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Religious Values Integration in STEM-R Based Science Learning: Insights From Jambi Teachers

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ABSTRACT

The integration of religious values in STEM education remains underexplored, particularly within the context of Islamic-based schools in Indonesia. Understanding how science teachers perceive and implement such integration is crucial for developing culturally responsive pedagogy. This study aims to explore the perceptions, strategies, and challenges faced by science teachers in implementing STEM-R (Science, Technology, Engineering, Mathematics–Religious) in their classrooms. Using a qualitative descriptive method, data were collected through in-depth interviews, classroom observations, and document analysis involving selected science teachers from Islamic-based senior high schools. Visual clustering and thematic analysis were employed to interpret data. The study focused on identifying emotional responses, instructional strategies, reflective practices, and perceived student outcomes related to the STEM-R approach. Findings indicate that teachers perceive STEM-R positively, describing it as spiritually meaningful and pedagogically enriching. The study concludes that STEM-R facilitates holistic education by integrating scientific understanding with ethical and spiritual development. This research contributes to the field by offering empirical insight into STEM-R implementation and proposing a practical model for faith-integrated STEM pedagogy in religious education contexts.

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A. INTRODUCTION

Science, Technology, Engineering, and Mathematics (STEM) approaches globally demonstrate significant capacity in advancing critical thinking skill development among secondary school students (Yaki, 2022). Educational frameworks require continuous instructional innovation to fulfill the increasingly complex demands of twenty-first-century student competencies (Nurwahyuni, 2021). Indonesian academic systems currently face severe challenges regarding massive moral degradation and character decline among elementary students (Aningsih et al., 2022). Hidden curriculum strategies within Islamic boarding school environments present a highly effective alternative solution for fostering moderate character values (Salim et al., 2024).

Aligning modern scientific knowledge with Islamic values offers a remarkably comprehensive approach to resolving the ongoing student character crisis. Millennial learners studying at Islamic higher education institutions exhibit highly positive responses toward the integration concept of these two distinct domains (Suciati et al., 2022). Cultural backgrounds alongside specific religious factors demonstrably exert a substantial influence on shaping student attitudes during science learning activities

(Kurniawan et al., 2022). Meta-analyses evaluating educational practices across Indonesia strongly confirm the beneficial pedagogical effects of implementing Islam and science integration (Ardi et al., 2024). The STEM-R (Science, Technology, Engineering, Mathematics, and Religious values) model directly targets the existing gap between empirical scientific inquiry and faith-based reasoning (Sarwi et al., 2024).

Educational researchers previously initiated various integrated science learning models to holistically prepare future academic generations. Developing research-based student worksheets intentionally infused with religious values successfully facilitates the complex process of independent knowledge assimilation (Ranti & Usmeldi, 2019). Utilizing local wisdom within integrated science instruction provides a truly concrete contribution toward enhancing overall student cognitive competencies (Usmeldi & Amini, 2020). Multicultural education implementation strategies strongly rooted in local cultural values act as a strategic meeting point amidst classroom diversity (Suri & Chandra, 2021). Religious moderation education curricula at the higher education level fundamentally demand continuous structural evaluation and systematic development processes (Mukhibat et al., 2024). Close institutional collaboration between school authorities and the surrounding community plays an indispensable role in ensuring inquiry-based learning success (Irwandi et al., 2022).

The current digitalization era introduces highly complex psychological consequences for the cognitive and emotional development of secondary education students. Intensive adolescent interactions with immersive virtual worlds like the metaverse possess immense disruptive potential regarding mental health quality (Muslihati et al., 2023). Student mental well-being logically requires top prioritization as the primary foundation before complex science knowledge transfer processes commence optimally. Inculcating solid moral values proactively helps teenagers develop exceptionally wise information-filtering mechanisms against uncontrolled modern online platforms. Character education resting firmly upon Islamic orthodoxy values proves extremely crucial in producing moderate Muslim intellectual generations today (Mujahid, 2021). Transforming educational dormitory management systems directly elevates institutional learning quality while simultaneously improving ease of access for all groups (Darwanto et al., 2024). Structured literature reviews conclusively confirm religious curriculum renewal as an absolute prerequisite to accommodating the dynamic needs of modern learners (Nurdin et al., 2024).

