



# STEM Literacy: Value-Based Education Innovation in Islam

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**Abstract.** This study aims to examine how the integration of Islamic Religious Education (IRE) into the STEM (Science, Technology, Engineering, and Mathematics) learning approach can enhance students' literacy in the 21st century. Amid technological advancements and global challenges, education is not only expected to foster critical thinking and problem-solving skills but also to cultivate character rooted in spiritual and moral values. Using a descriptive qualitative approach, this study examines various studies showing that integrating Islamic values into STEM learning can enhance learning motivation, digital literacy, conceptual understanding, and foster religious and ethical character in students. STEM integration rooted in Islamic values is expected to produce holistic students: intellectually intelligent, spiritually strong, and morally upright.

**Keywords:** Digital Literacy, Islamic Religious Education, STEM.

## 1 Introduction

The increasingly sophisticated era of technological advancement has played a major role in changing the order of life. In this era of the 4.0 industrial revolution, technology and knowledge are moving rapidly and competitively in various fields, one of which is education. Through education, it is possible for a person to change and improve their character, develop with the times, develop knowledge and technology, and develop all forms of human civilization [1]. Education plays an important role in overcoming the challenges of the 21st century by continuously adapting to technological advances. This enables everyone to develop their talents and potential through “Technology-Based Knowledge” [2]. With the introduction of information technology into education regulations, the world of education has seen a new future. However, this growth has not been matched by an increase in human resources, which are essential for the success of education [3].

The integration of technology in education can build a learning system through the STEM model approach. The STEM approach in education can create active learning. The integration of knowledge in STEM fields is an urgent need to ensure that technological advances contribute to human welfare [4]. STEM education is an approach that combines the disciplines of Science, Technology, Engineering, and Mathematics in an interdisciplinary context. Science is part of nature with laws, facts, concepts, and

principles related to physics, chemistry, and biology. The technology aspect includes skills in organizing technology, operating tools, and designing and executing procedures. The mathematics aspect includes skills in effectively communicating ideas based on data, patterns, space, and reasoning. To prepare students to face the developments of the times and be able to solve problems in the real world [5]. In general, STEM education means providing students with opportunities to become inventors, innovators, confident and logical thinkers, problem solvers, and skilled in technology [6].

The current trend of globalization makes the STEM-based video approach a goal that is in line with the characteristics of the 21st century, namely providing students with higher-order thinking skills [7]. Education in the 21st century requires students to have critical thinking, problem solving, creativity, and innovation skills in order to compete in the midst of information technology competition. However, Indonesian students still lack these skills, especially literacy. STEM education will be the solution to face future challenges by improving digital literacy in Indonesia.

Digital literacy is the ability to use technology and information from digital devices effectively in various contexts, such as education, work, and daily life [8]. In Islam, education is the main gateway to life; without education, life cannot run smoothly. Effectiveness in this field will increase by incorporating religious themes into STEM education in Muslim communities [9] and encourage educators to provide an understanding of STEM literacy in Islam. When combined with Islamic values, the STEM method has the potential to improve students' cognitive abilities. This can lead them to become better thinkers who can understand scientific concepts and religious teachings at a deeper level [10].

However, as technology advances in STEM education, religion is becoming increasingly separated from science. In addition, the conflict between religion and science leads students to view religion and science as two different and incompatible bodies of knowledge [11]. In addition, STEM-based Islamic education faces many challenges, such as limited infrastructure and resources, cultural resistance, and a lack of understanding of the importance of STEM in the curriculum [12]. To that end, improving STEM literacy can be achieved by combining the role of Islamic religious education.

A recent study by Baehaqi et al. [13] found that incorporating Islamic values into STEM learning helps students better understand how science relates to religious teachings and encourages them to apply the knowledge they learn in their daily lives in accordance with Islamic values. A study by Yakob et al. [14] found that Islamic education contains scientific knowledge, indicating that STEM is integrated into its curriculum. The process of human evolution and the benefits of certain religious practices such as prayer, ablution, and fasting are topics of scientific knowledge in education. Diani [15] found that Islamic literacy-based STEM multimedia learning not only improves students' conceptual understanding but also enhances their computational thinking skills. Therefore, it can be effectively applied in education that combines technology and spirituality.

The purpose of this study is to examine the integration of STEM education in Islamic Religious Education by improving digital literacy. Through the role of education, human resources can be developed by improving STEM digital literacy so that high-quality students are produced. Thus, the researcher is interested in examining the development of a model for integrating STEM education into Islamic religious education. This

model not only focuses on academic aspects but also helps students acquire better digital literacy. It is hoped that this method can help students prepare for the challenges of the 21st century by combining religious principles and technological skills.

