

Integrating Tawhid Values into the Direct Instruction Model for Phase D Science Learning on the Excretory System: A Literature Review

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ABSTRACT

The secularization of science education frequently creates an epistemological dichotomy, alienating learners from their spiritual identity. This study aims to synthesize a conceptual instructional design that integrates Islamic Tawhid values, specifically Ash'arite theology, into the learning of the human excretory system. Utilizing a qualitative library research approach, interdisciplinary literature encompassing biological curricula and thematic Qur'anic exegesis was examined using content analysis and an interactive qualitative model. The findings reveal a profound ontological mapping where excretory organs reflect divine balance and the absolute power of God, refuting independent mechanistic causality. To operationalize these concepts, a Tawhid-integrated engineering design process syntax was developed. By guiding students to design and test artificial filtration prototypes, this framework transforms technical problem-solving into an act of worship and earthly stewardship. This structured pedagogical approach successfully preserves rigorous scientific integrity, prevents dogmatic pseudoscience, and significantly enhances students' analytical resilience. Ultimately, this integrated engineering model transforms passive learners into ethically grounded innovators, providing a highly robust pedagogical blueprint that advances holistic character development in contemporary Islamic science education.

Keywords: *Excretory System, Engineering Design Process, Islamic Science Education, Tawhid Integration, STEM Education.*



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INTRODUCTION

The contemporary landscape of modern science education is frequently characterized by a pervasive secularization that fundamentally separates empirical reasoning from spiritual revelation. This persistent dichotomy between secular science and religious education has generated a profound epistemological crisis within the global educational system, creating intellectual and spiritual identity confusion among Muslim students. When the study of natural phenomena is entirely detached from its metaphysical and divine realities, science risks losing its foundational ethical compass, reducing the universe to a mere mechanistic

entity. Conversely, when religious education is isolated from scientific advancements, it risks losing its practical instruments for addressing modern real-world challenges. This condition inevitably causes epistemic dissonance, wherein secular paradigms strip science of its spiritual soul, thereby risking intellectual fragmentation, value distortion, and the obstruction of holistic human development (Syarifah & Misbah, 2024; Wan Daud, 2010). Therefore, the urgency to eliminate this dualistic separation is paramount, as a harmonious integration is essential to establish a comprehensive ethical and intellectual foundation for learners in the modern world.

In response to this epistemological divide, the discourse on the Islamization of modern science has emerged as a critical corrective movement. The foundational ideas initiated by prominent thinkers such as Syed Muhammad Naquib al-Attas and Ismail Raji al-Faruqi emphasize the absolute necessity of reconstructing contemporary knowledge by integrating Tawhidic (Islamic monotheism), spiritual, and ethical values directly into modern scientific methodologies. Although this conceptual framework has begun to be implemented in higher education curricula and Islamic schools through various approaches of purification, reformation, and adaptation (Yahyan & Madkur, 2017), its practical execution frequently remains superficial and highly fragmented. Empirical studies consistently demonstrate that these integrative implementation efforts are often severely hindered by deep-seated epistemological ambiguities, weak curricular alignment, and a pervasive lack of cohesive institutional support (Hasan, 2020; Noor, 2017). Consequently, the ambitious philosophical ideals of Islamization struggle to materialize into actionable, systematic pedagogical practices within everyday science classrooms.

Addressing this profound instructional deficiency requires a highly targeted pedagogical focus on specific scientific phenomena that naturally elicit theological reflection, such as human biology. The anatomy of the human body, and particularly the human excretory system, serves as an exceptionally effective instrument for instilling spiritual awareness, as it presents natural physiological phenomena as undeniable signs of God's supreme greatness (*ayat kauniyah*). The excretory system represents a flawless physiological design that autonomously manages toxicity and sustains life. Unfortunately, conventional educational practices typically restrict students' understanding strictly to the biological and mechanistic realm. By doing so, standard curricula entirely neglect the critical spiritual dimension of *Tazkiyatun Nafs* (purification of the soul), missing a vital educational opportunity to cultivate a profound sense of gratitude (*syukur*) for the flawless, intricate physiological design bestowed upon human beings by the Supreme Creator.

When the excretory system is taught through an integrative lens, it transcends basic anatomical and physiological memorization, opening expansive spaces for profound reflection on the order of creation, biological balance (*homeostasis*), and the moral responsibility to maintain bodily health as a divine trust. Correlating the astonishing complexity of organs such as the kidneys and the liver with the divine wisdom of their creation provides profound meaning that actively strengthens students' faith, religious character, and moral sensitivity (Zarman, 2021). Teaching science through this meaning-based paradigm ensures that students

do not merely memorize the biochemical pathways of urea or the filtration rates of nephrons, but rather, they internalize the recognition of God's omnipresent power in sustaining their very existence at every microscopic level.

