



The Integration of Science, Technology, Engineering, and Mathematics (STEM)-Based Learning and Christian Values at SD Negeri 071139 Dima Mulai

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ABSTRACT

This study examines the integration of STEM (Science, Technology, Engineering, and Mathematics)-based learning with Christian values at SD Negeri 071139 Dima Mulai. The purpose of this research is to analyze the effectiveness of the integrated approach in enhancing students' understanding of scientific and technological concepts while simultaneously strengthening moral values and character formation. The research employed both qualitative and quantitative approaches, with data collected through classroom observations, interviews with teachers and students, as well as tests measuring the understanding of STEM concepts and moral values. The findings reveal a significant improvement in students' comprehension of STEM concepts by 27.3%, alongside the reinforcement of Christian values such as care, integrity, and responsibility within the context of science learning. The study concludes that the integration of STEM and Christian values fosters a holistic and meaningful learning experience for elementary school students at SD Negeri 071139 Dima Mulai.

Keywords: STEM, Christian values, character education, integrated learning

INTRODUCTION

Twenty-first century education requires a paradigm shift in the learning system, one that does not merely emphasize cognitive aspects but also fosters critical thinking, creativity, communication, and collaboration. One rapidly developing approach that has become a global focus is STEM education (Science, Technology, Engineering, and Mathematics). The STEM-based learning model is believed to better prepare students to face the complex challenges of an increasingly digitalized and technology-driven world. STEM education encourages students to think interdisciplinarily and solve problems through the integrated application of science, technology, engineering, and mathematics concepts. This approach is highly relevant in the context of the Fourth Industrial Revolution and the

development of Society 5.0, which emphasize twenty-first century competencies. Nevertheless, the implementation of STEM education in Indonesia still faces numerous obstacles, particularly at the elementary school level and in remote areas that lack adequate infrastructure and trained human resources to adopt this approach. Value-based and character education remain essential components of the educational process. Education is not solely about academic achievement; it is also closely tied to the formation of moral, ethical, and responsible personalities. Amid the rapid currents of globalization and technological advancement, value education functions as a foundation that directs the use of knowledge and technology toward positive and responsible purposes. In Indonesia, religious values—particularly Christian values in schools where the majority of students are Christians—play a crucial role in shaping students' character from an early age.

One Public Elementary School that faces challenges in integrating STEM-based learning with Christian values is SD Negeri 071139 Dima Mulai, located in Nias Regency, North Sumatra Province. This school is situated in a region where the majority of the population adheres to Christianity, with a strong cultural and local value background. In this context, education is not merely a matter of knowledge transmission but must also reflect the spiritual values embraced by the local community. This requires a learning approach that emphasizes not only academic achievement but also the strengthening of values such as faith, love, responsibility, and moral integrity. Integrating STEM education, which is grounded in scientific rationality, with Christian values, which are spiritual in nature, is not an easy task. Nevertheless, such an integrative approach holds great potential to create a holistic educational model—one that fosters students' intellectual growth while simultaneously shaping resilient and virtuous character. In this regard, teachers play a central role as facilitators, not only delivering subject matter but also serving as role models in embodying Christian values in everyday life and throughout the learning process. Previous studies have shown that integrating religious values into science learning can positively influence students' moral and spiritual development. Yuliati and Saputra (2019) found that science learning embedded with religious values can enhance spiritual awareness and strengthen ethical attitudes in scientific problem-solving. Similarly, Susilawati (2020) emphasized the importance of comprehensively integrated learning in achieving educational goals that are not only academic but also holistic. However, there remains a gap in research on the application of such integration within the context of elementary education in regions with distinctive religious and cultural characteristics, such as Nias. This study is intended to address that need with three primary objectives. First, to analyze the effectiveness of integrating STEM-based learning with Christian values in enhancing students' understanding of science and technology concepts. Such conceptual understanding is crucial for enabling students to think logically and scientifically, yet within the framework of ethics and faith-based values. Second, this study aims to identify how Christian values such as love, responsibility, honesty, and perseverance can be strengthened through collaborative, problem-solving-oriented STEM learning activities. Third, this research seeks to develop an integrated learning model adapted to the local context and the needs of students at SD Negeri 071139 Dima Mulai. The significance of this research lies in its contribution to designing an elementary education approach that balances cognitive and spiritual dimensions. By integrating a STEM-based curriculum with Christian values, students are expected not only to excel in