Pre-university program students apparently harbor various diverse perspectives regarding the specific urgency of the STEM approach in their career trajectories (Nawawi et al., 2021). Implementing interactive STEM-based workshops for deaf special education communities has notably shown highly encouraging and positive effectiveness levels (Anwar et al., 2024). Designing highly interactive learning devices demonstrably proves effective in stimulating the rapid growth of critical thinking skills among learners. The innovation of developing the sprider learning model represents a unique form of science teacher creativity at the junior high school level (Puspitasari et al., 2021). Classroom action research focused directly on character strengthening often becomes the primary embryo for creating comprehensive educational policies (Saepudin et al., 2023). Comprehensive literature reviews starkly reveal a considerably wide empirical gap regarding current religion-based science education literature frameworks. Most previous scientific publications remain heavily trapped in solely evaluating the cognitive benefits of various natural approaches without considering eschatological dimensions (Fathoni et al., 2019). The novelty value of this present research rests specifically upon an in-depth investigation into the phenomenological experiences of educators directly in the field.

The central objective animating this research project revolves around dissecting the nuanced perceptions of science teachers regarding STEM-R implementation prospects. Visual cluster mapping techniques present a remarkably innovative methodological way to deconstruct teacher emotional expressions while handling classroom instruction. Selecting Islamic senior high schools as the primary research locus provides a highly specific cultural context rich in traditional religious values. The investigation process meticulously records all diverse variants of pedagogical teaching strategies adopted by educators in the classroom environment. The scarcity of adequate facility support from school management frequently emerges as the absolute biggest barrier wall against teaching method innovations. The main substance of this detailed academic manuscript offers a comprehensive structural blueprint for schools intending to adopt the STEM-R model. Publishing these empirical research results is strongly expected to ignite a massive national-scale scientific discourse regarding the redefinition of science and religion. Policymakers residing at the Ministry of Education can actively utilize the derived conclusions as crucial consideration materials in drafting future curriculum revisions. The STEM-R education paradigm ultimately stands as the most logical academic response to widespread public anxiety over the younger generation's moral decline.

B. RESEARCH METHOD

This study utilized a qualitative approach employing a phenomenological design to deeply explore the lived experiences of science teachers in implementing the STEM-R approach. The phenomenological framework specifically allowed researchers to investigate the phenomenon of integrating Islamic values into science learning directly from the subjective perspectives and consciousness of the participants. The study involved 26 science teachers actively teaching in various Islamic-based Senior High Schools in Jambi. Participant selection was conducted using purposive sampling techniques with the primary inclusion criterion being educators who possessed direct experience in designing and applying religion-integrated science learning strategies. Involving this specific number of participants was deemed highly adequate to reach data saturation in mapping the diversity of experiences, emotions, and instructional strategies occurring within the classroom.

Data collection procedures were executed through a combination of in-depth interviews, classroom observations, and document analysis adhering strictly to phenomenological protocols. Researchers initially applied the process of epoché (bracketing) to consciously set aside all personal biases and preconceptions regarding the integration of religious education and science. Suspending these preliminary assumptions ensured the phenomenon was investigated purely from the participants' genuine perspectives. The data extraction process utilized a semi-structured interview format containing open-ended questions to elicit highly rich textural descriptions of the teachers' pedagogical routines.

Core questions presented during the interview sessions were carefully formulated to capture the essence of the educators' daily realities. Examples of these primary interview questions included: (1) "How do you interpret and personally experience the process of integrating religious values within your science instruction?"; (2) "Can you describe a specific classroom activity where you successfully connected scientific inquiry with faith-based reasoning?"; and (3) "What specific pedagogical or institutional challenges do you encounter when implementing the STEM-R framework in your school?".

Qualitative data processing was conducted using a thematic analysis approach integrated with NVivo 12 software to facilitate coding and visual cluster mapping.

Analytical procedures consistently commenced with the horizonalization stage, wherein every participant's statement or utterance was initially treated with entirely equal value and weight. Researchers subsequently extracted significant meaning units systematically from the interview transcripts and categorized them into several core themes. This analytical framework facilitated the researchers in constructing textural descriptions detailing what the participants experienced alongside structural descriptions elaborating on the context of how those experiences occurred. Both forms of description were ultimately synthesized comprehensively in the final stage to capture the fundamental essence of the STEM-R approach implementation phenomenon in schools..

