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ARTICLE

Exciting science learning in elementary schools with the STREM model: innovative integration for students

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Abstract

Science learning in elementary schools often faces challenges in student engagement and conventional teaching methods. The STREM model offers an interdisciplinary approach that not only improves science understanding but also integrates Islamic values. Therefore, this study aims to analyse the effectiveness of applying the STREM model in improving students' understanding and engagement in science learning at one private elementary school in the West Java province. This study used the Kemmis and McTaggart CAR model with 2-3 cycles, consisting of the stages of planning, implementation, observation, and reflection. Data were collected through observation, interviews, learning outcome tests (pre-test and post-test), and student response questionnaires, then analysed descriptively quantitatively and qualitatively. The results showed that the application of the STREM model improved student learning outcomes, with the average score increasing from 68 to 87, and a decrease in students in the "Needs Guidance" category from 45% to 10%. In addition, students' involvement in exploration increased from 55% to 92%, indicating that project-based learning and experimentation in the STREM model can increase students' interest and understanding of science. Thus, the STREM model proved effective in improving students' understanding of science, strengthening the integration between science and Islamic values, and increasing engagement in scientific exploration. However, teacher adaptation to exploratory methods and project time management are challenges that need to be refined. Therefore, additional training for teachers and flexibility in managing learning time are needed to optimize the implementation of the STREM model.

Keywords: STREM; Science Learning; Classroom Action Research

1. Introduction

Science learning in elementary schools has an important role in building students' understanding of scientific concepts as well as training critical thinking and problem solving skills since early childhood (Handono et al., 2023) . Science learning should be designed to encourage students to actively explore scientific concepts through direct experience and innovative approaches (Fadhilah, Wardatussaidah, and Wardhani 2024) . However, in practice, science learning still faces various challenges, including the lack of active student involvement, limited learning media, and teaching methods that are still conventional (Fadhilah, Wardatussaidah, and Wardhani 2024) , especially at SDIT Nusintama Lab School Cirebon. To overcome these challenges, innovation in learning is needed, one of which is through the application of the STREM Model (Science, Technology, Religion, Engineering, and Mathematics) which integrates science with technology, engineering, and religious values (Anas and Iswantir 2024; Jelita et al. 2023; Wiyatno et al. 2024). The STREM model can improve students' concept understanding and critical thinking skills with a more interdisciplinary and contextual approach (Handayani, Agustina, and Firdaus 2022) . This model not only improves students' understanding of science concepts holistically, but also instills religious values that are relevant to everyday life ((Pribadi, Nurahman, and Jufriansah 2024). The integration of religion in STEM learning provides a stronger ethical and moral dimension, so that students can see the connection between science and the greatness of God (Anas and Iswantir 2024) . The advantage of the STREM model over other models is its ability to build integration between science and religious values, making it more relevant for students who pursue spiritual value-based education (Yuyung, Arismunandar, and Lutfi 2024). The implementation of this STREM model becomes more significant when applied at one private elementary school in the West Java province, an Islamic school that emphasizes the balance between general science and religious education. This school has the characteristics of students with a strong Islamic educational background, so that the learning methods applied must be able to accommodate academic and spiritual aspects simultaneously. The approach used in learning the school combines theory and practice, and emphasizes the connection between science concepts and Islamic values, such as linking natural phenomena with signs of God's greatness in the Qur'an. Thus, STREM-based science learning in this school not only improves students' academic understanding, but also instills awareness that science is part of religious teachings that must be studied and utilized properly (Handono, Nisa, and Prihatni 2023; Mujaddi, Agustina, and Maryanti 2022).

2. Research Method

This study uses the Classroom Action Research (CAR) method with the Kemmis and McTaggart model, which consists of four stages: planning, action, observation, and reflection. This model is often used by teachers in Indonesia to improve the quality of learning in the classroom(Wijaya et al. 2023). The application of the STREM model in science learning in elementary schools aims to improve student interest, quality and learning outcomes.

The Kemmis and McTaggart model of CAR with 2-3 cycles allows STREM-based learning to be continuously refined through gradual evaluation and improvement. Each cycle includes planning, implementation, observation and reflection, which helps teachers to adjust teaching strategies to better suit students' needs. With the reflection of each cycle, teachers can identify challenges faced in implementing the STREM model and develop more effective solutions to improve students' understanding of science concepts. The integration of STREM in science learning encourages students to be more active, explorative, and understand science concepts in depth through project-based approaches and real experiments. This is in line with the principles of the Merdeka Curriculum, which emphasizes experiential learning and problem solving to increase student competence and learning independence.

3. Result of the research

The research showed an increase in students' understanding of science concepts as well as an increase in active involvement in exploration and project-based learning. Each cycle underwent improvements based on the results of reflection, so that the learning approach was optimized. Quantitative and qualitative data were used to measure the effectiveness of the STREM model through comparison of

Table 1. Research design

Aspects	Description
Type of Research	Classroom Action Research
Research Location	SDIT Nusintama Lab School Cirebon
Research Subject	Teachers and grade 5 students who became the research sample of 30 students.
Research Design	Kemmis & McTaggart CAR model with 2-3 cycles
Stages in Each Cycle	Planning: Design learning using the STREM model.
	Implementation: Implementing the STREM model in science learning.
	Observation: Observe student activity and the effectiveness of the learning method.
	Reflection: Evaluate results and make improvements for the next cycle
Data Collection Technique	Observation (teacher and student observation sheet)
	Interviews with teachers and
	Student learning outcomes test (pre-test and post-test)
	Student response questionnaire on STREM learning
Data Analysis Technique	Quantitative and qualitative descriptive analysis
	Comparison of pre-test and post-test results
	Reflection on each cycle for learning improvement

Table 2. Stages of CAR Kemmis and McTaggart Model

Stages	Activity Description
Planning	Develop a STREM-based lesson plan.
	Prepare media and tools for science experiments integrated with STREM.
	Design observation, interview and assessment sheets.
implementation	Implementing STREM-based science learning in the classroom.
	Students conduct project-based exploration, experimentation, and discussion.
Observation	Observe student and teacher activities during learning.
	Analysing students' engagement in the project and understanding of science concepts.
Reflection	Evaluate student learning outcomes based on observations and assessments.
	Identify obstacles in learning and find solutions for improvement in the next cycle.