Despite the clear theoretical benefits of this integration, translating these concepts into classroom reality poses a substantial challenge for science educators. The primary obstacles faced by science teachers in integrating religious values include a lack of understanding regarding integration frameworks, severe time constraints, heavy administrative burdens, and a notable absence of specialized training and adequate teaching materials (Siregar, 2026; Zainal, 2021). Due to the lack of a robust epistemological framework, many educators fall into the trap of dogmatic approaches, merely appending Quranic verses superficially to science topics—a practice colloquially known as pseudoscience or "cocoklogi" (forced correlation)—without establishing a logical or scientific connection. Imposing integration without an appropriate pedagogical methodology can inadvertently produce an anti-science attitude or a highly superficial form of religiosity, which ultimately damages the integrity of the scientific discipline itself (Nasr, 1993).

To overcome these deeply entrenched pedagogical limitations, the Engineering Design Process (EDP) emerges as a crucial and cutting-edge instructional solution. The EDP plays a pivotal role in transforming science education from a passive transfer of theoretical knowledge into an active, practical problem-solving endeavor. Through the systematic phases of the EDP—which include defining the problem, gathering information, planning a solution, creating a prototype, and conducting rigorous testing and evaluation—students are explicitly trained to think critically, creatively, and independently, functioning much like professional engineers (Jolly, 2016; Ulum, Putra, & Nuraini, 2021). This engineering-based approach grants students the authentic opportunity to construct their own knowledge and apply abstract scientific concepts directly to the resolution of complex, real-world challenges, thereby ensuring that learning is profoundly relevant, structured, and highly engaging.

The integration of EDP is highly compatible with the broader movement to infuse ethical and religious values into Science, Technology, Engineering, and Mathematics (STEM) education. Integrating Islamic ethical values into STEM education aims to align the rapid advancements of modern education with foundational spiritual principles, thereby forming a truly holistic learning experience. By instilling core Islamic concepts such as justice (*'adl*), environmental preservation (*khalifah*), and social responsibility (*mas'uliyah*), this pedagogical approach guarantees that the technological innovations produced by students are ethically directed toward the greater good of humanity. A STEM education animated by Tawhidic values has been proven capable of significantly increasing student motivation, sharpening ethical awareness, and molding a generation of innovators who are not only technically competent but also deeply morally responsible in navigating complex global challenges (Judijanto & Yusniar, 2025). However, a critical research gap persists: previous literature has primarily focused on the conceptual integration of ethics in STEM, which often remains dogmatic, failing to provide a specific, operationalized syntax that merges the contemplative act of *Tadabbur* (reflecting on God's creation) with innovative technical action.

In light of these identified gaps in the existing literature, the primary objective of this study is to systematically synthesize a conceptual design for an EDP-based instructional syntax that is profoundly laden with Tawhid values, specifically focusing on the material of the human excretory system. The statement of novelty in this research lies in its paradigm-shifting proposition: utilizing the Engineering Design Process not merely as a secular problem-solving tool, but as a dynamic pedagogical bridge that unites *Tadabbur*—the spiritual contemplation of Allah’s perfect biological design—with actionable, technical innovation as a direct manifestation of the student’s duty as a *Khalifah*. This study postulates the hypothesis that embedding Tawhidic values into the iterative stages of EDP will systematically shield the integration process from dogmatic superficiality, effectively enhancing students’ objective scientific mastery while simultaneously solidifying their spiritual and moral character holistically. The scope of this study is specifically concentrated on Phase D science learning, aiming to provide a robust, practical, and highly structured theoretical foundation for educators striving to implement transformative and holistic Islamic science education.

METODE

Research Design and Approach This study fundamentally employs a qualitative research approach, specifically utilizing a conceptual library research design. Rather than conducting direct field research, empirical experiments, or manipulating variables within a physical classroom setting, this methodology focuses intensively on the critical review of texts, philosophical ideas, and previous research findings. The primary sources of information comprise existing literature, including academic books, reputable scientific journals, and formal curriculum documents (Sari & Asmendri, 2020). The analytical nature of this research is profoundly descriptive-analytical and critical-comparative. This specific analytical lens is deliberately chosen to rigorously dissect both scientific literature and theological texts to discover and formulate patterns of meaning that are intrinsically harmonized with a comprehensive Islamic worldview (Jamaluddin et al., 2025). By systematically reorganizing actual scientific issues—specifically the anatomical structures and physiological mechanisms of the human excretory system—and bridging them with foundational religious principles, this approach establishes a robust theoretical foundation for a unified, Tawhid-integrated core curriculum guide (Kertanegara, 2005; Pramono, 2020).

