

Perceptual Invariance and Question Types in the Digital Age: An Integrated Epistemological, Theological, and AI-Supported Model

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Abstract

This study examines the determining role of question types in knowledge production along epistemological and theological axes, focusing on how meaning can be preserved amid the escalating flow of information in the digital age. The original contribution of this work lies in linking question types with the concept of *perceptual invariance*, demonstrating that knowledge is not merely produced but is also consistently preserved and reconstructed. According to Perceptual Invariance Theory (PIT; Demirkus, 2026a), semantic noise in educational materials is the primary cause of student failure, and materials designed with the 99% Precision Principle are essential to reduce this noise. Scientific and religious domains of knowledge were comparatively examined; quantitative analyses revealed statistically significant differences in perceptual invariance rates across different question types [$F(4, 495) = 89.47, p < .001, \eta^2 = .417$]. The EduCode Protocol experimental intervention achieved a 42% reduction in semantic noise in the experimental group (Cohen's $d = 0.72, 95\% \text{ CI} = [0.38, 1.05]$). The proposed Digital Wisdom Guide and PIF-Prompt Model offer pedagogically grounded frameworks for meaning-preserving AI integration in education.

Keywords: Epistemology; Theology; Question Types; Perceptual Invariance; Semantic Noise; Digital Wisdom; Knowledge Production; Artificial Intelligence; DIKW Model; Education

1. Introduction

This study focuses on understanding the effect of question types — "What?", "Why?", "Who?", "Which?", "How?" and "For What Purpose?" — on both individual thought and the universal educational system within the framework of epistemology and pedagogical approaches. It simultaneously presents an approach grounded in an AI-assisted digital guidance model at both theoretical and applied levels. Emphasising the complementary roles of science and religion, the study addresses the contribution of theologically grounded knowledge-seeking to the epistemological structure (Bakar, 2024; Giberson, 2012; Nasr, 1992).

Humanity's relationship with knowledge has throughout history not only been a process of acquiring knowledge, but has itself been the very process of constructing meaning (Audi, 2011; OpenStax, 2022). In the digital age, the ease of access to information has brought with it the illusion that meaning forms spontaneously. Knowledge production is possible not through random questions, but through questions that are correctly sequenced, of the right quality, and that preserve meaning (Demirkus, 2026a).

According to Perceptual Invariance Theory (Demirkus, 2026a), the most critical pathology facing educational systems is semantic noise. Semantic noise refers to the situation in which the language, symbols, technical jargon, visuals or cultural codes used by the sender trigger the construction of a fundamentally different meaning in the receiver's mind from what the sender intended (Shannon & Weaver, 1949).

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The question categories "What?", "Why?", "Who?", "Which?", "How?" and "For What Purpose?" offer a cognitive ladder from both a pedagogical and an epistemological perspective (Chin, 2007; Bloom, 1956). Current research demonstrates that inquiry-based learning significantly enhances critical thinking skills (Sam, 2024; Syawaludin et al., 2025). This study aims to demonstrate the complementarity of science and religion in the process of making knowledge meaningful (Giberson, 2012; Malik, 2024).

The original contribution of this study lies in its conceptualisation of question types as carriers of perceptual invariance. Rather than treating questions merely as instructional tools, the study positions them as epistemological and theological mechanisms through which meaning is preserved, reconstructed, and transformed into wisdom in the digital age. This framework is the first to integrate traditional question classification, perceptual invariance measurement, and human-AI communication under a single theoretical structure.

2. Method

This study was structured using a mixed-methods design — specifically a convergent mixed-methods design — (Creswell & Poth, 2018). In this design, qualitative conceptual analysis and quantitative survey and experimental findings were analysed separately and subsequently integrated during the interpretation phase.

2.1. Qualitative Data Collection

Systematic Literature Review: Classical and current sources in the fields of epistemology, theology, educational sciences and AI ethics were examined (Audi, 2011; Nasr, 1992; Vallor, 2016). Conceptual Analysis: The theoretical frameworks of key concepts were analysed. Text Mining: The distribution of question types in large text datasets was analysed using AI models (GPT-4 and Claude), with a predefined coding schema based on the five question-type categories.

2.2. Quantitative Data Collection

Survey Study: The Perceptual Invariance Scale (PIS) was developed and administered to 150 educators and 350 undergraduate students (Total N = 500). Participants were selected from higher education institutions in Van, Turkey using convenience (availability) sampling. Ethical approval was obtained from the institutional ethics review board (Protocol No: YYU-2025-EDU-089) and all participants signed informed consent forms prior to data collection. It should be noted that students' field/department affiliation was not recorded as a demographic variable; this limitation is addressed in Section 10.

Table 1 Participant Demographic Characteristics

Demographic Variable	Category	n	%
Gender	Female	315	63.0
	Male	185	37.0
Age Group	18–25	350	70.0
	26–40	100	20.0
	41+	50	10.0
Education Level	Bachelor's	350	70.0
	Master's	100	20.0
	Doctorate	50	10.0
Experience (Educators)	0–5 years	70	46.7
	6–15 years	60	40.0
	16+ years	20	13.3

2.3. Scale Validity and Reliability

Validity and reliability analyses were conducted for the Perceptual Invariance Scale (PIS). The PIS consists of 25 items rated on a 5-point Likert scale (1 = Strongly Disagree; 5 = Strongly Agree). Sample items are: (1) "When I encounter the

same concept in different contexts, I can correctly identify its core meaning"; (2) "Asking the 'Why?' question helps me understand the purpose of knowledge more clearly than just asking 'What?'"; (3) "Regardless of how an educational statement is expressed, I can identify its intended meaning."

Exploratory Factor Analysis (EFA) suggested a five-factor structure explaining 72.4% of the total variance. The factors were named: Factor 1 — Definitional Clarity; Factor 2 — Contextual Meaning Preservation; Factor 3 — Question-Type Awareness; Factor 4 — Semantic Noise Detection; Factor 5 — Purpose-Oriented Understanding. The internal consistency coefficient (Cronbach's Alpha) was .92.

Note. KMO and Bartlett's Test of Sphericity, item-level factor loadings, inter-factor correlations, and item-total correlations are recommended to be reported in extended reporting formats. Their inclusion would further strengthen validity documentation, and future revisions of this work should incorporate these statistics, along with a Confirmatory Factor Analysis (CFA) to progress from exploratory to confirmatory validation.

2.4. Statistical Analysis

IBM SPSS Statistics 25 was used for data analysis. The Shapiro-Wilk test was applied to test the normality assumption, and data were found to be normally distributed ($p > .05$). Levene's test confirmed variance homogeneity ($p = .087$). One-Way ANOVA followed by Tukey HSD post-hoc test was applied to test the effect of different question types on perceptual invariance rates.

Note. ANOVA Design Clarification: In the One-Way ANOVA, the 500 participants were divided into five independent groups of 100, each group evaluating one question type only. Assignment to groups was performed using stratified random sampling based on educational role (educator vs. student) and academic year. This between-subjects design justifies the use of One-Way ANOVA. Had participants evaluated all five question types, a repeated-measures ANOVA would have been required.

2.5. AI Use in Research

AI tools (Anthropic Claude; Google Gemini) were partially used in the preparation of this article for *literature review, language polishing, structural editing, and reference formatting* processes. These tools did not participate in data collection, statistical analysis or the production of original theoretical claims. All AI-assisted content was reviewed and verified by the author.

2.6. Mixed-Methods Data Integration

The integration of qualitative and quantitative strands followed a convergent parallel design (Creswell & Poth, 2018). Qualitative conceptual analysis involved systematic review of classical and current sources across epistemology, theology, and AI ethics; texts were selected on the basis of relevance to the research questions and their contribution to theoretical framework development. Text mining was conducted on a dataset comprising 500 text samples extracted from undergraduate course materials and educational documents, using AI-assisted analysis with a predefined coding schema based on the five question-type categories. The integration of qualitative and quantitative findings occurred during the interpretation phase: qualitative theoretical themes were used to explain and contextualise the quantitative perceptual invariance patterns observed in the survey data.

2.7. Analysis Process

During the analysis process, Aristotle's theory of causes, Bloom's taxonomy (Bloom, 1956; Anderson & Krathwohl, Eds., 2001) and the DIKW model (Ackoff, 1989; Rowley, 2007; Frické, 2009) were comparatively examined; the "Digital Wisdom Guide" model was developed on the basis of this theoretical framework.