C. RESULTS AND DISCUSSION

This study investigated how science teachers perceive, implement, and reflect on the integration of religious values within the STEM-R framework in Islamic-based schools. Data were collected through semi-structured interviews, classroom observations, and supporting documentation, then analyzed using thematic and cluster-based approaches. The findings revealed that teachers exhibit overwhelmingly positive perceptions of STEM-R implementation. Their emotional responses ranging from enthusiasm and gratitude to a deep sense of spiritual fulfillment indicate a strong affective connection to the pedagogical process and a belief in the transformative potential of integrating faith with science education.

These findings support the notion that STEM-R is not only an instructional model but also a value-oriented pedagogical philosophy. It situates the teacher as both a knowledge facilitator and a moral guide, emphasizing character and spiritual formation alongside cognitive development. The integration of religious values with scientific content fosters a more holistic learning environment one that nurtures not only intellectual growth but also ethical awareness and spiritual consciousness among students. This underscores the relevance of culturally and religiously responsive teaching models in shaping meaningful educational experiences.

1. Teachers' Feelings When Implementing STEM-R

Based on the survey results, which were qualitatively analyzed through word cluster visualization, it was found that the majority of science teachers exhibited a positive affective response to the implementation of the STEM-R approach in their teaching and learning. Feelings such as enthusiasm, gratitude, enthusiasm, and pleasure appear predominantly, reflecting a strong acceptance of the integration between science and religious values. This aligns with the teacher's view that the STEM-R approach not only enriches the cognitive dimension of science learning but also presents spiritual nuances that make the learning process more meaningful and contextual. In practice, teachers believe that associating scientific concepts with Qur'anic verses and faith values enhances students' motivation to learn and fosters an awareness that science is part of God's manifestation of greatness.

Furthermore, a feeling of pride and satisfaction also arises from the experience of teaching using this approach, especially because teachers feel that they can carry out both educational and transformative roles not only as science teachers but also as moral and spiritual guides. The STEM-R approach is viewed as a learning innovation that facilitates the integration of science and noble religious values, which has not been widely explored in conventional learning practices. Despite initial challenges, such as limited references or concerns about student readiness, teachers tend to view them as part of the adaptation process. In general, these findings indicate that the STEM-R approach can foster a humanistic and transcendent learning climate, which not only enhances the quality of

science education but also strengthens the religious identity and professionalism of teachers in their duties

2. Student Response

Classroom observations and teacher interview results show that students respond positively to STEM-R-based learning. They showed a higher interest in participating in learning activities that linked science and religious values. Active responses are evident in discussion, question-and-answer activities, and reflections, where students seek to understand scientific phenomena from the perspective of faith. This indicates that the STEM-R approach effectively engages students in their emotional and spiritual involvement in learning.

In addition, teachers noted an increase in student learning motivation, characterized by enthusiasm for completing projects and problem-based tasks that incorporate religious values. Students feel more challenged and more inspired because they see learning not only as an academic obligation but also as a form of worship. In the long term, this approach is considered to foster the habit of critical thinking that is integrated with moral values, making student responses an indicator of the success of a holistic approach in science education.

3. Strategies in Learning

Teachers employ various pedagogical strategies to integrate religious values into STEM-R-based science learning. Commonly used methods include associating science materials with verses of the Qur'an, utilizing case studies that incorporate nuances of religious ethics, and project-based learning that emphasizes the value of social and spiritual responsibility. This strategy is designed so that students not only understand science as a collection of concepts and formulas but also as a means of getting to know and get closer to God.

Some teachers also creatively prepare thematic, integrative teaching materials by combining principles of science and religion in a unified learning narrative. In its implementation, teachers use reflective discussion methods, guided questions and answers, and assignments that challenge students to find connections between natural phenomena and religious values. This strategy has proven effective in fostering student engagement, as well as strengthening cohesion between scientific knowledge and spiritual awareness.

4. STEM-R Development Strategy

Teachers recognize the importance of sustainable development in implementing STEM-R approaches. They propose various strengthening strategies, such as specialized training to develop teaching tools that are systematically integrated between science and religious values. In addition, teachers emphasized the need for institutional support from schools, especially in the form of developing learning communities among science teachers that focus on integrating STEM-R as a school culture.