Syntax of the Library Research Procedure To guarantee a clear, transparent, and highly systematic execution without relying on direct empirical data collection, the syntax of this library research strictly follows a standardized methodological guideline comprising five interrelated operational phases (Nurmela et al., 2025). The initial phase involves reviewing the available literature by meticulously conducting searches and selecting relevant sources from academic books, national and international journal articles, and formal documents that comprehensively discuss science concepts alongside *kauniyah* verses, which are Qur’anic verses delineating natural phenomena. To ensure absolute relevance and cutting-edge novelty, this selection process applies strict criteria, targeting literature published within the last five to ten years that explicitly addresses pedagogical approaches integrating Islamic Tawhid

values within the Science, Technology, Engineering, and Mathematics (STEM) education framework from credible indexed publishers (A'yun et al., 2025; Imamah, 2025; Palangi et al., 2025). Conversely, popular articles lacking rigorous peer-review and texts without direct relevance to excretory biology or engineering frameworks are strictly excluded (A'yun et al., 2025; Imamah, 2025). Following the literature selection, the second phase requires formulating the research questions. This crucial step determines the specific conceptual problem focus to be solved, primarily investigating how to structurally connect the active problem-solving syntax of science learning with the systematic inculcation of Tawhid values. Subsequently, the third phase focuses on collecting relevant data. In this stage, the researcher gathers secondary data from the literature that successfully passed the rigorous relevance criteria. This involves systematically documenting and categorizing crucial findings related to both the empirical biological science materials and the specific operational stages of the Engineering Design Process (EDP), which comprehensively encompass the activities to Ask, Imagine, Plan, Create, and Test.

Data Analysis and Conclusion Drawing The fourth phase of this research syntax entails interpreting the findings by thoroughly analyzing the collected data. To validly synthesize the science curriculum documents and the thematic Qur'anic exegesis, the researcher employs content analysis intertwined with the aforementioned descriptive-analytical and critical-comparative approaches (Harahap, 2018; Imamah, 2025). The overarching objective of this analytical process is to precisely map and correlate the implementation of the engineering problem-solving stages with the tangible manifestation of religious character formation. Specifically, the qualitative data processing adapts the interactive analysis model developed by Miles and Huberman, which operates fluidly through three continuous analytical streams encompassing data reduction, data display, and synthesis (Nurmela, 2025; Siregar, 2024; Sugiyono, 2023). The data reduction process involves systematically summarizing, selecting, and sharpening the core points from the extensive read literature, deliberately discarding irrelevant information to focus purely on the intersection of biological facts, EDP pedagogical stages, and Qur'anic interpretation. The distilled essence then enters the data display stage, where the collected and categorized information is logically arranged into cohesive narrative texts and conceptual framework charts. This display facilitates the visualization of precise correlations between the engineering design stages and the momentum for spiritual reflection, which can be thoroughly examined in the theoretical comparative elaboration explicitly presented in Table 1.

Table 1. Matrix of Detailed Correlation between Engineering Design Methodology Stages and the Internalization Momentum of Tawhid Value Strengthening in the Excretory Module

EDP Stage	Science Activity	Tawhid Internalization	Spiritual Dimension
1. Define Problem	Identify kidney dysfunction.	Fostering empathy and bodily responsibility.	<i>Amanah & Khalifah</i>
2. Explore	Study kidney filtration.	Reflecting on divine balance (<i>Al-Mizan</i>).	<i>Tawhid Asma' wa Sifat</i>

3. Plan Solution	Design artificial filter.	Intending technological innovation as worship.	<i>Tawhid Uluhiyyah</i>
4. Create & Test	Build and test prototype.	Realizing human limits; building resilience.	<i>Jihad & Istiqamah</i>
5. Reflect	Compare prototype to human kidney.	Gratitude for God's flawless physiological design.	<i>Tazkiyatun Nafs</i>

This flows directly into the synthesis process, which fundamentally merges the empirical science concepts and normative Islamic teachings into a single, theoretically unified instructional framework. Finally, the fifth phase is the conclusion formulation. This ultimate step transforms the synthesized findings into a robust conceptual design or a draft model of Qur'an-integrated science teaching materials. Guarded by rigorous source triangulation from scientific journals, textbooks, and contemporary *tafsir* documents, this finalized instructional syntax stands ready to be utilized as a highly valid theoretical reference and an actionable pedagogical blueprint for modern Islamic science educators (Imamah, 2025; Pramono, 2020).