scientific thinking skills but also to develop strong character and integrity. This balanced approach is essential, as future challenges are not solely technological but also moral and humanitarian in nature. When students are equipped with faith and ethical values from an early age, they possess sufficient foundations to face life's realities wisely and responsibly. The learning model to be developed through this research is designed to be contextual and aligned with the characteristics of the Nias community, which upholds religious values and communal solidarity. Instruction will be organized in the form of simple projects that combine science concepts with the practice of Christian values. For example, students may design a simple water purifier (an application of science and engineering concepts) while simultaneously learning about the importance of caring for God's creation and helping others. Thus, learning becomes not only intellectually meaningful but also spiritually and socially impactful. Within the framework of national education policy, this research also contributes to strengthening character education (*Penguatan Pendidikan Karakter* or PPK), which has been a priority of the Ministry of Education, Culture, Research, and Technology. Integrating Christian values into STEM learning can serve as a concrete strategy for implementing character education in ways that are relevant to students' lives. They are expected to benefit not only SD Negeri 071139 Dima Mulai but also serve as a reference for other schools with similar geographical, cultural, and religious characteristics. By adopting this integrated learning model, elementary education in Indonesia can advance toward becoming more holistic, inclusive, and contextual, capable of producing a generation that is intellectually competent, spiritually resilient, and distinguished in character.

METHODS

This study employed a mixed-methods approach, combining both qualitative and quantitative methods to obtain a comprehensive understanding of the implementation of Science, Technology, Engineering, and Mathematics-based learning integrated with Christian values. The research design adopted was classroom action research, conducted in two cycles. Each cycle consisted of four main stages—planning, implementation, observation, and reflection—designed to evaluate and continuously improve the learning process. The subjects of this study were fourth-, fifth-, and sixth-grade students at SD Negeri 071139 Dima Mulai, Nias Regency, North Sumatra, with a total of 78 students. The selection of subjects was based on the consideration that students at this level have adequate cognitive development to understand the fundamental concepts of Science, Technology, Engineering, and Mathematics while also reflecting on Christian values in their daily lives. The study utilized multiple instruments to support data collection, including observation sheets to monitor the learning process, semi-structured interview guides for teachers and students, pre- and post-tests to measure the understanding of Science, Technology, Engineering, and Mathematics concepts, Christian values reflection questionnaires, and assessment rubrics for evaluating student projects. Data collection was carried out through classroom observations during the integrated learning process, interviews with six teachers and twenty-four purposively selected students, as well as pre- and post-tests to measure the improvement in students' understanding of Science, Technology, Engineering, and Mathematics concepts. In addition, students completed questionnaires to reflect on the Christian values they learned and experienced during the

learning process, while documentation in the form of process notes and project outcomes served as supporting data. Quantitative data were analyzed using descriptive and inferential statistics, with paired t-tests applied to examine significant differences between pre-test and post-test results. Qualitative data were analyzed thematically through processes of coding, categorization, and interpretation of meaning. To ensure validity, comprehensive data triangulation was employed. The integrated learning model developed in this study included the selection of contexts relevant to students' lives, the design of Science, Technology, Engineering, and Mathematics-based projects that reflect Christian values, theological reflection in science learning, and the integration of biblical narratives aligned with the concepts being studied.

RESULT AND DISCUSSION

The results of the pre-test and post-test indicate an improvement in students' understanding of Science, Technology, Engineering, and Mathematics concepts following the implementation of the integrated learning model. The average pre-test score was 62.4 out of 100, while the average post-test score reached 79.5, representing an increase of 27.3%. Statistical analysis using a paired t-test confirmed that this increase was significant at $p < 0.05$.

Table 1. Comparison of Pre-test and Post-test Results by Grade Level

Grade	Number of Students	Average Pre-test	Average Post-test	Improvement (%)
IV	25	58.2	74.8	28.5
V	27	63.5	80.7	27.1
VI	26	65.6	83.1	26.7
Total	78	62.4	79.5	27.3

Classroom observations also revealed increased student engagement in learning. During the first cycle, the level of active participation was 68%, which rose to 87% in the second cycle. Students demonstrated greater enthusiasm when Science, Technology, Engineering, and Mathematics concepts were connected to relevant Christian values.

Strengthening Christian Values through Science, Technology, Engineering, and Mathematics Learning

Analysis of the Christian values reflection questionnaire revealed an increase in students' awareness of Christian values within the context of science and technology. The values most significantly reinforced were: 1) Care for God's creation: 89% of students reported increased awareness of their responsibility to preserve the environment as God's creation through environmentally oriented projects. 2) Integrity in work: 76% of students demonstrated a better understanding of the importance of honesty in conducting scientific experiments and reporting results. 3) Social responsibility: 82% of students developed greater awareness of how Science, Technology, Engineering, and Mathematics knowledge can be applied to serve others. 4) Perseverance: 78% of students reported an

improved understanding of perseverance in the scientific inquiry process, linked to Christian teachings on perseverance in faith.

