/2332858419884905

Kodeih, F., & Greenwood, R. (2014). Responding to Institutional Complexity: The Role of Identity. *Organization Studies*, *35*(1), 7–39. https://doi.org/10.1177/0170840613495333

Kohlberg, L. (1981). *The philosophy of moral development: Moral stages and the idea of justice* (1st ed). Harper & Row.

Krist, C. (2020). Examining how classroom communities developed practice-based epistemologies for science through analysis of longitudinal video data. *Journal of Educational Psychology*, *112*(3), 420–443. Scopus. https://doi.org/10.1037/edu0000417

Lakens, D. (2013). Calculating and reporting effect sizes to facilitate cumulative science: A practical primer for t-tests and ANOVAs. *Frontiers in Psychology*, *4*. https://doi.org/10.3389/fpsyg.2013.00863

Latjompoh, M., Gonibala, A., Ahmad, J., Al-Zou'bi, R. M., Alanazi, A. A., Fitriani Nasir, N. I. R., & Damopolii, I. (2025). Meaning-Based Learning: Integration of Islamic Values to Empower Students' Moral Sensitivity in Science Learning. *Educational Process International Journal*, *17*(1). https://doi.org/10.22521/edupij.2025.17.398

Leavy, P. (2017). *Research design: Quantitative, qualitative, mixed methods, arts-based, and community-based participatory research approaches*. Guilford Press.

Mansour, N. (2008). The Experiences and Personal Religious Beliefs of Egyptian Science Teachers as a Framework for Understanding the Shaping and Reshaping of their Beliefs and Practices about Science-Technology-Society (STS). *International Journal of Science Education*, *30*(12), 1605–1634. https://doi.org/10.1080/09500690701463303

Mansour, N. (2010). Science teachers' interpretations of Islamic culture related to science education versus the Islamic epistemology and ontology of science. *Cultural Studies of Science Education*, *5*(1), 127–140. https://doi.org/10.1007/s11422-009-9214-5

Mansour, N. (2011). Science teachers' views of science and religion vs. the Islamic perspective: Conflicting or compatible? *Science Education*, *95*(2), 281–309. https://doi.org/10.1002/sce.20418

Melin, U., Sarkar, P. K., & Young, L. W. (2020). To couple or not to couple: A case study of institutional legitimacy relating to SaaS applications in two universities. *Information Technology and People*, *33*(4), 1149–1173. Scopus. https://doi.org/10.1108/ITP-06-2018-0312

Memon, M. A., Thurasamy, R., Ting, H., & Cheah, J.-H. (2025). Purposive Sampling: A Review and Guidelines for Quantitative Research. *Journal of Applied Structural Equation Modeling*, *9*(1), 1–23. https://doi.org/10.47263/JASEM.9(1)01

Meyer, J., & Rowan, B. (1977). Institutionalized Organizations: Formal Structure as Myth and Ceremony. *American Journal of Sociology*, *83*(2), 340–363. https://doi.org/10.1086/226550

Meyer, J., & Rowan, B. (Eds.). (2012). *The New Institutionalism in Education*. State University of New York Press. https://doi.org/10.2307/jj.18255536

Mishra, P., Pandey, C., Singh, U., Gupta, A., Sahu, C., & Keshri, A. (2019). Descriptive statistics and normality tests for statistical data. *Annals of Cardiac Anaesthesia*, *22*(1), 67. https://doi.org/10.4103/aca.ACA_157_18

Nasr, S. H. (1996). *Religion & the order of nature*. Oxford University Press.

Ozcan-Ermis, G., & Hervé, N. (2023). Identifying Pre- and In-service Teachers' Stances on Teaching Socioscientific Issues: A Systematic Review of Empirical Studies. *Canadian Journal of Science, Mathematics and Technology Education*, *23*(4), 741–764. https://doi.org/10.1007/s42330-023-00306-w

Paiva, J. C., Rosa, M., Moreira, J. R., Morais, C., & Moreira, L. (2022). Science-Religion Dialogue in Education: Religion Teachers' Perceptions in a Roman-Catholic Context. *Research in Science Education*, *52*(1), 287–304. https://doi.org/10.1007/s11165-020-09941-x

Park, W., Erduran, S., & Guilfoyle, L. (2022). Secondary teachers' instructional practices on argumentation in the context of science and religious education. *International Journal of Science Education*, *44*(8), 1251–1276. https://doi.org/10.1080/09500693.2022.2074565

Patton, M. Q. (2002). *Qualitative research & evaluation methods* (3rd ed.). SAGE

Polit, D. F., & Beck, C. T. (2006). The content validity index: Are you sure you know what's being reported? critique and recommendations. *Research in Nursing & Health*, *29*(5), 489–497. https://doi.org/10.1002/nur.20147

Raquib, A., Channa, B., Zubair, T., & Qadir, J. (2022). Islamic virtue-based ethics for artificial intelligence. *Discover Artificial Intelligence*, *2*(1), 11. https://doi.org/10.1007/s44163-022-00028-2

Raths, L. E., Harmin, M., & Simon, S. B. (1978). *Values and teaching: Working with values in the classroom* (2d ed). C. E. Merrill Pub. Co.