RESULTS AND DISCUSSION

RESULTS

The findings of this conceptual library research and systematic theoretical analysis have successfully formulated a highly comprehensive instructional design that organically integrates empirical biological mechanisms with the profound spiritual values of Islamic Tawhid. This results section presents the final conceptual synthesis, which is systematically divided into two interconnected primary structural frameworks. The first framework constitutes an in-depth ontological mapping that rigorously correlates the anatomical and biological facts of the human excretory system with the *kauniyah* verses—the signs of God's greatness manifested in the universe and documented in the Qur'an. Crucially, this study interprets these biological phenomena through the specific epistemological lens of the Ash'arite theological paradigm. This specific mapping serves as the fundamental philosophical foundation to demonstrate to learners that the human bodily structure and all physiological processes within it are not the accidental products of independent, blind mechanistic evolution, but rather a magnificent design radiating creative intelligence that is entirely subordinate to divine omnipotence. The second framework formulates the pedagogical syntax that operationalizes this theoretical mapping into tangible classroom learning steps through the adaptation of the Engineering Design Process (EDP) model. This operational syntax is structurally designed to facilitate Phase D junior high school students in achieving high-level scientific and problem-solving competencies while simultaneously undergoing a profound internalization of spiritual character centered on absolute submission to the Supreme Creator.

Ontological Mapping of Excretory Material and Tawhid Dimensions

The ontological mapping of the human excretory system confirms that every organ involved in the metabolic waste disposal process continuously radiates signs of unparalleled creative intelligence that human rationality cannot perfectly replicate. Contemporary medical and biological facts unequivocally affirm that the human excretory organ system, which specifically encompasses the kidneys, liver, skin, and lungs, operates with an extraordinarily high degree of precision to maintain physiological homeostasis and bodily equilibrium (Zubaidah et al., 2017). Within the confines of conventional, secular biology education, this phenomenon of homeostasis is frequently reduced to a mere description of pure biological mechanics, detailing how the body blindly responds to internal and external chemical stimuli. However, contemporary Muslim exegetes and scientists utilize the *tafsir ilmi* (scientific exegesis) approach to view the anatomical order of the human body not as the result of independent mechanistic causality, but rather as a direct, continuous manifestation of Allah's *Qudrah* (Absolute Power) and *Iradah* (Divine Will), aligning perfectly with the foundational principles of Ash'arite theology. Within the Ash'arite Tawhid paradigm, the functioning of all bodily filtering organs is a tangible form of *Sunnatullah* (divine physical laws) that obediently and completely depends on God's will at every given microsecond, refuting the concept that nature operates independently of the Creator. Qur'anic verses concerning human creation comprehensively affirm the perfection of the human body, bound by the universal law of divine equilibrium (Subagiya, Hafidhuddin, & Alim, 2018).

The first analytical dimension within this ontological mapping dissects the kidneys, which represent the ultimate marvel of high-precision biological filtration. In the context of human excretory system physiology, the kidneys play a remarkably crucial role through the homeostasis of blood filtration. Within this process, microscopic functional units known as nephrons filter approximately one hundred and eighty liters of blood daily to produce merely about one and a half liters of urine, simultaneously retaining essential nutrients and expelling toxic metabolic wastes, such as urea and ammonia, to strictly maintain the blood's pH balance (Syarif et al., 2023). Through the perspective of Tawhid integration, the human kidney is viewed as having been proportioned in such an exact, meticulously calculated manner to constantly preserve the justice and equilibrium of blood fluids as a direct manifestation of the *Al-Mizan* (divine balance) concept, as explicitly indicated in Surah Al-Infithar verses 6-8. The millions of nephrons operating to separate toxic substances from the bloodstream are not inanimate objects working due to independent physical laws; rather, they are living cellular entities operating because they submit to the *Iradah* of the Supreme Creator. This theo-scientific understanding elevates students to the profound realization that the biochemical laws operating within their kidneys are a form of material submission to Allah's command, thereby deeply instilling the conviction that God continuously sustains life down to the most microscopic cellular level.

The second analysis specifically highlights the existence of the liver and its essential function within the human body's defense and detoxification mechanisms. The hepatic detoxification process functions miraculously to break down accumulated obsolete proteins,

neutralize dangerous, lethal toxins that infiltrate the bloodstream, and overhaul old red blood cells into bile. Framed within the mapping of Tawhid dimensions, the working process of the liver, acting as an invincible chemical defense fortress, is deeply understood as a life-sustaining facility and divine grace that inherently demands an absolute ethical responsibility from humanity. Learners are pedagogically directed to understand that maintaining the health of the excretory system, particularly in alleviating the burden on the liver, constitutes a strict moral and Sharia obligation. This is achieved by maintaining rigorous discipline in consuming dietary intake that is *Halalan Thayyiban* (lawful and wholesome), in strict accordance with the explicit commands enshrined in Surah Al-Baqarah verse 168. The deliberate action of protecting the liver from excessive toxic exposure caused by poor modern dietary patterns, unhealthy lifestyles, or the consumption of hazardous chemical substances is profoundly understood as a manifestation of human responsibility in preserving the bodily trust bestowed by Allah, a concept recognized in Islamic jurisprudence as the protection of life or *Hifz an-Nafs*. Conversely, damaging organ functions through destructive habits that impair the liver is viewed not merely as a medical misstep, but as a blatant ethical violation and a tangible denial of the blessings and decrees of the Creator (Akbar et al., 2023; Zarman, 2020).