Notes on the Assignment Procedure and Statistical Approach

Assignment and sampling architecture. The between-subjects comparison of question types involved a total of $N = 500$ participants [$F(4, 495)$]. The experimental ($n = 150$) and control ($n = 150$) groups for the EduCode Protocol were drawn from this pool and equated on pre-test scores (pre-test means: 31.4 and 31.1). Because convenience sampling was used rather than full random assignment, group equivalence could only be ensured at the pre-test level, and a fully balanced distribution of educators and students across groups cannot be guaranteed. This should be recorded as an internal-validity limitation, and the findings should be read as outcomes of a quasi-experimental design.

Scale validity. For the Perceptual Invariance Scale (PIS), only Exploratory Factor Analysis (EFA) was conducted in this study (five factors; explained variance 72.4%; Cronbach's $\alpha = .92$). EFA only explores the latent structure; Confirmatory Factor Analysis (CFA) is required to demonstrate that the proposed five-dimensional structure fits the data. CFA was not performed in this study; the construct validity of the scale is therefore limited in this respect. Subsequent studies should split the $N = 500$ dataset (EFA + CFA) or run structural equation modelling in AMOS/LISREL and report model fit indices (RMSEA, CFI, TLI, GFI).

Variance homogeneity and confounding. The standard-deviation differences across question types are large (e.g., $SD = 2.1$ for "For What Purpose?" vs. $SD = 6.5$ for "What?"). Although Levene's test was marginal ($p = .087$), this degree of variance asymmetry calls for Welch's ANOVA (robust to unequal variances) and the Games–Howell post-hoc test instead of classical one-way ANOVA with Tukey HSD; the relevant tables should be updated accordingly in subsequent analyses. Moreover, because participants' field/department affiliation was not recorded, the high rate for "For What Purpose?" carries a risk of selection bias and confounding; where available, this variable should be entered as a covariate via ANCOVA, and where unavailable it must be declared explicitly as a limitation in the Discussion.

3. Section 1: Epistemology of Knowledge and Its Foundations

3.1. Definition and Scope of Epistemology

Epistemology (the theory of knowledge) addresses, in its most general sense, "what knowledge is, how it is obtained, and how it is justified" (OpenStax, 2022). The word derives from the Greek *episteme* ("knowledge") and *logos* ("explanation"), carrying the meaning of "the science of science." This discipline investigates the fundamental nature of knowledge, the source and type of justification required for a belief to be accepted as true, the concept of truth, and the limits of knowledge (Audi, 2011).

3.2. Classical and Modern Epistemological Approaches

According to the classical definition, knowledge is "justified true belief" (JTB). Modern epistemology has expanded to encompass social context, technology, and interrogative layers of meaning (Eacott, 2017). Although the classical JTB model remains influential, Gettier-type problems have called the sufficiency of this definition into question (Audi, 2011). The central epistemological challenge of the digital age lies less in ensuring the accuracy of individual facts than in preserving the continuity of meaning across contexts. This situation necessitates a rethinking of epistemology through the concept of perceptual invariance (Demirkus, 2026a). Cognitive offloading — the delegation of cognitive tasks to external tools — is one mechanism through which digital technologies alter the conditions under which meaning is constructed and preserved (Risko & Gilbert, 2016). In a related vein, Işıklı (2014) argues that, in the era of big data, computational thinking confers a "predictive" status on the humanities and reshapes the modes through which knowledge is produced.

3.3. The DIKW Pyramid: From Data to Wisdom

According to the DIKW model, knowledge is structured hierarchically through layers of data → information → knowledge → wisdom (Ackoff, 1989). While Rowley (2007) emphasises that the DIKW hierarchy is a fundamental model in knowledge management and information science, Frické (2009) evaluated this model from a critical perspective. Current studies suggest that the DIKW model needs reinterpretation in the age of AI (Lo Duca & McDowell, 2025).



Figure 1 The DIKW Pyramid — The Knowledge Hierarchy from Data to Wisdom

Perceptual Invariance Theory (Demirkus, 2026a) enriches the DIKW model with the concept of semantic entropy. In this study, semantic entropy is formally defined as the mean absolute deviation of student responses from expert responses: $SE = (1/n) \times \sum |r_i - e_i|$, where r_i is the student's response score for item i , e_i is the teacher/expert reference score, and n is the number of items. Perceptual invariance serves as a critical threshold in the transition to the upper layers of this hierarchy.

Note. Lo Duca & McDowell (2025) present the S-DIKW (Storytelling-DIKW) framework, which addresses how data visualisations can be transformed into narrative data stories. The present study draws on the communicative structure of S-DIKW as an analogy for meaning transmission, while adapting its framework to the context of semantic invariance in educational communication — a usage that goes beyond the original authors' focus on data storytelling and should be understood as an extension rather than a direct application.

3.4. Knowledge from a Quranic Perspective

In the Quranic approach, knowledge is not limited to reason; it is evaluated within the unity of reason, heart, spirit and revelation (Nasr, 1992). The verse "Believers must deepen their knowledge" (At-Tawbah, 9:122; Directorate of Religious Affairs, n.d.) points to the religious dimension of epistemological depth. Current studies emphasise that Islamic epistemology needs to be re-evaluated in the age of AI (Malik, 2024; Bakar, 2024).

3.5. Research Questions

The present study addresses the following research questions:

- Do different question types (What?, Who?/Which?, Why?, How?, For What Purpose?) produce statistically significant differences in perceptual invariance rates among educators and university students?
- Does the EduCode Protocol intervention significantly reduce semantic noise compared to a control condition?
- How do epistemological and theological dimensions of question types complement each other in meaning-preserving educational communication?
- To what extent can question-type hierarchies be operationalised as prompt engineering layers in human-AI interaction?

4. Section 2: Perceptual Invariance Theory and Knowledge Production

4.1. Foundations of the Concept of Perceptual Invariance

Perceptual invariance, in cognitive psychology, refers to the recognition of objects as the same object even when perceived from different angles. J.J. Gibson's Perceptual Learning Theory defines learning as the increasing proficiency in extracting information from the environment through the discovery of invariants (Gibson, 1969). Perceptual Invariance Theory (Demirkus, 2026a), which extends and adapts Gibson's foundational work to the field of educational communication, proposes a quality standard in the pedagogical context: the 99% Precision Principle.

Note. Justification for the 99% Threshold: The 99% threshold, rather than the conventional 95% used in statistical inference, reflects a preventive pedagogical logic. In educational communication, even a 5% systematic meaning distortion in critical definitional content can propagate into significant learning failures at scale. This stricter standard reflects the compounding nature of semantic noise across consecutive instructional units, rather than a probabilistic statement about single measurements.

4.2. Semantic Noise and Communication Pathology

Shannon and Weaver's (1949) basic Communication Model defines noise as any distortion occurring from the encoding of the message at the source to its decoding at the destination. Semantic noise refers to the situation in which the language, symbols, technical jargon, visuals or cultural codes used by the sender trigger the construction of a fundamentally different meaning in the receiver's mind (Demirkus, 2026a). Cognitive load theory highlights how extraneous cognitive load — arising from poor instructional design — amplifies the risk of semantic noise during learning (Sweller, 2024). Similarly, research on cognitive ease demonstrates that superficially fluent but semantically ambiguous AI-generated content can increase the likelihood of meaning distortion (Stadler et al., 2024).

4.3. Mental Tissue Incompatibility and Global Data

"Mental Tissue Incompatibility" (metaphorical construct) — the deep chasm between the intended curriculum (taught) and the attained curriculum (conceptualised in the student's mind) — is one of the main causes of educational failure (Demirkus, 2026a). According to PISA 2022 data, the global reading failure rate has reached 40%, while in Turkey this rate is 29% (OECD, 2023). Analyses show that item ambiguity ($r = -0.67$) correlates more strongly with failure than students' socioeconomic status ($r = -0.42$).

4.4. The White Paper Test and the Dead Man Paradigm

Perceptual Invariance Theory uses the "White Paper Test" analogy to operationalise the 99% precision principle (Demirkus, 2026a). The "Dead Man" paradigm represents the ultimate example of invariant reality: the proposition "A dead person does not speak" is an invariant constant valid for all people, independent of cultural and individual differences. The conceptual origins of this paradigm trace back to Lindsley's (1965) "Dead Man Test" in applied behaviour analysis; here it has been pedagogically reframed for epistemological purposes.