## **2 Method**

This study uses a library research approach with a descriptive qualitative method relevant to the integration of Islamic education in the STEM learning approach. Data collection techniques were carried out by reviewing, classifying, and analyzing literature documents focusing on the development of Islamic value-based STEM literacy in the educational environment. Analysis was conducted using a thematic approach to findings from previous studies to identify patterns, relationships, and the impact of such integration on 21st-century thinking skills, digital literacy, and character development of students. After data collection, inductive analysis was performed to generate theories based on data rather than hypotheses [16]. Data validity was strengthened through triangulation of sources from various references in the form of literature reviews by collecting data, particularly verbal data, from various scientific literature such as books, articles, and notes.

## **3 Result and Discussion**

### **3.1 The State of Digital Literacy and Science Among Students in Indonesia**

Positive enthusiasm, mastery of knowledge, and skills aligned with technological advancements have not fully kept pace with the demands placed on teachers in the digital age. Many educators still tend to rely on traditional teaching methods such as verbal explanations, writing on the blackboard, and direct face-to-face discussions with students. This phenomenon is particularly pronounced in schools located in non-urban areas. A similar situation is observed in higher education institutions. Despite the availability of diverse information to support the teaching and learning process, some lecturers still opt for conventional approaches such as lectures and discussions without utilizing educational media that could enhance both the process and outcomes of learning. The use of multimedia technology remains limited and has not been fully leveraged to support educational activities [17].

Not only that, but cultural diversity in Indonesia also adds complexity to the implementation of uniform digital literacy programs, requiring a culturally sensitive approach to ensure effective digital education. Low levels of digital literacy in Indonesia, coupled with infrastructure limitations, pose major challenges to efforts to improve digital literacy, especially for children who are already heavily exposed to digital media. To improve this situation and enhance the quality of education, Indonesia needs to invest in teacher training, infrastructure development, curriculum updates, and assessment system improvements. Challenges such as language differences, motivation levels, and digital capabilities require innovative solutions, such as the use of interactive

learning media and the application of culturally sensitive approaches when teaching the national language [18].

In the world of higher education, research findings reveal three main factors influencing students' digital literacy levels. First, environmental support factors, including the campus environment and family roles. Second, socio-economic conditions involving individual financial aspects and critical thinking skills regarding media. Third, the intensity of digital media use in daily life and academic tasks. These findings emphasize the importance of a comprehensive and collaborative approach in enhancing students' digital literacy competencies in the rapidly evolving technological era.

### **3.2 The Relationship Between Islamic Religious Education (PAI) and STEM**

Education in the 21st century must be able to face global challenges while maintaining students' cultural and moral values. In this situation, a learning approach that prioritizes Islamic values can increase student participation and make the learning process more meaningful, especially in countries with a Muslim majority. Education can create a relevant learning environment and support student character development by incorporating Islamic values into the curriculum [19]. STEM education has a strong correlation with this approach, especially amid rapid advances in information technology, as it can teach students the practical skills and problem-solving abilities needed in the modern world [20].

The STEM (Science, Technology, Engineering, and Mathematics) approach is now one of the main pillars of contemporary education, given the important role of these disciplines in driving innovation and technological advancement. Through cross-disciplinary integration, this approach encourages a more in-depth and application-oriented learning process. By incorporating Islamic values into STEM learning, students not only gain technical knowledge but also develop moral attitudes and social responsibility that will help them become positive contributors to society.

The integration of STEM learning with Islamic values positively impacts global challenges by emphasizing ethics and morality, thereby fostering responsible and humanitarian-minded human resources. This approach also helps students understand the connection between scientific concepts and daily life from an Islamic perspective [21]. This is reflected through learning activities that are direct and student-centered [22]. Islamic education integrated with the STEM approach is aimed at producing students who are not only competent cognitively and affectively but also skilled in psychomotor aspects [23]. In addition to developing technological skills, students also learn to become socially responsible individuals with noble character. Therefore, education that combines Islamic values and STEM can produce innovative, character-driven generations ready to actively participate in sustainable development.

### **3.3 The Importance of Integrating Islamic Religious Education Into STEM Education**

The Importance of Integrating Islamic Religious Education into STEM Education 21st-century education not only requires higher-order thinking skills but also emphasizes the

development of students' character so they can live and contribute ethically in a global society [24] However, the greatest challenge of the rational and empirical STEM approach is the lack of spiritual and moral values [25], even though in the midst of rapid technological advances, the crisis of values and ethical degradation is actually getting worse. This is emphasized in QS. Al-Mujadilah [58]:11: Allah will exalt those of you who believe and those who have been given knowledge by several degrees. And Allah is All-Knowing of what you do." This verse emphasizes that knowledge in Islam cannot be separated from faith, and that Islamic education is education that transfers knowledge while nurturing faith and character [14].