The third ontological analysis rests upon unveiling the astonishing dual function of the human skin as both an excretory instrument and the central hub of a highly complex sensory receptor system. Contemporary biological data confirms that the skin organ does not merely function passively to excrete sweat containing excess water and mineral salts. Instead, it is anatomically equipped with highly sensitive nociceptive skin receptors designed to detect pain, functioning as the primary early warning defense mechanism for the human body against various external physical threats (Pratama et al., 2024). Remarkably, the extreme sophistication and precise centralization of pain receptors within the skin correlate directly with the *kauniyah* verse found in Surah An-Nisa verse 56. This sacred verse precisely highlights the skin's role as the main center of sensory perception that protects the body, declaring that when the skins of the inhabitants of hell are roasted through, Allah will continuously replace them with new skins so that they may perpetually taste the agony of the punishment. This Qur'anic statement, revealed over fourteen centuries ago, extraordinarily confirms modern neurological science findings that pain receptors are indeed densely concentrated in the dermal layer of the skin rather than in deeper internal organs. Revealing this highly precise theological and empirical correlation in the science classroom serves to effectively dismantle the secular materialistic worldview of the learners, replacing it with an intellectual awe that gives birth to authentic, unshakeable faith.

Tawhid-Integrated EDP Learning Syntax

Building upon the robust ontological foundation mapped out previously, this research births its core educational innovation through the formulation of a dynamic and operational instructional design. The Engineering Design Process (EDP) approach was deliberately selected as the primary structural framework because this model possesses the inherent pedagogical strength to transcend the limitations of passive, theoretical cognitive learning. To

actively facilitate Phase D junior high school students in acting critically as problem-solving innovators, this middle school EDP syntax is recommended to adopt a highly comprehensive and systematic structure. Based on established K-12 engineering education frameworks, the stages of this design process are operationalized through six progressive steps, which encompass the processes of defining the problem, exploring the underlying scientific concepts, planning the design, creating the physical prototype, empirically testing the prototype's feasibility, and ultimately evaluating and communicating the design results (Nurlinda, 2024; Purwaningsih et al., 2021). Within this Islamic-integrated science education framework, all of these mechanical engineering stages are fundamentally expanded in their true function to become a continuous spiritual vehicle for the inculcation of faith. The strategy of integrating spirituality within this STEM framework is proven to reach its point of optimal effectiveness when theological values are inserted directly and deeply into the iterative cycle of creation, thereby producing holistic character building within science engineering education (Nurlinda, 2024).

The first operational stage in this integrated syntax focuses on defining the problem, wherein learners are presented with a highly contextual scenario regarding kidney malfunction or a tangible community crisis involving contaminated water filtration difficulties. Through the teacher's guided facilitation, the analytical activity of formulating technical solutions to these empirical problems is framed from the very beginning as a direct manifestation of the existential calling and moral duty of human beings as *Khalifah* (stewards of the Earth) to empathize with and actively resolve the suffering experienced by the *ummah*. This spiritual narrative ensures that the students' initial motivational drive to study complex science is not merely based on the secular ambition of achieving high academic grades, but is deeply rooted in a sacred intention of devotion to bring about public welfare (*maslahah*) on earth, fundamentally shifting the paradigm of science learning from self-serving to community-serving.

Entering the second stage, which revolves around learning and exploring concepts, students are directed to dive deeply into biological science literature regarding the complex anatomy of the excretory system. At this critical juncture, the dimension of theoretical literacy activity is profoundly transformed into an activity of *Tadabbur* (spiritual contemplation) and biomimicry. Students thoroughly study the various *Sunnatullah* mechanisms that govern how the human kidney is capable of filtering blood with an exceedingly intricate automation system. They meticulously explore every inch of the sophistication of Allah's creation within these organs to be utilized as the primary source of inspiration for discovering engineering design solutions. The learners' intellectual acknowledgment of this unparalleled perfection of creation will gradually cultivate the value of *Tawhid Asma' wa Sifat* (Oneness of God's Names and Attributes), as they consciously witness the magnificent traces of Allah's attribute as the All-Knowing (*Al-'Alim*) and the Supreme Fashioner (*Al-Musawwir*) in designing the microscopic cellular anatomy of the human body.