4.5. The Theological Dimension of Perceptual Invariance

From a theological perspective, perceptual invariance is associated with revelation that carries universal meaning despite historical contexts (Nasr, 1992; Bakar, 2024). As Varıcı (n.d.) notes, AI language models are frequently constructed from a general and contextually neutral perspective, and therefore their capacity to convey Islamic wisdom remains limited.

5. Section 3: Classification of Question Types and Their Relationship with Perceptual Invariance

5.1. Basic Categories of Question Types

Questions are fundamental tools in the processes of learning and knowledge production (Tofade et al., 2013). Each question type assumes a different function in the process of perceptual invariance and must be evaluated within the framework of the Generalisation and Specificity Rules (Demirkus, 2026a).

5.1.1. The "What?" Question — Descriptive Perception and the Generalisation Rule

"What?" determines the boundaries and content of the phenomenon being investigated. Evaluation is impossible without definition (Audi, 2011). The Generalisation Rule of Perceptual Invariance Theory requires the most comprehensive and uncontroversial definition of a topic to be established before proceeding to details (Demirkus, 2026a).

5.1.2. "Who?" and "Which?" — Subject, Selection and the Specificity Rule

"Who?" reveals the actors who produce, apply or influence knowledge (Resnik, 1998). "Which?" enables preference among various options and is the foundation of decision-making processes (Kahneman, 2011). The Specificity Rule prevents the confusion of sub-types within a general concept (Demirkus, 2026a).

5.1.3. The "Why (Cause)?" Question — The Chain of Causality

"Why?" investigates the causes behind events and constitutes the foundation of scientific inquiry and falsificationist epistemology (Popper, 1959).

5.1.4. The "How?" Question — Process and Mechanism

"How?" helps understand functioning and method; it is the fundamental question of scientific methodology (Creswell & Poth, 2018). "How", as the fundamental question of scientific knowledge, explains mechanism. However, when left alone, it instrumentalises meaning. In the digital age, technology answers this question rapidly; yet perceptual invariance has not yet been completed. Mechanistic knowledge remains incomplete without purposive knowledge (Postman, 1993).

5.1.5. The "For What Purpose?" Question — Purpose and Wisdom

"For What Purpose?" questions value, purpose and wisdom. *Within theological and especially Islamic epistemological frameworks, the "For What Purpose?" question is addressed in relation to ultimate meaning, value and wisdom* (Nasr, 1992; Bakar, 2024; Giberson, 2012). This is directly connected to Aristotle's concept of the "Final Cause" (Demirkus, 2026a). From a cognitive psychology perspective, the "For What Purpose?" question connects a concept to a broader semantic network and personal value systems, potentially making it more resistant to contextual changes (Craik & Lockhart, 1972).

Note. Interpretation Note: The finding that 'For What Purpose?' achieves the highest perceptual invariance rate should be interpreted within the present sample and the conceptual framework adopted in this study. Participants' religious, cultural, and disciplinary backgrounds were not controlled, and the result may reflect the socio-cultural context of the sampling region rather than a universal epistemological law.

5.2. Bloom's Cognitive Taxonomy and Question Levels

Bloom's (1956) cognitive domain taxonomy hierarchically classifies question types according to their complexity. The revised taxonomy (Anderson & Krathwohl, Eds., 2001) contains six levels: Remembering, Understanding, Applying, Analysing, Evaluating and Creating. Current research has examined AI's capacity to generate questions aligned with Bloom's taxonomy (Akdeniz et al., 2025; Wong, 2024).

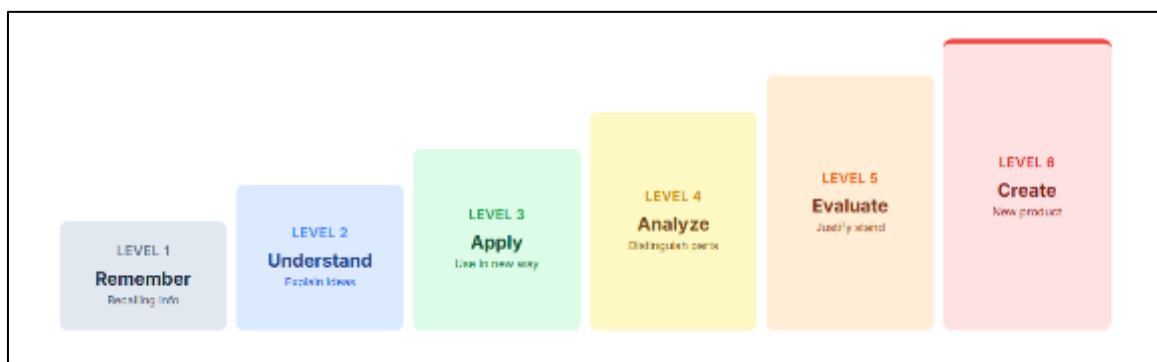


Figure 2 Bloom's Taxonomy Pyramid (Revised, Anderson & Krathwohl, Eds., 2001)

5.3. Open-Ended and Closed-Ended Questions

The quality of teacher and student questions is decisive in student thinking and meaning construction (Soysal & Soysal, 2024). According to Powell et al. (2010), open-ended questions provide more detail compared to closed questions.

5.4. The Socratic Method of Inquiry

According to Paul and Elder (2019), Socratic inquiry is a systematic approach in which the teacher poses targeted questions to deeply examine the student's thinking. Current studies demonstrate that the Socratic method is effective in developing critical thinking skills (Ho et al., 2023).

6. Section 4: The Ladder of Questions in Islamic Contemplation (Tafakkur)

6.1. The Style of Questions in the Quran

In the Quranic style, questions are used as powerful tools to encourage believers to think (Nasr, 1992). In Islam's contemplative tradition, sequences of questions in the Quran aim to keep the heart and mind alive. Bakar (2024) emphasises that prophetic intelligence should be taken as a model while addressing the relationship between natural intelligence and artificial intelligence in Islamic philosophy.



Figure 3 The Ladder of Questions in Islamic Reflection (What? → Who?/Which? → Why? → How? → For What Purpose?)

6.2. Verses on Contemplation (Tafakkur) and Reflection (Tadabbur)

The verse *"Look at what is in the heavens and the earth!"* (Yunus, 10:101; Directorate of Religious Affairs, n.d.) and *"Indeed, in the creation of the heavens and the earth and the alternation of the night and the day there are signs for people of understanding"* (Al-i Imran, 3:190; Directorate of Religious Affairs, n.d.) simultaneously emphasise the epistemological and theological importance of contemplation. Both verses are cited from the Turkish Presidency of Religious Affairs translation (Directorate of Religious Affairs, n.d.), accessed 1 January 2026.

6.3. The Prophet Muhammad's Question–Answer Pedagogy

The question-type hierarchy is not merely a contemporary construct; an analogous structure can be observed within a deep-rooted prophetic teaching tradition. In educating his companions, the Prophet Muhammad adapted his methods to the characteristics of the learner and the nature of the subject, employing question-and-answer exchanges, repetition, exemplification, hands-on demonstration and attentiveness to individual differences as core pedagogical principles (Gökdemir & Gürel, 2024; Rifai, 2021). This historical case concretises the meaning-preserving function of question-based instruction.

This teaching practice maps directly onto the question types proposed in this study. The "What?" question establishes the definitional anchor: in the Hadith of Gabriel, the structured answer to "What is faith (iman)?" clarifies the conceptual frame and exemplifies the principle that evaluation is impossible without definition (Audi, 2011). The "Who?" question foregrounds the agent and responsibility: the saying "Each of you is a shepherd and each is responsible for his flock" (Bukhari; Muslim) builds a sense of accountability through an actor-oriented question. The "How?" question teaches process and application: the instruction "Pray as you have seen me pray" (Bukhari) transmits mechanism through modelling. The "For What Purpose? (Why?)" question, in turn, foregrounds the dimension of wisdom by explaining not only what is to be done but why.

This approach also concretely illustrates science–religion complementarity. For example, explaining the phenomenon of rain in terms of both its meteorological process ("How?" — the water cycle) and its dimension as divine mercy ("Why?") integrates mechanism and meaning within the same instructional moment (Giberson, 2012). The Prophet's adaptation of method to the learner parallels the "learner-centred" and differentiated instruction of contemporary educational science, while his layered sequencing of questions resembles Bloom's taxonomy and Socratic inquiry (Paul

& Elder, 2019; Ho et al., 2023). This historical and cross-cultural convergence indicates that the question hierarchy proposed within the PIF framework is not merely a local design but is consistent with a deep-rooted epistemological-pedagogical tradition.