Table 3. Stages of CAR Kemmis and McTaggart Model

Cycle	Focus of Improvement	Action Taken
Cycle 1	Early implementation of the STREM model in science learning.	The teacher introduces the concept of STREM; Students conduct simple projects based on science experiments.
Cycle 2	Optimizing the application of STREM and increasing student participation.	Teachers improve differentiation-based teaching strategies; Students are given more complex exploration challenges.
Cycle 3	STREM-based learning enhancements.	The teacher and students reflect together; Refinement of STREM-based project according to feedback.

student assessment results before and after implementation, as well as analysis of observations and interviews.

Before the implementation of the STREM model, science learning was still conventional, with students tending to be passive and less involved in exploration. The average student score was only

Table 4. Comparison of Student Learning Outcomes Before and After the Application of STREM (Percent)

Assessment Aspect	Before STREM Implementation	Cycle 1	Cycle 2	Cycle 3	Increase
Average formative assessment score	68	75	82	87	0.279
Students in the "Needs Guidance" category	45	0.3	0.18	0.1	-0.35
Students in the "Beginning to Master" category	40	0.45	0.5	0.5	0.1
Students in the "Mastered" category	0.15	0.25	0.32	0.4	0.25
Students who are active in exploration & projects	0.55	0.7	0.85	0.92	0.37

68, with 45% of students still in the "Needs Guidance" category. In Cycle 1, the STREM model began to be applied by emphasizing simple project-based exploration. Students began to show an increase in understanding of science concepts, as seen from the increase in the average score to 75. However, several obstacles were still found, such as student adaptation to new methods and lack of courage to explore independently. In Cycle 2, improvements were made with experimental and collaboration-based learning strategies, as well as more intensive guidance for students who were still having difficulties. The average score increased to 82, and students in the "Mastered" category increased to 32%. Engagement in exploration also increased from 70% to 85%. Entering Cycle 3, learning was further optimized with a differentiated approach, where students were given exploration challenges according to their level of understanding. The teacher also played a more facilitating role in guiding students' scientific exploration. At this stage, the average score reached 87, with 40% of students in the "Mastered" category and involvement in the project increased to 92%. These results show that the application of the Kemmis and McTaggart CAR model with the STREM model gradually improves students' science understanding, involvement in exploration, and learning outcomes in accordance with the principles of the Merdeka Curriculum. Based on qualitative data obtained through observations and interviews. The following are the results of qualitative analysis obtained from observations and interviews:

Table 5. Analysis of Observation and Interview Results

Category	Observation and Interview Findings
Student Interest & Motivation	Students are more enthusiastic and actively involved in project-based learning and exploration.
Science Concept Understanding	Students better understand science concepts because they are related to everyday life and real experiments.
Differentiation Approach	STREM enables learning that meets the individual needs of students, as emphasized in the Merdeka Curriculum.
Teacher's Role	The teacher acts as a facilitator, guiding students' exploration without dominating the class.
Challenges Faced	(1) Teachers need to adapt to the STREM exploratory method; (2) Students need more time in completing scientific projects.
Solution Applied	(1) Training for teachers on STREM-based exploratory strategies and projects; (2) Adjusting the project time so that students have more opportunities to experiment.

It was found that students were more enthusiastic and actively involved in project-based learning and exploration. They find it easier to understand science concepts because they are linked to everyday life through real experiments. In addition, the STREM approach also allows for more differentiated learning according to students' individual needs, as emphasized in the Merdeka Curriculum. The teacher's role changes from an instructor to a facilitator who guides students' exploration, thus encouraging independence in learning.

However, there are some challenges in implementing the STREM model, such as teacher adaptation to exploratory methods and the time needed to complete scientific projects. To overcome these challenges, teacher training was conducted to improve understanding of STREM's exploratory strategies, as well as adjustments to project time so that students had more opportunities to experiment. However, it can be proven that the STREM model is effective in improving students' science understanding, encouraging scientific exploration, and increasing active engagement in project-based learning. With the Kemmis and McTaggart model of CAR approach, learning can be improved each cycle through evaluation and reflection, thus having a positive impact on student learning outcomes.

4. Conclusion and Suggestion

Based on the results of the study, the application of the STREM model in science learning at one private elementary school in the West Java province, CAR Kemmis and McTaggart model with 2-3 cycles was proven to improve students' understanding of science concepts, involvement in exploration, and learning outcomes. Quantitatively, there was an increase in the average score of formative assessments from 68 to 87, with a decrease in students in the "Needs Guidance" category from 45% to 10% and an increase in students in the "Has Mastered" category from 15% to 40%. From a qualitative perspective, observations and interviews show that students become more enthusiastic and active in project-based learning and more easily understand science concepts because they are associated with real phenomena and Islamic values. However, in its implementation, there are some challenges, such as teachers' adaptation to explorative methods and the time needed to complete scientific projects. Therefore, it is recommended that schools conduct training for teachers to improve their understanding of the STREM model and provide flexibility in project timing so that students can maximize their exploration. In addition, further research can be conducted with a wider scope to explore the effectiveness of the STREM model at higher education levels or deeper integration with the Merdeka Curriculum approach.

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