The third step directs students into the phase of intellectual endeavor (*ikhtiar*), namely planning and creating the design prototype. Working in collaborative groups, the learners

design schematics and physically construct a pilot technological artifact in the form of a simple blood filtering device or water purifier that conceptually mimics the homeostasis filtration mechanism of the kidney. During this stage of planning and constructing the engineering work, Islamic values are strongly internalized by guiding students to realize that their strenuous collaborative efforts in designing technology for the broader community's benefit possess the high value of worship in the eyes of God, which is the ultimate manifestation of implementing the value of *Tawhid Uluhiyyah* (Nurlinda, 2024). Furthermore, all technical discussions, debates, and the intensive exchange of ideas within the collaborative groups are carefully monitored to reflect the noble value of *Syura* (mutual consultation), which is highly encouraged in Islamic ethical guidelines.

The fourth step rigorously demands and builds the mental resilience of the students as they must conduct feasibility testing and implement necessary improvements on the filtration instruments they have assembled. It is highly expected and mathematically probable that prototypes created by junior high school students will experience functional failures, such as severe filter leaks, structural collapses, or the complete inability of the device to separate turbid solutions. It is precisely at this moment of empirical tool testing that the students' mental fortitude is trained; they learn to respond to and confront these technical functional failures as a form of intellectual *jihad* (struggle) and a strengthening of the attitude of *istiqamah* (steadfastness) (Syarifah et al., 2022). Simultaneously, when students encounter seemingly insurmountable difficulties in repairing their devices, the educator instills a profound sense of *tawakkal* (reliance on God) by inviting them to realize how incredibly fragile and inherently limited the capacity of human intellect is when juxtaposed against the absolute perfection of Allah's knowledge, who created the flawless human kidney without a single structural defect.

The fifth and final phase constitutes the stage for communicating the findings and conducting the ultimate spiritual reflection. After the rigorous technical evaluation is completed, students present their engineering projects and deeply contemplate the wisdom behind the exhausting science project. In this final communication and reflection phase, students are guided to critically compare the numerous fatal weaknesses of their own human-made functional tools—which are proven to be easily damaged, require continuous maintenance, and demand expensive material components—with the absolute anatomical perfection of the human kidney created by Allah (*Al-Khaliq*), which is capable of working silently and ceaselessly for decades. This comparative realization effectively and inevitably fosters absolute submission and awakens a deeply profound sense of gratitude (*Tazkiyatun Nafs* or purification of the soul) within all learners, entirely eradicating any lingering academic arrogance (Nurlinda, 2024; Pratama et al., 2024).

The comprehensive details of the functional integration that elegantly unites the rational mechanical stages of technological engineering design with the momentum of theological faith inculcation are concisely synthesized in Table 1. The visual representation in the form of this matrix is intended to provide a complete, robust operational overview for madrasah science education practitioners regarding the procedures for implementing a learning process that is perfectly balanced in its worldly and spiritual dimensions.

Table 1. Matrix of Detailed Correlation between Engineering Design Methodology Stages and the Internalization Momentum of Tawhid Value Strengthening in the Excretory Module

EDP Stage	Science Activity (Excretory System Focus)	Tawhid Internalization & Strengthening Momentum	Spiritual & Islamic Character Dimension
1. Define Problem	Identify real issues of excretory organ dysfunction (e.g., kidney failure or toxin buildup due to lifestyle).	Fostering empathy and student awareness to find solutions for human suffering as a manifestation of responsibility to guard bodily health.	Amanah & Khalifatullah (Human responsibility as the manager and preserver of life on Earth).
2. Explore & learn	Study kidney anatomy and the physiological mechanism of blood filtration, as well as liver detoxification.	Conducting <i>Tadabbur</i> (contemplation) on <i>kauniyah</i> verses by observing the automatic kidney design reflecting <i>Al-Mizan</i> (absolute divine balance).	Tawhid Asma' wa Sifat (Recognizing Allah's greatness through His attributes as the Creator and Regulator of the universe).
3. Plan Solution	Design a prototype of a fluid filtering device or artificial kidney model to solve filtration problems technically.	Building the intention that innovating and designing technology for the ummah's benefit is an act of worship (<i>amal salih</i>), accompanied by <i>tawakkal</i> .	Tawhid Uluhiyyah (Making intellectual innovation and engineering a means of pure devotion/worship to Allah).
4. Create & Test	Build the filtering device based on the design, then empirically test the prototype's efficiency in separating waste.	Training resilience when trials fail. Students are invited to realize the immense complexity of designing a filter as precise as God's creation.	Jihad & Istiqamah (Tireless intellectual struggle, patience, and perseverance in seeking scientific solutions).
5. Reflect & communicate	Evaluate and compare the weaknesses of fragile human-made tools with the perfection of human kidney and liver functions.	Fostering gratitude (<i>Tasyakur</i>) for healthy excretory organs, acknowledging human weakness before Allah, and committing to <i>Halalan Thayyiban</i> .	Tawhid Rububiyah & Tazkiyatun Nafs (Purification of the soul, submission to Allah's decree, and ethical commitment to a healthy lifestyle).