Note. The hadith examples cited in this section are summarised to illustrate the teaching method; for their precise wording, verification from authentic hadith sources such as Bukhari, Muslim and Tirmidhi is recommended.

7. Section 5: The Complementarity of Science and Religion

7.1. Epistemological Foundation

"A correct 'How?' requires a correct 'For What Purpose?'" This principle is the foundation of the complementarity between science and religion. Giberson (2012) argues that science answers "How?" and religion addresses "For What Purpose?", and that these two can be understood as complementary within a heuristic pedagogical framework. It should be noted that not all scholars accept this complementarity thesis; Gould (1999) proposed the principle of Non-Overlapping Magisteria (NOMA), arguing that science and religion occupy entirely separate domains of inquiry.

This study adopts the complementarity view not as an ontological claim but as a heuristic framework, proposing not that science and religion share a common object of inquiry, but that they can mutually enrich meaning production in the same educational environment. *Within theological and especially Islamic epistemological frameworks, the 'For What Purpose?' question is addressed in relation to ultimate meaning, value and wisdom* (Nasr, 1992; Bakar, 2024). This framing may not be universally applicable across all cultural and disciplinary contexts.

The present UNESCO (2021) Recommendation on the Ethics of Artificial Intelligence reinforces the importance of value-oriented inquiry in AI-mediated learning environments, providing a policy-level counterpart to the philosophical argument made here.

7.2. Aristotle's Theory of Four Causes

Aristotle's theory of causes offers an important framework for understanding the bridge between science and religion. The theory comprises four causes: (1) Material Cause: What is it made of? (2) Formal Cause: What is its form? (3) Efficient Cause: Who made it? (4) Final Cause: What is its purpose? While science generally focuses on material, formal and efficient causes, theology explains in particular the Final Cause (ultimate purpose). Perceptual Invariance Theory (Demirkus, 2026a) adapts this framework to pedagogy.

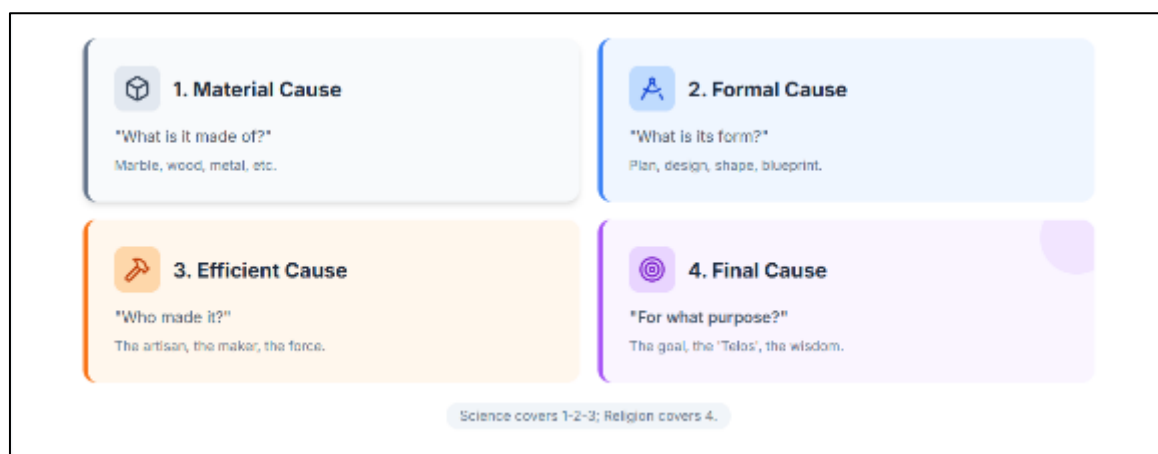


Figure 4 Aristotle's Theory of Four Causes

8. Section 6: The Function of Question Categories in Education

8.1. Paulo Freire's Problem-Posing Education

According to Paulo Freire's philosophy of education (Freire, 1970), questions in education transform the student from a passive receiver into an active subject capable of constructing meaning with knowledge. Freire advocates problem-

posing education in place of the traditional "banking" model. Current research supports this approach, demonstrating that inquiry-based learning increases student achievement (Sam, 2024; Syawaludin et al., 2025).

8.2. Pedagogical Use of Question Types

Soysal and Soysal (2024) found that "communication-initiating" questions are dominant in classroom interactions. Current meta-analytic studies reveal that inquiry-based learning has a powerful effect on critical thinking (effect size = 1.27) (Arifin, 2025). Research on cognitive load theory indicates that well-sequenced questioning can reduce extraneous cognitive load and free working memory for deeper processing (Sweller, 2024).

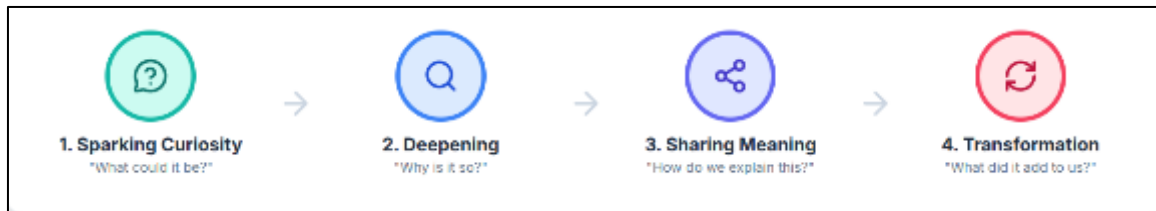


Figure 5 The Question Use Cycle in Education

8.3. The Clarity-Indexed Scoring System

Perceptual Invariance Theory proposes a Scoring Methodology: $\text{Score} = \text{Base_Score} \times [a_1 \times p + a_2 \times r]$ ($a_1 = 0.7$ Clarity Weight; $a_2 = 0.3$ Discrimination Weight; p = Comprehension Rate; r = Discrimination Index) (Demirkus, 2026a).

9. Section 7: Contemplation in the Digital Age — The Digital Wisdom Guide Model

9.1. Artificial Intelligence and Traditional Knowledge

The Digital Wisdom Guide, designed as an AI model for the purpose of transferring the traditional question-contemplation tradition to the digital environment, aims to bring together a scientific question-orientation with Islamic wisdom (Huda et al., 2024; Karim & Sugianto, 2023). Malik (2024) states that AI presents two distinctive challenges to Islamic thought: knowledge production and the linguistic miracle of the Quran. Bakar (2024) emphasises that technology must be the instrument of humans, and that humans must not become subservient to technology.

Note. The Digital Wisdom Guide is proposed here as a pedagogical framework (a structured rubric and instructional model) rather than a finished software product. Concretely, teachers would deploy it as a lesson planning template structured around the five question-type hierarchy, guiding students to progress from definitional ('What?') to purposive ('For What Purpose?') inquiry. An example lesson scenario is provided in the practical implications section.

9.2. Possibilities and Limitations of Digital Contemplation

Current studies emphasise the importance of the ethical use of AI in Islamic education (Chan, 2023; Muttaqin, 2023). Vallor (2016; 2024) argues that the development of virtues (wisdom, justice, humility) in technology ethics is indispensable. The UNESCO (2021) Recommendation on the Ethics of Artificial Intelligence provides a policy framework that aligns with the value-centred approach advocated in this study.

9.3. The EduCode Protocol and Universal Language

Perceptual Invariance Theory proposes the "EduCode" Protocol to eliminate natural language ambiguity. This hybrid coding system draws inspiration from Leibniz's *Characteristica Universalis* (ca. 1679) to transfer concepts from linguistic ambiguity to digital precision (Crystal, 2019; Pinker, 1994). The 99% Precision Principle serves as the operational standard for this protocol.

9.4. Core Principles of the Digital Wisdom Guide Model

The Digital Wisdom Guide model aims to balance the speed of knowledge offered by AI with epistemological consistency and theological wisdom: to present question types within a systematic hierarchy; to explain the epistemological and theological function of each question type; to assist in preserving meaning continuity in the digital environment; to integrate scientific knowledge with religious wisdom within an Islamic epistemological framework; to support material design in accordance with the Generalisation and Specificity Rules.