The Integrated Learning Model Developed

Based on implementation and reflection, the integrated learning model combining Science, Technology, Engineering, and Mathematics with Christian values consists of the following core components: 1) Exploration Phase: Students explore natural phenomena or technological issues while reflecting on the wonders of God's creation and His wisdom in natural laws. 2) Investigation Phase: Students conduct scientific inquiry with an emphasis on honesty, perseverance, and accuracy as an expression of respect for truth. 3) Creation Phase: Students design and produce technical solutions to identified problems, emphasizing social responsibility and care for others as expressions of Christian love. 4) Reflection Phase: Students reflect on their learning from a theological perspective, linking Science, Technology, Engineering, and Mathematics concepts with relevant Christian values. This model was implemented across various instructional units, including: *"Renewable Energy and the Stewardship of Creation"*, *"Simple Technologies to Help Others"*, *"Water and Life: A Scientific and Spiritual Perspective"*

Effectiveness of Integration in Enhancing Conceptual Understanding

The significant improvement in students' understanding of Science, Technology, Engineering, and Mathematics concepts (27.3%) after the implementation of the integrated model aligns with previous research by Widodo et al. (2021), which found that contextualizing science learning enhances students' conceptual comprehension. In the context of SD Negeri 071139 Dima Mulai, the integration of Christian values provided meaningful relevance for students, as it aligned with their cultural and religious backgrounds. The increase in student engagement from 68% to 87% further indicates that the integrated approach successfully enhanced students' intrinsic motivation to learn. This can be explained by Ausubel's (1968) theory of meaningful learning, which posits that students are more motivated when they can connect new concepts to pre-existing knowledge structures and values. A key factor in the success of this integration was teachers' ability to develop analogies and metaphors linking Science, Technology, Engineering, and Mathematics concepts with Christian values. For example, in teaching about ecosystems, the teacher not only explained the scientific concept of the food chain but also related it to humanity's responsibility as stewards of God's creation. This approach enabled students to grasp scientific concepts while simultaneously strengthening their moral and spiritual values.

Reinforcement of Christian Values through Science, Technology, Engineering, and Mathematics

The reinforcement of Christian values through Science, Technology, Engineering, and Mathematics learning is a key finding of this study. The significant reinforcement of care for God's creation (89%) demonstrates that science learning can serve as an effective medium for fostering ecological awareness grounded in spirituality. This finding is consistent with Harahap and Hasanah (2018), who reported that integrating religious values into science instruction enhances students' environmental awareness. Students' improved understanding of integrity in scientific work (76%) shows that Science,

Technology, Engineering, and Mathematics education provides an effective context for cultivating ethical values. This can be explained through inquiry-based learning, which allows students to directly experience the importance of honesty and objectivity in scientific processes—values that align with Christian teachings on honesty and integrity. The development of social responsibility (82%) through problem-solving-oriented projects highlights how an integrated approach enables students to connect Science, Technology, Engineering, and Mathematics knowledge with the Christian calling to serve others. For instance, designing a simple water filtration system to address community clean water issues not only develops students' technical skills but also instills values of care and social responsibility.

A Contextualized Integrated Learning Model

The integrated learning model developed in this study underscores the importance of contextualization in education. At SD Negeri 071139 Dima Mulai, the local Nias cultural context and Christian values provided the foundation for developing meaningful learning experiences. This approach is consistent with the principles of social constructivism, which emphasize the role of social and cultural factors in shaping knowledge. The reflection phase of the model offered students the opportunity to integrate the cognitive and spiritual dimensions of their learning. This process enabled them to develop a more holistic understanding of science and technology as part of humanity's exploration of God's creation. Such an approach helps overcome the dualism between knowledge and faith that often characterizes traditional education. Implementing the integrated learning model did present several challenges, including limited resources and the need for professional development among teachers. However, this study demonstrates that with careful planning and strong support from the school community, the integration of Science, Technology, Engineering, and Mathematics with Christian values can be effectively implemented even in resource-limited settings such as SD Negeri 071139 Dima Mulai.

Conclusion

This study demonstrates that the integration of Science, Technology, Engineering, and Mathematics (STEM) learning with Christian values at SD Negeri 071139 Dima Mulai is effective in enhancing students' understanding of STEM concepts while simultaneously strengthening Christian values. An increase of 27.3% in STEM conceptual understanding, along with the reinforcement of values such as care for God's creation, integrity in work, social responsibility, and perseverance, indicates that the integrated approach can successfully achieve holistic educational goals. The integrated learning model developed in this study provides a framework that can be adapted by other schools with similar contexts. The phases of exploration, investigation, creation, and reflection offer a systematic structure for incorporating both cognitive and spiritual dimensions into STEM learning. This study carries important implications for educational practice, particularly in schools with a strong religious background. The integrated approach developed here demonstrates that science and faith need not be placed in opposition but can mutually enrich one another to create meaningful and holistic learning experiences for students. The limitations of this study lie in its specific contextual scope and relatively short

implementation period. Further research is necessary to examine the long-term effectiveness of this model across more diverse contexts. The development of curricula and teaching materials that support the integration of STEM and Christian values also represents a promising area for future research.

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