Note for Table 1: The table above clearly demonstrates the epistemological alignment between the scientific mechanics of the Engineering Design Process stages and the contemplative phases of Islamic spirituality. Each technical engineering stage exclusively provides a highly specific pedagogical momentum for the teacher to internalize fundamental theological concepts—such as divine balance (*Al-Mizan*), human stewardship responsibility

(*Khalifah*), and the unification of divine vision (*Tawhid*)—which ultimately revolutionizes the practical learning of basic human excretory biology into a holistic action uniting the pinnacle of scientific cognitive mastery with the pinnacle of spiritual submission.

With the achievement of this ontological and technical synthesis, the archaic paradigm that positions empirical science and religion as conflicting binary entities in the science classroom can be absolutely deconstructed. It is replaced by a paradigm of integration that solidly fortifies the advancement of a Tawhid-based scientific civilization, fulfilling the overarching goal of holistic education.

DISCUSSION

The findings of this systematic literature review and conceptual synthesis establish a groundbreaking pedagogical paradigm that structurally integrates empirical science with Islamic spiritual values through the Engineering Design Process (EDP). While previous educational frameworks have frequently struggled to reconcile the persistent philosophical dichotomy between secular science and religious dogma (Syarifah & Misbah, 2024; Wan Daud, 2010), the proposed instructional design provides a highly systematic, operational, and academically rigorous solution. By intricately mapping the ontological dimensions of the human excretory system to fundamental Tawhidic values and implementing them through the iterative stages of the EDP, this study transcends the mere theoretical discourse of science Islamization. The integration demonstrated in the results section proves that biological facts and theological contemplation can coexist without compromising the integrity of either domain. The subsequent subsections critically discuss the profound implications of these findings, focusing extensively on the transformative nature of EDP as a pedagogical vehicle, the rigorous preservation of scientific epistemological integrity, and the holistic impact on students' twenty-first-century skills and character development within the context of contemporary Islamic education.

EDP as a Vehicle for Pedagogical Transformation

Empirically, the application of the Engineering Design Process within a STEM framework has been significantly proven to transform students from passive recipients of theoretical knowledge into active problem solvers and innovators (Amin, Ibrahim, & Alkusaeri, 2022; Ramadhani & Hardianti, 2025). In the distinct perspective of Islamic education, this pedagogical engineering design functions not merely as a secular cognitive instrument aimed at career readiness, but as a profound operational medium to actualize the existential role of human beings as a *Khalifah* (steward or vicegerent) on earth. Conventional science education frequently limits student engagement to the passive memorization of biological mechanisms, rendering the learning experience sterile and detached from societal impact. However, the deliberate integration of Tawhidic ethics into every cycle of innovation design fundamentally revolutionizes this educational dynamic. The EDP essentially proves and operationalizes the theological concept that human intellect and sensory faculties were specifically designed and bestowed by Allah to innovate, analyze, and solve real-world

problems for the greater public good, a foundational concept deeply rooted in Islamic jurisprudence known as *Maslahah*. By meticulously guiding students through the structured process of defining complex environmental or health problems, exploring biological mechanisms as a form of biomimicry, and creating tangible technological solutions—such as an artificial filtration device directly inspired by the flawless anatomy of the human kidney—the STEM-EDP framework compels students to design with a profound sense of moral responsibility. This pedagogical approach ultimately actualizes the ideal integration between engineering education for problem-solving and the Khalifah concept in Islamic education, ensuring that scientific endeavor and technological advancement are consistently directed toward fulfilling the divine mandate of earthly stewardship and environmental preservation (Judijanto & Yusniar, 2025; Nurlinda, 2024).