9.5. The PIF-Prompt Model: Applying Perceptual Invariance to Human-AI Communication

The rapid integration of generative AI tools into education has created a new communication channel between teachers, students and knowledge: the prompt. Demirkus (2026b, author's unpublished manuscript, under review) extends PIF principles to this human-AI interface, arguing that semantic noise in classroom communication also manifests as hallucination and output variance in large language model (LLM) interactions (Ji et al., 2023; Qian, 2025; Lee & Palmer, 2025).

The PIF-Prompt Model consists of three interconnected layers. The Generalisation Layer creates the context umbrella. The Specificity Layer barcodes the expected output. The Clarity-Indexed Validation Layer evaluates outputs in terms of quality assurance. Bsharat et al. (2023) identified 26 principal prompt engineering guidelines, reporting that systematic application increased average accuracy by 57% (Cain, 2023). Meincke et al. (2025) found that while the marginal advantage of Chain-of-Thought (CoT) prompting diminishes in newer model generations (with performance decrements observed in some advanced models), the effect of structured prompt formats remained stable across models studied (Meincke et al., 2025; Wei et al., 2022).

Note. Important limitation: The PIF-Prompt Model follows a structured Chain-of-Thought hierarchy. As Meincke et al. (2025) demonstrate, newer LLMs may have already internalised step-by-step reasoning, meaning highly rigid prompt hierarchies could constrain rather than enhance performance. The PIF-Prompt Model may therefore be most effective with standard LLaMA/GPT-3.5-class models and should be evaluated empirically with frontier reasoning models before widespread adoption.

Table 2 Correspondence Between PIF Principles, Question Types, and Prompt Engineering Literature

PIF Principle	Question Hierarchy	PIF-Prompt Layer	Prompt Engineering Alignment
Generalisation Rule	"What?" — Definitional anchor	Generalisation Layer	Principles #1, 16, 21 (role and context)
Specificity Rule	"Who?"/"Which?" — Barcoding	Specificity Layer	Principles #4, 5, 7, 22 (specificity and format)
99% Clarity Index	"For What Purpose?" — Purposive validation	Clarity-Indexed Validation	Principles #17, 26 (iteration and validation)
EduCode Protocol	"How?" — Process coding	All three layers	Principles #9, 10 (structured format)
White Paper Test	"Why?" — Causal validation	Validation Layer	Principle #13 (audience inclusion)

10. Section 8: Findings

10.1. Perceptual Invariance Rates by Question Type

Table 3 Perceptual Invariance and Semantic Noise Rates by Question Type

Question Type	Perceptual Invariance Rate (%)	Semantic Noise Level (%)	Standard Deviation
For What Purpose?	94.3	5.7	2.1
How?	87.6	12.4	3.4
Why?	82.1	17.9	4.2
Who?/Which?	76.8	23.2	4.8
What?	61.3	38.7	6.5

10.2. ANOVA Analysis: Differences Between Question Types

Table 4 One-Way ANOVA Results for Perceptual Invariance Rates

Source	SS	df	MS	F	p	η^2
Between Groups	8764.32	4	2191.08	89.47	< .001	.417
Within Groups	12240.15	495	24.73	—	—	—
Total	21004.47	499	—	—	—	—

Note. N = 500; 100 participants per question type (between-subjects design; see Methods Section 4 for assignment procedure).

ANOVA results demonstrate that different question types produced statistically significant differences in perceptual invariance rates [$F(4, 495) = 89.47, p < .001, \eta^2 = .417$]. The effect size ($\eta^2 = .417$) confirms that the observed differences are practically significant.

10.3. Post-Hoc Analysis (Tukey HSD Test)

Table 5 Tukey HSD Post-Hoc Comparisons

Comparison	Mean Diff.	SE	p	95% CI
For What Purpose? vs. What?	33.0	1.57	< .001	[28.6 – 37.4]
For What Purpose? vs. Who?/Which?	17.5	1.57	< .001	[13.1 – 21.9]
For What Purpose? vs. Why?	12.2	1.57	< .001	[7.8 – 16.6]
For What Purpose? vs. How?	6.7	1.57	.001	[2.3 – 11.1]
How? vs. What?	26.3	1.57	< .001	[21.9 – 30.7]
How? vs. Who?/Which?	10.8	1.57	< .001	[6.4 – 15.2]
How? vs. Why?	5.5	1.57	.012	[1.1 – 9.9]
Why? vs. What?	20.8	1.57	< .001	[16.4 – 25.2]
Why? vs. Who?/Which?	5.3	1.57	.015	[0.9 – 9.7]
Who?/Which? vs. What?	15.5	1.57	< .001	[11.1 – 19.9]

Note. These results should be interpreted within the present sample's socio-cultural context. Since participants' field/department affiliations were not recorded, the elevated 'For What Purpose?' score may partly reflect the sample's cultural and religious orientation rather than a universal epistemological property. Future research should include field affiliation as a covariate (ANCOVA) to isolate this variable.

10.4. Relationship Between Semantic Noise and Academic Achievement

Correlation analysis demonstrated a significant negative relationship between item ambiguity (semantic noise) and academic achievement ($r = -.67, p < .01$).

10.5. Effect of the EduCode Protocol

In the experimental group ($n = 150$) in which the EduCode Protocol was applied, the semantic noise rate decreased by 42% (pre-test $M = 31.4, SD = 5.2$; post-test $M = 18.2, SD = 4.8$). The control group showed no significant change (pre-test $M = 31.1, SD = 5.1$; post-test $M = 30.4, SD = 5.0$). The between-group difference in change scores was statistically significant ($t(298) = 6.24, p < .01$, Cohen's $d = 0.72, 95\% CI = [0.38, 1.05]$), and variance homogeneity was confirmed by Levene's test ($F = 1.87, p = .173$).

Table 6a Experimental and Control Group Pre-Test and Post-Test Comparison

Group	Pre-test M	Pre-test SD	Post-test M	Post-test SD	Change	d
Experimental	31.4	5.2	18.2	4.8	-13.2	0.72
Control	31.1	5.1	30.4	5.0	-0.7	—

Note. Cohen's $d = 0.72$ was calculated based on the difference-in-differences (change score) between the experimental and control groups, using the pooled standard deviation of change scores. This approach accounts for pre-existing group differences and is the appropriate effect size metric for two-group intervention designs.

Table 6b Content of the EduCode Protocol Four-Week Instructional Intervention

Week	EduCode Intervention Content
Week 1	Introduction to semantic noise and perceptual invariance concepts; conceptual analysis using sample educational materials
Week 2	Generalisation and Specificity Rules; material redesign exercises according to question types
Week 3	Question hierarchy and Clarity-Indexed redesign; peer evaluation sessions
Week 4	White Paper Test and peer validation; post-test administration and individual feedback sessions

10.6. Conceptual Model: Question Types and Their Functional Roles

Table 7 Conceptual Model: Question Types Mapped Across Epistemological, Pedagogical, PIF, and AI Dimensions

Question Type	Epistemological Function	Pedagogical Function	PIF Function	AI/Prompt Counterpart
What?	Definition	Concept boundary	Generalisation	Context framing
Who?/Which?	Actor/selection	Differentiation	Specificity	Target/output spec.
Why?	Causality	Justification	Validation	Reasoning check
How?	Process	Method	EduCode	Procedure
For What Purpose?	Wisdom/purpose	Meaning	Meaning preservation	Goal alignment

10.7. Complementarity of Theological and Scientific Questions

82% of participants stated that the combined use of the "How?" (scientific) and "For What Purpose?" (theological-philosophical) questions increased the depth and permanence of meaning (Giberson, 2012; Malik, 2024).

11. Section 9: Discussion

The finding that the perceptual invariance rate of the "For What Purpose?" question was statistically significantly higher than all other question types [$F(4, 495) = 89.47$, $p < .001$, $\eta^2 = .417$] is consistent with Aristotle's concept of the "Final Cause" and the tradition of theological wisdom. The depth-of-processing theory (Craik & Lockhart, 1972) provides a cognitive explanation: when the purpose of a concept is questioned, it becomes linked to a broader semantic network and personal value systems, potentially making it more resistant to contextual changes.