Research by Iqbal Anas & Iswantir [21] in an integrated Islamic school shows that integrating Islamic values into the STEM curriculum not only enhances conceptual understanding but also shapes character traits such as honesty, responsibility, and cooperation. This indicates that education is not solely about academic achievement but also about the formation of a complete personality in accordance with religious values as part of Allah's trust. Meanwhile, Siregar et al. [26] (2024) found that students studying STEM using a Qur'an-based values approach showed significant improvements in motivation and academic outcomes. Students realized that studying science is not merely for exam grades but also as a form of worship and seeking wisdom from Allah's creation through scientific concepts and the verses of the universe, i.e., the verses of the cosmos.

For example, in ecology lessons, teachers can relate it to QS. Al-Baqarah [2]:164: "Indeed, in the creation of the heavens and the earth, the alternation of night and day, the ships that sail the sea carrying what is useful to mankind... there are signs (of Allah's greatness) for those who reflect." This verse not only broadens students' scientific knowledge but also invites them to reflect on the orderliness of nature as evidence of the existence of an all-powerful Creator. In this context, STEM education does not stop at rational understanding but also touches on spiritual and ethical dimensions. In line with the views of Elbashir et al. [10] linking scientific concepts with revelation can create a more profound learning experience, as students are encouraged to see science as a means of knowing God, not merely as a collection of theories and formulas.

According to Ahmad [27], the Islamic contextual approach in STEM education can integrate scientific observation with the instillation of values such as purity, gratitude, and ecological responsibility. This approach is particularly relevant in the modern era, where science is often separated from moral and spiritual dimensions. By integrating Islamic values into scientific experiments or projects, students are not only encouraged to think logically but also to develop an awareness that science is a tool to draw closer to Allah. In this context, teachings about *thaharah* or purity are not merely understood in ritual terms but are contextualized in efforts to preserve the environment. This is reflected in QS. Al-Anfal [8]:11: "And He sends down rain from the sky to cleanse you with it and remove from you the evil of Satan..." This verse shows that water has a spiritual dimension as a medium of purification, not merely seen as a chemical substance. By placing this verse in a scientific context, students learn that maintaining water and environmental cleanliness is not merely an academic or ecological

task, but part of their religious responsibility. Therefore, this integration not only deepens the meaning of learning but also cultivates students' spiritual and social sensitivity. This is important so that STEM learning does not get stuck in a utilitarian orientation but develops into a vehicle for character building and strengthening religious values.

Another study by Istiqhfariyah [28] shows that integrating piety values into science learning can enhance students' spirituality. This finding shows that spiritual aspects need not be separated from the world of science but can coexist harmoniously to form holistic individuals. When scientific experiments are not only focused on results but also grounded in the intention of worship and awareness of Allah's presence, the learning process becomes more meaningful and transcendently valuable. This is important because values such as patience and scientific responsibility align with the moral values of a devout Muslim, both of which require perseverance and meticulousness.

Therefore, Islamic values do not restrict scientific thinking but rather deepen the meaning and purpose of science itself. Rather than hindering it, religious values provide a noble direction and purpose for scientific exploration, namely as a means to understand the greatness of the Creator and to benefit others as much as possible. Thus, the integration of spiritual values into science is not a form of indoctrination, but a process of raising awareness of the moral dimension of every piece of knowledge acquired. And the integration of Islamic religious education into STEM is not a symbolic merger, but an epistemological reconstruction that unites 'aql (rationality) and qalb (spirituality). This aligns with Islam's goal of forming the perfect human being, that is, a person who is intellectually intelligent, spiritually strong, and morally noble [29].

### **3.4 Integrative Implementation Model: Islamic Values-Based STEM Education**

To realize this integration in practice, a comprehensive and sustainable implementation model is needed, covering curriculum, learning strategies, assessment, and teacher competency strengthening, including:

#### **Interdisciplinary Curriculum Based on Maqashid Syariah**

An Islamic-based STEM curriculum must be built on the foundation of Maqashid Syariah, which includes safeguarding religion (din), life (nafs), intellect ('aql), lineage (nasl), and wealth (mal), all of which can be integrated into STEM topics. For example, in renewable energy lessons, students not only learn about the technical aspects of energy efficiency but are also encouraged to understand their ecological responsibilities as stewards of the earth. Quran 2:30 states: "Indeed, I will place a khalifah on the earth." This verse establishes the foundation that humanity has been appointed by Allah to manage nature responsibly, and this is what must be achieved through Islamic STEM education [13]. Islamic values-based STEM education is not sufficient if it merely teaches science and technology; it must also cultivate awareness of ecological responsibility and ethical considerations toward Allah's creation. By integrating this verse into learning, students are encouraged to understand nature scientifically while also reflecting on it as a spiritual trust. In the midst of technological progress that often overlooks values, the concept of khalifah serves as a guide so that knowledge is not only used for exploration but also as a form of devotion. Islamic STEM education, therefore, not only equips students intellectually but also shapes their character to be aware of their divine responsibility.