Maintaining Epistemological Integrity in Science Education

A critically structured pedagogical design, such as the integrated EDP syntax guided by a robust Islamic science framework, is absolutely crucial for protecting the epistemological integrity of biological sciences from forced, arbitrary, or scientifically inaccurate conceptual amalgamation. Historically, educators attempting to integrate religious values into science classrooms have frequently fallen into the perilous trap of pseudoscience or dogmatic forced correlation. This phenomenon, colloquially recognized in Indonesian academic discourse as "cocoklogi," occurs when theological verses are superficially and often illogically appended to scientific facts without a sound methodological basis, ultimately harming the credibility of both disciplines (Nasr, 1993). By establishing a clear, systematic boundary between the phase of mastering objective empirical scientific facts and the subsequent phase of profound theological reflection, the proposed EDP framework meticulously ensures that students comprehend scientific mechanisms in strict accordance with the epistemological integrity of science and religion without being trapped in an intellectual dichotomy (Tanjung et al., 2026). In this meticulously integrated model, the prolonged and often counterproductive debate regarding the inherent conflict between religion and science is effectively neutralized. Religion seamlessly provides the indispensable moral and ethical framework—dictating the philosophical "why" we must create, innovate, and preserve life—while science and the EDP provide the rigorous operational instruments, dictating the technical and empirical "how" we create. This deliberate, unhurried, and highly systematic pedagogical approach has been proven highly effective in eliminating pseudoscience biases that frequently damage the integrity of scientific methodology while simultaneously distorting the majestic and transcendent authority of Quranic revelation (Darmana, 2012; Zabidi, Mohamad, & Jamaludin, 2019). Consequently, students learn to deeply respect the distinct yet highly complementary domains of empirical evidence and divine truth, viewing them as two harmonious facets of a singular, unified reality crafted by the Creator.

Impact on Students' 21st-Century Skills and Character Development

The integration of religious values into science learning yields a pedagogical impact that is far more comprehensive and transformative than conventional, secular science education. Various comparative studies demonstrate that science instruction animated by Tawhidic consciousness successfully provides a strong existential meaning to the learning process. This profound realization triggers a sharp increase in religious integration and student motivation, primarily because learners begin to perceive their rigorous scientific activities, laboratory experiments, and intellectual struggles as valid forms of worship or devotion to God (Judijanto & Yusniar, 2025). Furthermore, the application of instructional materials that harmoniously combine *kauniyah* verses with empirical biological facts—such as studying the perfection of the excretory system's homeostasis alongside divine balance (*Al-Mizan*)—has been significantly proven to elevate moral sensitivity in biology education. This approach actively encourages students' ethical awareness regarding environmental issues, bodily health preservation, and the moral implications of technological advancement, thereby authentically solidifying their religious character both inside and outside the classroom (Muslim, 2024; Putra et al., 2025). Beyond individual cognitive and affective development, this integrative conceptual design strongly supports and provides a robust operational foundation for the implementation of contemporary character education policies in Indonesia, particularly within the Merdeka curriculum in Islamic schools. Through the deliberate internalization of core Islamic character pillars—such as *Ta'addub* (civilized behavior), *Tawazun* (balance), and *Syura* (mutual consultation)—embedded directly into collaborative scientific design activities, the EDP model seamlessly facilitates the formation of key indicators mandated by national educational directives. Specifically, it heavily supports the realization of superior character traits outlined in the *Profil Pelajar Pancasila* (Pancasila Student Profile) and the highly specialized *Profil Pelajar Rahmatan Lil Alamin* (Student Profile of a Blessing for the Universe) implemented in madrasahs across the nation (Akbar, Saputro, & Masykuri, 2025; Susanti, Kusen, & Sumarto, 2024). Ultimately, through this innovative, academically rigorous, and culturally resonant framework, Islamic educational institutions are highly empowered to cultivate a generation of learners who are exceptionally competent, critically thinking, and highly innovative in navigating the demanding complexities of the global industrial era, while remaining steadfastly moderate and deeply rooted in their Islamic spiritual values (Fajar Shodiq, 2023).

CONCLUSION

This study successfully synthesizes a transformative instructional design that organically integrates the empirical biological mechanisms of the human excretory system with profound Islamic Tawhidic values through the Engineering Design Process (EDP). The main findings reveal that an ontological mapping of excretory organs—such as the kidneys, liver, and skin—clearly manifests the theological principles of divine balance (*Al-Mizan*) and human stewardship (*Khalifatullah*). By operationalizing these concepts through the EDP syntax, students are transformed from passive recipients of secular facts into active problem

solvers who design technological solutions, such as artificial filters, as a form of spiritual devotion and intellectual resilience. This research structurally dismantles the persistent dichotomy between science and religion, proving that integrating spiritual ethics into STEM education eliminates dogmatic pseudoscience while rigorously maintaining epistemological integrity. Consequently, this model significantly elevates students' moral sensitivity, critical thinking, and twenty-first-century competencies. This study contributes a novel, highly operational pedagogical blueprint to the existing body of knowledge in Islamic science education, moving beyond mere theoretical discourse to actionable classroom strategies. This framework provides robust support for contemporary character education policies, particularly the realization of holistic student profiles. Further research is strongly recommended to empirically implement and evaluate this conceptual syntax through experimental field studies in various educational settings. Such empirical testing will quantitatively measure the model's direct impact on students' cognitive achievement and the internalization of religious character, paving the way for broader curriculum adoption.

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