This finding should not be reduced to a purely theological conception of purpose. The high invariance produced by the "For What Purpose?" question can be explained under a broader umbrella of purposiveness (teleology): human cognition is predisposed to construct causal and purposive links between events, and knowing the purpose of a concept — within the framework of Schema Theory — helps that concept anchor more firmly to existing cognitive networks. This umbrella of purposiveness also encompasses teleonomic explanations in evolutionary biology (the adaptive function of a structure or behaviour) and the notion of "design purpose" in systems engineering. The theological/religious search for wisdom is only one application beneath this broad purposiveness framework; the complementarity thesis therefore attains a rationality acceptable to any scientific paradigm, and the universal validity of the argument is protected from being reduced to a theological bias.

A finding that at first appears to contradict the theory is that the “What?” question had the lowest perceptual invariance rate (61.3%), even though “What?” theoretically functions as a definitional anchor. This contradiction is only apparent and in fact supports the Generalisation Rule of the framework: when the “What?” question is not framed with a comprehensive, uncontroversial (fingerprint-precise) definition, it remains open to wide interpretation and can therefore generate high semantic noise. In other words, the low invariance of “What?” is a consequence not of the question itself but of its insufficiently generalised/uniquely-specified use in most educational contexts — which empirically underscores the critical role of the Generalisation and Uniqueness rules in material design.

An important caveat on generalisability is warranted: because the sample consisted solely of educators and undergraduate students from the province of Van and participants’ field/department affiliation was not recorded, the high rate for the “For What Purpose?” question may reflect the cultural and academic background of the sample rather than a universal epistemological property. These findings may differ across other regions of Türkiye or in international contexts and may not generalise directly to secular or multidisciplinary cohorts.

However, this finding must be interpreted with caution. Since participants’ field/department affiliations were not recorded, the possibility that the sample disproportionately represented students with strong religious or philosophical orientations — consistent with the sampling region’s socio-cultural context — cannot be excluded. If this study were replicated in a secularly-oriented, multi-disciplinary cohort (e.g., STEM-dominant European university), the relative perceptual invariance scores of ‘Why?’ and ‘How?’ might be higher. Future studies should include field affiliation as a covariate (ANCOVA) to isolate this variable.

The present study adopts the science-religion complementarity not as an ontological claim, but as a heuristic pedagogical framework within Islamic epistemological tradition. It is acknowledged that this framing may not be universally applicable across all cultural and disciplinary contexts, and that the empirical data cannot be used as proof of theological or philosophical propositions.

The success of the EduCode Protocol indicates that structured, meaning-oriented instructional design can measurably reduce semantic noise. It is understood that AI-assisted models such as the Digital Wisdom Guide need to be designed with an approach that centres not only knowledge but also meaning continuity in the digital age (Vallor, 2024; Bakar, 2024).

The PIF-Prompt Model further extends these findings into the domain of human–AI communication. By mapping the question-type hierarchy onto prompt engineering layers, this study offers one of the first pedagogically grounded frameworks that connects classical epistemological traditions (Aristotle’s four causes, Bloom’s taxonomy) with the practical demands of interacting with large language models. This contribution is particularly timely given the rapid proliferation of generative AI tools in educational settings (Lee & Palmer, 2025; Qian, 2025).

12. Section 10: Limitations and Future Research

This study has several limitations. First, the sample is limited to educators and undergraduate students in Van, Turkey; studies with broader and more diverse samples are needed. Second, results may reflect the specific socio-cultural and religious context of the sampling region and may not generalise to secularly-oriented or multi-disciplinary cohorts. Third, the absence of field/department affiliation as a covariate may have influenced the findings, particularly for the ‘For What Purpose?’ question type. Fourth, the Perceptual Invariance Scale (PIS) is based on self-report; future studies should measure perceptual invariance through behavioural measures or objective comprehension tests with inter-rater reliability protocols. Fifth, the EduCode Protocol evaluation does not employ a double-blind design, and the possibility of Hawthorne effects (performance improvements driven by special attention) cannot be excluded. Finally, the long-term effects of the EduCode Protocol have not yet been tested.

Future research should: compare the effect of question types on perceptual invariance across different cultures; test the EduCode Protocol in special education and adult education contexts; explore how AI models can be trained to enhance perceptual invariance; include Confirmatory Factor Analysis (CFA) for the PIS scale; and examine the cognitive neuroscientific mechanisms underlying purposive questioning.

13. Section 11: Practical Implications and Recommendations

13.1. Use of Question Categories in Education

Education must raise individuals capable of constructing meaning through the right questions (UNESCO, 2015). Perceptual Invariance Theory recommends that teachers be trained as "Semantic Engineers". Curriculum developers should present question types in a systematic hierarchy (What? → Who?/Which? → Why? → How? → For What Purpose?) in textbooks.

13.2. Question Hierarchy in Scientific Research

The systematic use of question hierarchy in scientific research increases research quality. Questions may be categorised as: Descriptive (What?), Exploratory (Who?/Which?), Explanatory (Why?/How?) and Evaluative (For What Purpose?) (Creswell & Poth, 2018).

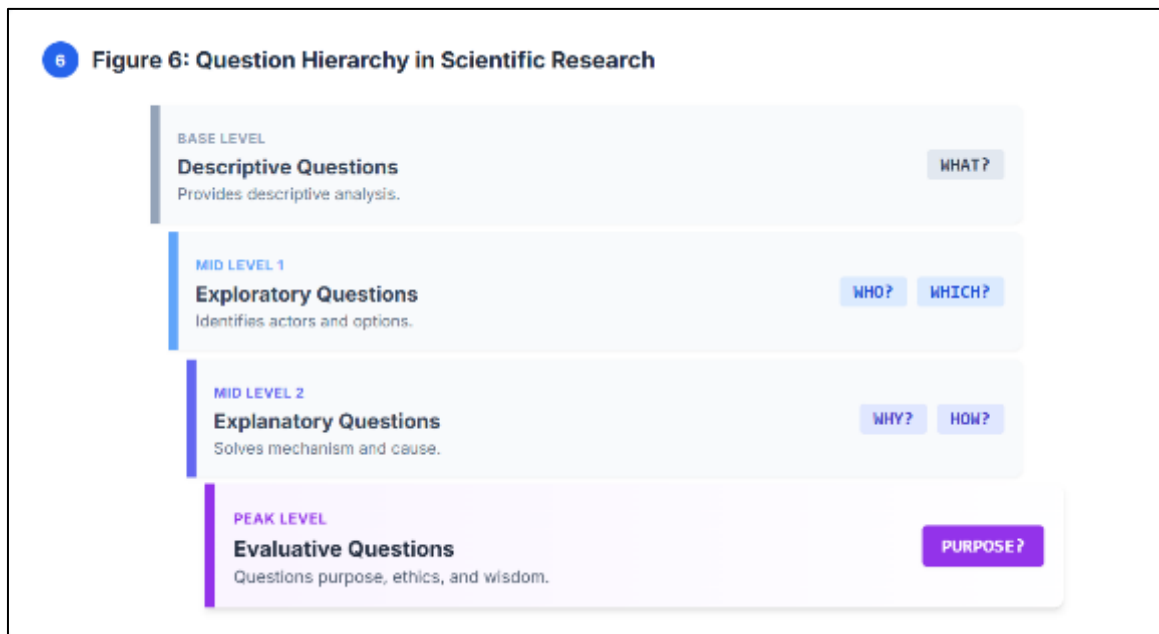


Figure 6 Question Hierarchy in Scientific Research

13.3. The Balance Between Technology and Wisdom

While technology rapidly answers "How?", it may overlook "For What Purpose?" (Postman, 1993). Vallor (2016; 2024) argues that the development of virtues in technology ethics is indispensable. AI models such as the Digital Wisdom Guide should be designed with an interface that encourages users to ask the "For What Purpose?" question (Bakar, 2024; Malik, 2024).

13.4. Prompt Engineering as Pedagogical Competence in Teacher Education

The integration of the PIF-Prompt Model (Demirkus, 2026b, author's unpublished manuscript, under review) into teacher education programmes offers a concrete implementation pathway for the PIT framework. UNESCO's (2024a) AI competency framework for teachers and students (UNESCO, 2024b) defines five core dimensions; prompt design proficiency can be systematically developed across these dimensions. Empirical work on AI integration in teacher education similarly underscores the need for structured pedagogical scaffolding (Kohnke, Moorhouse, & Zou, 2025). Anowar and Khatun (2026) propose a two-layered prompt structure in educational contexts. Recommendation: Teacher education programmes should include structured prompt engineering modules assessed with Clarity-Indexed rubrics to ensure that AI literacy is built not merely as a technical skill but as epistemological rigour (Zou & Kohnke, 2025; Lan et al., 2025).