Teachers also assessed the importance of strengthening resources, including teaching materials, learning media, and implementation guidelines. The development of learning modules that are contextual and relevant to the student's religious backgrounds is necessary for this approach to run consistently. Collaborative strategies among science teachers, PAI teachers, and school management are considered the primary key to the success of holistic and sustainable STEM-R development.

5. The Challenges of STEM-R Implementation

Teachers face several challenges in implementing the STEM-R approach, particularly related to the limitations of learning resources that explicitly integrate religious values with science materials. The lack of official guidance or curriculum that supports this

integration forces teachers to innovate in developing learning strategies, which sometimes results in inconsistencies in classroom implementation. Additionally, administrative burdens and limited class time are also obstacles to developing in-depth religious reflection.

In addition to technical challenges, teacher competence is also an important factor. Not all science teachers possess an adequate scientific background, so concerns arise when interpreting religious verses or values appropriately. This challenge is exacerbated by the diverse readiness of students, both in terms of science literacy and religious understanding. Therefore, teachers recognize the need for integrated training support that targets two dimensions of competence simultaneously: pedagogical-scientific and religious.

6. Long-Term Impact of STEM-R Implementation

Teachers believe that the consistent application of STEM-R will have a significant long-term impact on the formation of students' religious character. This approach is considered to foster a spiritual awareness that is inherent in the way students understand, interpret, and respond to science. Teachers hope that the religious values instilled during the learning process will form a strong moral foundation, which will continue to influence students' personal, social, and academic lives in the future. STEM-R thus not only has an impact on the current teaching and learning process but also the direction of sustainable character development of students.

In addition, this approach is also seen as equipping students with the ability to think systematically and critically while still operating within a framework of values based on faith. Teachers believe that students familiar with the integrative approach will be better prepared to face the complexity of the challenges of the times because they have the guidance of values in their actions and thinking. Therefore, teachers view the application of STEM-R as not only relevant to the context of religious education but also strategic in shaping future generations who excel intellectually and spiritually.

7. The Meaning of STEM-R for Teachers

Teachers interpret the STEM-R approach as a middle way between academic achievement and the formation of students' religious character. For them, this approach becomes a strategic space to align the roles of scientific educators and moral educators. Teachers believe that STEM-R not only transfers scientific knowledge but also the value of life so that the function of education extends beyond the cognitive aspect to encompass the affective and spiritual realms. This gives a new meaning to teaching practices that previously tended to be fragmented between science and religion.

Furthermore, teachers believe that STEM-R enhances their confidence in fulfilling the mission of faith-based education. This approach encourages them to continue learning, both in understanding Islamic concepts and in designing integrative pedagogical strategies. Teachers believe they have a role as agents of change, tasked not only with educating intelligent students but also with forming a generation that has faith, responsibility, and the ability to interpret knowledge as a means of drawing closer to God. STEM-R for teachers is not just a method of innovation but a new paradigm in education infused with profound values.

8. The Most Effective Teacher Experience

The most memorable experiences for teachers in implementing STEM-R generally occur when they witness a noticeable change in students' attitudes and ways of thinking. Some teachers expressed great happiness when they saw that students could relate scientific concepts, such as circular motion, to the regularity of God's creation, as well as express their amazement and gratitude for natural phenomena. These moments are proof

that integrating religious values into learning is not only acceptable to students but also able to shape their spiritual consciousness naturally.

Teachers are also touched when students show a more polite, honest, and reflective attitude after participating in STEM-R-based learning. One of the teachers revealed that students who were previously passive became more active in discussing and arguing by incorporating moral and religious values into their explanations. These experiences serve as a form of personal validation of their chosen approach, reinforcing their commitment to continue this integrative learning practice. For teachers, the greatest success is not only in academic grades but in the transformation of students' character.

9. Discussion

The empirical findings of this study demonstrate that science teachers perceive the integration of religious values within STEM-R pedagogy as a profoundly transformative and meaningful process. Emotional responses involving enthusiasm and spiritual fulfillment indicate that this model resonates deeply with the affective domain of educators beyond mere cognitive engagement. Scientific instruction in this context shifts from a value-neutral activity toward a morally infused practice that aligns with the spiritual identities of teachers (Kurniawan et al., 2022). High levels of professional satisfaction among teachers validate the implementation of STEM-R as a bridge between disciplinary knowledge and transcendent values (Suciati et al., 2022).