#### **Learning Strategy: Inquiry Project Design Thinking Islam**

Inquiry-based and project-based learning strategies greatly support the integration of Islamic values in STEM. Students are encouraged to find solutions to real-world problems, such as creating water filtration devices, while understanding the principles of cleanliness and social benefit. QS. Al-Anfal [8]:11 emphasizes the importance of maintaining purity: "And He sends down rain from the sky to purify you with it..." This verse indicates that water is not merely a physical element but also a symbol of spiritual purification. In STEM education, such interpretations add a value dimension, ensuring students not only understand nature functionally but also as part of Allah's mercy that must be preserved. The Islamic design thinking approach is an innovation that integrates values such as justice, empathy, and compassion into the process of creating solutions [30]. This shows that scientific thinking does not have to be value-free but can be directed toward social benefit and concern. In line with Islam's teachings as a mercy to all creation, STEM education should cultivate students who are not only technologically intelligent but also ethical and concerned about sustainability. Integrating values into design thinking makes learning more holistic by balancing cognitive, spiritual, and social aspects.

### **Holistic Assessment and Spiritual Evaluation**

Learning evaluation should not only focus on cognitive achievements but also include psychomotor and spiritual dimensions. This is important so that education does not merely measure how much students know about a concept but also how they behave, act, and interpret knowledge as part of worship. In this context, assessment rubrics need to be designed to measure character indicators that reflect Islamic values. Akcan [9] emphasizes that evaluation in STEM learning based on Islamic values must be able to capture aspects such as scientific honesty, responsibility, and awareness of tauhid values. This means that students' success is not only determined by the results of their experiments or the technical solutions they create, but also by the process of internalizing values that accompany their scientific work. Such assessment not only reflects competence but also integrity. For example, indicators such as sincerity in completing projects, discipline in carrying out experimental stages, and students' ability to connect STEM concepts with verses from the Qur'an are concrete forms of holistic assessment. Thus, the evaluation process is not merely a measuring tool but also a means of nurturing students' moral character and spirituality. This aligns with the vision of Islamic education, which does not separate knowledge from faith, and guides students to become individuals who are intellectually and spiritually whole.

### **Teacher Training and Interdisciplinary Collaboration**

Teacher training is a key requirement for the successful integration of Islamic values into STEM education. Curriculum transformation will not have a significant impact without the readiness of teachers as the primary implementers in the classroom. STEM teachers need to be equipped with a basic understanding of Islamic values and their connection to scientific concepts, so that they can relate scientific material to spiritual messages in a relevant and non-coercive manner. Conversely, Islamic Education (PAI) teachers also need to understand the basic principles of scientific logic and technological developments so that the Islamic narrative they convey remains contextual and able to address contemporary challenges [31]. This indicates that the integration of values in learning is not only about content but also about mindset and interdisciplinary competencies. Strengthening collaboration among teachers is an important aspect that cannot be overlooked. According to Rusni et al. [32], this collaboration can be facilitated through integrated workshops and the development of digital-based integrative modules. However, the success of such programs depends heavily on the sustainability and support of educational institutions, not just one-time training. The integrative modules developed must also be able to balance the depth of scientific content with the practical application of Islamic values, thereby serving as a practical guide that is also rich in values. Therefore, integration efforts cannot be carried out in a piecemeal manner. A serious commitment is needed to build teachers' capacities comprehensively—from pedagogical, theological, and technological aspects—to create a harmonious learning ecosystem between knowledge and faith.

## 4 Conclusion

The integration of Islamic religious education into the STEM learning approach has proven to be a relevant and effective strategy for addressing the challenges of 21st-century education. Education not only demands critical thinking skills and technological proficiency but also emphasizes the development of character rooted in spiritual and moral values. Research findings indicate that integrating Islamic values into STEM education can enhance students' motivation, conceptual understanding, and overall scientific and digital literacy.

Islamic values such as tawhid (monotheism), responsibility, honesty, and compassion can be instilled through Islamic inquiry-based learning and design thinking strategies, which allow students to connect scientific concepts with real-life experiences and spirituality. Holistic evaluation is also necessary to measure cognitive, psychomotor, and spiritual aspects, aiming to produce students who are not only academically competent but also of noble character. Islamic-values-based STEM education is not merely a pedagogical approach but also an important tool in cultivating a generation of well-rounded individuals who are intellectually intelligent, spiritually strong, and morally upright.

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