Razali, N. M., & Wah, Y. B. (2011). Power comparisons of Shapiro-Wilk, Kolmogorov-Smirnov, Lilliefors and Anderson-Darling tests. *Journal of Statistical Modeling and Analytics*, 21–33.

Romano, J., Kromrey, J. D., Coraggio, J., & Skowronek, J. (2006). Appropriate statistics for ordinal level data: Should we really be using t-test and Cohen's d for evaluating group differences on the NSSE and other surveys? *Annual Meeting of the Florida Association of Institutional Research.*

Rudolph, J. L. (2020). The lost moral purpose of science education. *Science Education*, *104*(5), 895–906. https://doi.org/10.1002/sce.21590

Saadat, Z., Alam, S., & Rehman, M. (2022). Review of factors affecting gender disparity in higher education. *Cogent Social Sciences*, *8*(1), 2076794. https://doi.org/10.1080/23311886.2022.2076794

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

Soysal, Y. (2025). Estimating Epistemic Practices Loads in Elementary and Middle School Science Curricula. *Science and Education*, *34*(6), 4021–4056. Scopus. https://doi.org/10.1007/s11191-024-00599-9

Stroupe, D., Suárez, E., & Scipio, D. (2024). Epistemic injustice and the "Nature of Science." *Journal of Research in Science Teaching*, *62*(4), 901–941. https://doi.org/10.1002/tea.21988

Sumarni, W., Faizah, Z., Subali, B., Wiyanto, W., & Ellianawati, E. (2020). The urgency of religious and cultural science in STEM education: A meta data analysis. *International*

Journal of Evaluation and Research in Education (IJERE), *9*(4), 1045. https://doi.org/10.11591/ijere.v9i4.20462

Supriyadi, T., Gunara, S., Rahman, A. A., & Djumaydillayevich, S. S. (2026). Arabic linguistic symbols and the internalization of students' religious identity: A mixed methods analysis in the context of Islamic Religious Education. *Multidisciplinary Reviews*, *9*(4). Scopus. https://doi.org/10.31893/multirev.2026181

Syauqi, M. L., Ghozali, M. Y., Khairah, R., Nurzen, K., Muksin, A., Romdhon, R., Prasetiawan, A. Y., Rezi, M., Sayska, D. S., & Muftadin, D. (2025). *Embedding Islamic values in higher education: Trends, practices, and future research agenda*. https://doi.org/10.58256/sfz8ag27

Taşkın, Ö. (2014). An exploratory examination of Islamic values in science education: Islamization of science teaching and learning via constructivism. *Cultural Studies of Science Education*, *9*(4), 855–875. https://doi.org/10.1007/s11422-013-9553-0

Tytler, R. W., Monroe, M. C., Eames, C., & White, P. J. (2025). Expanding the Scope of Science Education to Engage with Anthropocene Challenges. *Research in Science Education*, *55*(4), 1129–1147. https://doi.org/10.1007/s11165-025-10276-8

UNESCO. (2021). *Women in higher education: Has the female advantage eliminated gender gaps?* UNESCO Publishing. https://unesdoc.unesco.org/ark:/48223/pf0000377644

Van Der Leij, T., Goedhart, M., Avraamidou, L., & Wals, A. (2024). Designing a module for supporting secondary biology students' morality through socioscientific issues in the human-nature context. *Journal of Biological Education*, *58*(5), 1186–1203. https://doi.org/10.1080/00219266.2023.2174160

Zeidler, D. L. (Ed.). (2024). *A Moral Inquiry into Epistemic Insights in Science Education: Personal and Global Perspectives of Socioscientific Issues* (Vol. 61). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-63382-9

Zetterqvist, A., & Bach, F. (2023). Epistemic knowledge – a vital part of scientific literacy? *International Journal of Science Education*, *45*(6), 484–501. https://doi.org/10.1080/09500693.2023.2166372

Zidny, R., Sjöström, J., & Eilks, I. (2020). A Multi-Perspective Reflection on How Indigenous Knowledge and Related Ideas Can Improve Science Education for Sustainability. *Science & Education*, *29*(1), 145–185. https://doi.org/10.1007/s11191-019-00100-x