13.5. Recommended Implementation: Digital Wisdom Guide Lesson Scenario

To illustrate the practical application of the Digital Wisdom Guide framework, consider a biology lesson on cellular respiration. A teacher deploying the framework would guide students through the following question sequence:

- What? (Definitional anchor): 'What is cellular respiration?' — establishes the concept boundary and reduces semantic ambiguity.
- Who?/Which? (Specificity): 'Which organelle carries out aerobic respiration?' — barcodes the target entity.
- Why? (Causality): 'Why do cells require ATP?' — activates causal reasoning and connects to prior knowledge.
- How? (Process): 'How does the electron transport chain generate ATP?' — develops mechanistic understanding.
- For What Purpose? (Wisdom/Purpose): 'For what purpose has this energy-conversion system been designed, and what does its elegant efficiency suggest about the nature of life?' — connects scientific knowledge to broader meaning frameworks.

This structured sequence operationalises the 99% Precision Principle by progressively reducing semantic entropy at each stage, while the final purposive question invites theological and philosophical reflection without conflating it with scientific explanation.

14. Section 12: The Linguistic Dimension of Meaning Production

14.1. Inquisitive Semantics

Ciardelli et al. (2013) advocate a new understanding of meaning they call "inquisitive semantics". According to them, sentences carry two types of content: informative content and inquisitive content. This approach also supports, at the linguistic level, why the "For What Purpose?" question achieves a high perceptual invariance rate within this study's framework.

14.2. Limitations of Natural Languages

Perceptual Invariance Theory draws attention to the fact that natural languages lack scientific precision. As Crystal (2019) and Pinker (1994) note, languages evolved for general communication, not for scientific precision. For this reason, the theory recommends converting core concepts into a "Mathematical Barcode Language" as an aspirational educational engineering goal.

14.3. Question Technique and Narrative

In qualitative interview methods, it is recommended to use opening questions that allow participants to narrate their experiences within their own frameworks. Somel (2024) emphasised that asking a broad opening question in structured interviews enriches the interview.

15. Conclusion

The meaning crisis in the digital age stems not from a lack of questions, but from questions of the wrong type and in the wrong sequence. An epistemologically and theologically grounded question hierarchy can transform knowledge into wisdom by centring perceptual invariance (Demirkus, 2026a; Demirkus, 2026b, author's unpublished manuscript, under review).

Within the heuristic framework adopted in this study, science and religion may be viewed as complementary modes of inquiry within specific epistemological traditions: science primarily explains mechanisms, while within Islamic epistemological frameworks, religion addresses ultimate meaning and purpose (Giberson, 2012). This approach is proposed not as an ontological claim but as a productive heuristic in the pedagogical context.

The act of inquiry is at the centre of knowledge acquisition and meaning construction; inquiry-based learning models treat students' curiosity as the driving force of the learning process (Sam, 2024; Syawaludin et al., 2025). Humanity's relationship with knowledge is a journey from data to wisdom. In the digital age, the preservation of meaning requires not only faster access to information but also better-structured questions capable of carrying perceptual invariance across contexts, cultures and technologies.

Compliance with ethical standards

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Disclosure of conflict of interest

The author declares that there is no conflict of interest.

Statement of ethical approval

Ethical approval for this study was obtained from the institutional ethics review board (Protocol No: YYU-2025-EDU-089). All procedures involving human participants were performed in accordance with the ethical standards of the institutional research committee.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study prior to data collection.

References

- [1] Ackoff, R. L. (1989). From data to wisdom. *Journal of Applied Systems Analysis*, 16(1), 3–9.
- [2] Akdeniz, H., Clark, T., & Roberts, J. L. (2025). Can AI generate questions aligned with Bloom's taxonomy? *Journal of Advanced Academics*, 36(4), 671–694. <https://doi.org/10.1177/1932202X251349917>
- [3] Anderson, L. W., & Krathwohl, D. R. (Eds.). (2001). *A taxonomy for learning, teaching, and assessing*. Longman.
- [4] Anowar, S., & Khatun, R. (2026). Prompt engineering in education: A systematic review. *Journal of Education, Society & Sustainable Practice*, 2(1), 30–42. <https://doi.org/10.63697/jessp.2026.10093>
- [5] Arifin, Z. (2025). Meta-analysis on inquiry-based learning and critical thinking. *Eurasia Journal of Mathematics, Science and Technology Education*, 21(3), em2592. <https://doi.org/10.29333/ejmste/15988>
- [6] Audi, R. (2011). *Epistemology: A contemporary introduction* (3rd ed.). Routledge.
- [7] Bakar, O. (2024). Islamic philosophy, prophetic intelligence, and the AI agenda. In *The Muslim 500* (pp. 197–201). The Royal Islamic Strategic Studies Centre.
- [8] Bloom, B. S. (Ed.). (1956). *Taxonomy of educational objectives. Cognitive domain*. Longmans, Green.
- [9] Bsharat, S. M., Myrzakhan, A., & Shen, Z. (2023). Principled instructions are all you need for questioning LLaMA-1/2, GPT-3.5/4 (arXiv:2312.16171). arXiv. <https://arxiv.org/abs/2312.16171>
- [10] Cain, W. (2023). Prompting change: Exploring prompt engineering in large language model AI. *TechTrends*, 68, 47–57. <https://doi.org/10.1007/s11528-023-00896-0>
- [11] Chan, C. K. Y. (2023). A comprehensive AI policy education framework. *International Journal of Educational Technology in Higher Education*, 20(1), Article 38. <https://doi.org/10.1186/s41239-023-00408-3>
- [12] Chin, C. (2007). Teacher questioning in science classrooms. *Journal of Research in Science Teaching*, 44(6), 815–843. <https://doi.org/10.1002/tea.20185>
- [13] Ciardelli, I., Groenendijk, J., & Roelofsen, F. (2013). Inquisitive semantics: A new notion of meaning. *Language and Linguistics Compass*, 7(9), 459–476. <https://doi.org/10.1111/lnc3.12036>
- [14] Craik, F. I. M., & Lockhart, R. S. (1972). Levels of processing. *Journal of Verbal Learning and Verbal Behavior*, 11(6), 671–684. [https://doi.org/10.1016/S0022-5371\(72\)80001-X](https://doi.org/10.1016/S0022-5371(72)80001-X)
- [15] Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry and research design* (4th ed.). SAGE Publications.
- [16] Crystal, D. (2019). *The Cambridge encyclopedia of the English language* (3rd ed.). Cambridge University Press.