This reconfiguration of pedagogical purpose reinforces existing theoretical propositions regarding the necessity of addressing both the intellect and the soul in Islamic educational settings. Spiritual satisfaction experienced by educators promotes a necessary coherence between scientific inquiry and the Islamic philosophy of ta'dīb for holistic student nurturing. Previous research emphasizes that religious and cultural roles are central to shaping student attitudes and engagement within the science learning environment (Kurniawan et al., 2022). Integration of these values serves as a fundamental requirement in science education to ensure students develop a comprehensive understanding of the universe (Suprapmanto & Prasetyo, 2019). Modern science curricula in madrasahs must therefore continue to evolve by aligning scientific paradigms with spiritual foundations (Fauzi et al., 2024).

Teachers adopt several strategic practices to embed religious values within science instruction, including explicit Qur'anic integration and contextual learning tied to students' daily lives. Inquiry-based models such as Project-Based Learning (PBL) allow religious values to be pedagogically situated within the core learning process rather than being merely appended (Ardi et al., 2024). These strategies align with global trends in value-based education that emphasize reflective practice and ethical reasoning within disciplinary instruction (Sarwi et al., 2024). Connecting scientific epistemology with axiological religious foundations illustrates a significant epistemic shift toward a more civilized and integrative pedagogy (Hilda et al., 2020). Students eventually acquire a coherent worldview that supports both rigorous scientific inquiry and moral reflection (Ranti & Usmeldi, 2019). The use of research-based worksheets further supports the synthesis of scientific concepts and religious values in daily classroom activities (Ranti & Usmeldi, 2019).

Systemic and pedagogical challenges in implementing STEM-R highlight the tension between aspirational curriculum goals and ground-level realities. Educators frequently encounter resistance from students and the negative influence of digital media environments that disrupt academic focus (Muslihati et al., 2023). Successful implementation depends heavily on broader ecosystemic support, including professional development and supportive leadership (Darwanto et al., 2024). Teacher competence in

this model requires not only content knowledge but also deep theological literacy to handle sensitive topics accurately (Mujahid, 2021). Managing religious discussions requires high pedagogical precision to prevent misconceptions that could harm students' essential understanding (Salim et al., 2024). Establishing a moderate religious character through education remains a crucial institutional goal in modern Indonesian schooling (Saepudin et al., 2023).

Systematic cluster visualization provided in this study offers a valuable framework for understanding the diverse patterns of faith and science integration. These visual mappings serve as effective tools for comparative educational research across different religious and national contexts (Sarwi et al., 2024). Formative impacts of STEM-R on student character development include observable traits such as increased responsibility, confidence, and gratitude (Aningsih et al., 2022). Religious values act as potential enhancers of STEM learning rather than constraints, fostering morally aware and critically literate learners (Irwandi et al., 2022). Integrating local wisdom within science instruction significantly contributes to increasing overall student competency and critical thinking skills (Usmeldi & Amini, 2020). Collaborative inquiry-based learning involving school and community interaction further strengthens religious character and improves learning outcomes (Irwandi et al., 2022). Holistic education through STEM-R transcends traditional disciplinary boundaries to create a more integrated and meaningful learning experience (Saepudin et al., 2023).

D. CONCLUSION

This study concludes that integrating religious values into STEM education through the STEM-R approach is both pedagogically feasible and spiritually enriching for educators in Islamic-based schools. Positive perceptions among teachers indicate that STEM-R aligns deeply with their instructional goals and religious commitments, effectively transforming science education into a spiritually resonant and ethically grounded practice. Educators utilize diverse and contextually relevant strategies, ranging from explicit Qur'anic integration to inquiry-based methodologies, to bridge the gap between scientific inquiry and faith-based reasoning. While substantial challenges such as student resistance and sociocultural diversity persist, these obstacles highlight the urgent necessity for institutional scaffolding and continuous professional development. This research ultimately confirms the potential of STEM-R as a holistic educational model that fosters students' moral responsibility, gratitude, and spiritual consciousness alongside scientific literacy. Future research should expand this inquiry across various educational levels and national contexts to further validate and refine the framework as a culturally responsive pedagogy.

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