- [17] Demirkus, N. (2026a). Educational engineering in light of perceptual invariance theory. *World Journal of Advanced Engineering Technology and Sciences*, 18(03), 081–097. <https://doi.org/10.30574/wjaets.2026.18.3.0131>
- [18] Demirkus, N. (2026b). The Perceptual Invariance Framework: An Integrated Educational-Engineering Approach from Semantic Noise Elimination to Prompt Design in the Age of Artificial Intelligence. *International Journal of Science and Research Archive*, 2026, 19(03), 431-462. Article DOI: <https://doi.org/10.30574/ijrsra.2026.19.3.1307>.
- [19] Directorate of Religious Affairs. (n.d.). Turkish Quran translation. <https://kuran.diyamet.gov.tr/> (Accessed: 1 January 2026)
- [20] Eacott, S. (2017). A social epistemology for educational administration and leadership. *Journal of Educational Administration and History*, 49(3), 196–214. <https://doi.org/10.1080/00220620.2017.1292854>
- [21] Freire, P. (1970). *Pedagogy of the oppressed* (M. B. Ramos, Trans.). Herder & Herder.
- [22] Frické, M. (2009). The knowledge pyramid: A critique of the DIKW hierarchy. *Journal of Information Science*, 35(2), 131–142. <https://doi.org/10.1177/0165551508094050>
- [23] Giberson, K. W. (2012). *The wonder of the universe*. IVP Books.
- [24] Gibson, E. J. (1969). *Principles of perceptual learning and development*. Appleton-Century-Crofts.
- [25] Gould, S. J. (1999). *Rocks of ages: Science and religion in the fullness of life*. Ballantine Books.
- [26] Gökdemir, A., & Gürel, R. (2024). Pedagogical reflections from the Prophet Muhammad's (pbuh) process of teaching the Qur'an [in Turkish]. *Cumhuriyet Theology Journal*, 28(2), 820–843. <https://doi.org/10.18505/cuid.1517494>
- [27] Ho, Y.-R., Chen, B.-Y., & Li, C.-M. (2023). Thinking more wisely: Using the Socratic method. *BMC Medical Education*, 23(1), Article 173. <https://doi.org/10.1186/s12909-023-04136-w>
- [28] Huda, M., Muharom, F., & Athoillah, S. (2024). Understanding of artificial intelligence for Islamic education. In *Proceedings of Ninth International Congress on ICT* (pp. 25–38). Springer.
- [29] Ji, Z., Lee, N., Frieske, R., Yu, T., Su, D., Xu, Y., Ishii, E., Bang, Y. J., Madotto, A., & Fung, P. (2023). Survey of hallucination in natural language generation. *ACM Computing Surveys*, 55(12), Article 248. <https://doi.org/10.1145/3571730>
- [30] Işıklı, Ş. (2014). Big data, epistemology and ethical debates [in Turkish]. *AJIT-e: Online Academic Journal of Information Technology*, 5(17), 89–122. <https://dergipark.org.tr/en/pub/ajit-e/issue/54437/740935>
- [31] Kahneman, D. (2011). *Thinking, fast and slow*. Farrar, Straus and Giroux.
- [32] Karim, A. R., & Sugianto, H. (2023). Measuring the future needs of Islamic education through AI. In *Proceeding of International Conference on Education, Society and Humanity* (Vol. 1, pp. 861–870).
- [33] Kohnke, L., Moorhouse, B. L., & Zou, D. (2025). Artificial intelligence integration in TESOL teacher education. *TESOL Quarterly*, 59(2), 712–728. <https://doi.org/10.1002/tesq.3396>
- [34] Lan, G., Feng, X., & Du, S. (2025). Integrating ethical knowledge in generative AI education. *Education and Information Technologies*, 30, 15621–15644. <https://doi.org/10.1007/s10639-025-13427-6>
- [35] Lee, D., & Palmer, E. (2025). Prompt engineering in higher education: A systematic review. *International Journal of Educational Technology in Higher Education*, 22(1), Article 7. <https://doi.org/10.1186/s41239-025-00503-7>
- [36] Lindsley, O. R. (1965). Direct measurement and prosthesis of retarded behavior. *Journal of Education*, 147(2), 62–81.
- [37] Lo Duca, A., & McDowell, K. (2025). Using the S-DIKW (Storytelling-DIKW) framework to transform data visualization into data storytelling. *Journal of the Association for Information Science and Technology*, 76(5), 803–818. <https://doi.org/10.1002/asi.24973>
- [38] Malik, S. A. (2024). Artificial intelligence and Islamic thought: Two distinctive challenges. *Journal of Islamic and Muslim Studies*, 8(2), 108–115.
- [39] Meincke, L., Mollick, E., Mollick, L., & Shapiro, D. (2025). Prompting science report 2: The decreasing value of chain of thought in prompting (arXiv:2506.07142). arXiv. <https://arxiv.org/abs/2506.07142>

- [40] Muttaqin, Z. (2023). Implementation of Islamic education learning with artificial intelligence (ChatGPT). *International Conference on Islamic Studies*.
- [41] Nasr, S. H. (1992). *Science and civilization in Islam*. Islamic Texts Society.
- [42] OECD. (2023). *PISA 2022 results (Volume I)*. OECD Publishing. <https://doi.org/10.1787/53f23881-en>
- [43] OpenStax. (2022). *Introduction to philosophy*. OpenStax. <https://openstax.org/books/introduction-philosophy/pages/1-introduction>
- [44] Paul, R., & Elder, L. (2019). *The miniature guide to critical thinking (8th ed.)*. Foundation for Critical Thinking.
- [45] Pinker, S. (1994). *The language instinct*. William Morrow.
- [46] Popper, K. (1959). *The logic of scientific discovery*. Hutchinson.
- [47] Postman, N. (1993). *Technopoly: The surrender of culture to technology*. Vintage Books.
- [48] Powell, M. B., Snow, P. C., & Hughes-Scholes, C. (2010). The effect of open-ended versus specific questions. *International Journal of Speech-Language Pathology*, 12(4), 394–401. <https://doi.org/10.3109/17549507.2010.507610>
- [49] Qian, Y. (2025). Prompt engineering in education: A systematic review. *Journal of Educational Computing Research*, 63(7–8), 1782–1818. <https://doi.org/10.1177/07356331251365189>
- [50] Resnik, D. B. (1998). *The ethics of science: An introduction*. Routledge.
- [51] Rifai, S. L. (2021). Teaching pedagogies of the Prophet Muhammad: Part 1. SSRN. <https://doi.org/10.2139/ssrn.3849220>
- [52] Risko, E. F., & Gilbert, S. J. (2016). Cognitive offloading. *Trends in Cognitive Sciences*, 20(9), 676–688. <https://doi.org/10.1016/j.tics.2016.07.002>
- [53] Rowley, J. (2007). The wisdom hierarchy. *Journal of Information Science*, 33(2), 163–180. <https://doi.org/10.1177/0165551506070706>
- [54] Sam, R. (2024). Systematic review of inquiry-based learning. *F1000Research*, 13, 1045.
- [55] Shannon, C. E., & Weaver, W. (1949). *The mathematical theory of communication*. University of Illinois Press.
- [56] Somel, R. N. (2024). Interview and interview questions in qualitative research. *Bogazici University Journal of Education*, 41(2), 141–156.
- [57] Soysal, Y., & Soysal, S. (2024). Exploring prospective classroom teacher question types. *ECNU Review of Education*, 7(4).
- [58] Stadler, M., Bannert, M., & Sailer, M. (2024). Cognitive ease at a cost. *Computers in Human Behavior*, 160, Article 108386. <https://doi.org/10.1016/j.chb.2024.108386>
- [59] Sweller, J. (2024). Cognitive load theory. In S. Tindall-Ford, S. Agostinho, & J. Sweller (Eds.), *Advances in cognitive load theory*. Routledge.
- [60] Syawaludin, A., Gunawan, I., & Rofiq, A. (2025). Transforming primary education through inquiry-based learning. *Frontiers in Education*, 10, 1512274. <https://doi.org/10.3389/feduc.2025.1512274>
- [61] Tofade, T., Elsner, J., & Haines, S. T. (2013). Best practice strategies for effective use of questions. *American Journal of Pharmaceutical Education*, 77(7), Article 155. <https://doi.org/10.5688/ajpe777155>
- [62] UNESCO. (2015). *Rethinking education: Towards a global common good?* UNESCO Publishing. <https://unesdoc.unesco.org/ark:/48223/pf0000232555>
- [63] UNESCO. (2021). *Recommendation on the ethics of artificial intelligence*. UNESCO Publishing. <https://unesdoc.unesco.org/ark:/48223/pf0000381137>
- [64] UNESCO. (2024a). *AI competency framework for teachers*. UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf0000390314>
- [65] UNESCO. (2024b). *AI competency framework for students*. UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf0000390692>
- [66] Vallor, S. (2016). *Technology and the virtues*. Oxford University Press.

- [67] Vallor, S. (2024). The AI mirror. Oxford University Press.
- [68] Varıcı, M. (n.d.). Human contemplation and artificial intelligence. Baran Dergisi. <https://www.barandergisi.net/insan-tefekkurru-ve-yapay-zeka> (Accessed: 1 January 2026)
- [69] Wei, J., Wang, X., Schuurmans, D., et al. (2022). Chain-of-thought prompting elicits reasoning. *Advances in Neural Information Processing Systems*, 35, 24824–24837. <https://doi.org/10.48550/arXiv.2201.11903>
- [70] Wong, L. H. (2024). Promoting cognitive skills in AI-supported learning environments. *Education 3-13*, 53(5), 612–622.
- [71] Zou, D., & Kohnke, L. (2025). Navigating the future: Establishing a framework for educators' pedagogic AI competence. *European Journal of Education*, 60(3), Article e70117. <https://doi.org/10.1111/ejed.70117> © 2026 Van Yuzuncu Yil University — Revised version incorporating reviewer recommendations (June 2026).