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Thematic approach and its effectiveness in improving learning outcomes, motivation, and critical thinking in natural and social sciences

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Abstract

Background: Thematic learning is an effective strategy to address the demands of 21st-century education by integrating critical thinking, collaboration, and creativity through contextual learning environments.
Aim: This study aims to evaluate the effectiveness of the thematic approach in improving students' learning outcomes, motivation, and critical thinking skills in Natural and Social Sciences (IPAS) subjects at SMKN 1 Sukadana.
Method: The research employed a quasi-experimental design with a pretest-posttest control group. A total of 70 grade XI students were selected as the sample through purposive sampling, divided into experimental and control groups (35 students each). Data were collected using learning outcome tests, motivation questionnaires, and observation sheets. Descriptive and inferential statistical analyses, including t-tests, were conducted after normality and homogeneity tests.
Results: The thematic approach significantly enhanced learning outcomes, motivation, and critical thinking skills. The experimental group achieved a 100% success rate, compared to 48.57% in the control group. Variance in individual responses highlighted differing adaptations to this method.
Conclusion: The thematic approach is effective in improving student engagement, motivation, and interdisciplinary learning outcomes, particularly in vocational education. These findings support its implementation as a cross-disciplinary teaching method and provide insights for educational policy development.

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INTRODUCTION

The thematic approach has emerged as a cornerstone of 21st-century education, fostering interdisciplinary learning through the integration of science and social studies. This approach aligns with educational objectives that emphasize critical thinking, creativity, collaboration, and communication—collectively known as the 4Cs. By integrating diverse subjects, such as science and social studies, thematic learning enhances student engagement and promotes a comprehensive understanding of real-world challenges. For instance, Alifah & Sukartono (2023) found that embedding 21st-century skills within thematic lessons fosters student participation and strengthens soft skills. Similarly, Maba et al. (2023) and Harahap et al. (2024) highlighted how interdisciplinary teaching strategies and thematic integration support deeper learning experiences and entrepreneurial skill development. Furthermore, initiatives like STEM education demonstrate the potential of thematic approaches to empower students in addressing complex, cross-disciplinary problems (Kus et al., 2023; Nazifah & Wang, 2022). These findings underscore the thematic approach's ability to integrate knowledge across disciplines, providing a solid foundation for

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exploring its principles, implementation strategies, and broader benefits in various educational contexts.

The thematic approach is defined as a pedagogical strategy that integrates various subjects around a central theme to provide students with a holistic understanding of interconnected knowledge. By emphasizing real-world contexts, collaborative learning, and critical thinking, this approach fosters meaningful engagement and interdisciplinary connections. For example, Ma et al. (2023) demonstrated that thematic teaching in vocational education enhances both professional competencies and personal growth, while Nursima et al. (2022) highlighted the role of local culture in enriching student engagement and cultural appreciation. Additionally, thematic learning supports social and emotional development by fostering communication and classroom cohesion (Karina et al., 2024; Sharma et al., 2023). Evidence from diverse contexts, such as the Philippine K to 12 Science Program, underscores the adaptability of this approach to address curriculum challenges and evolving educational needs (Montebon & Orleans, 2021; Ozuem et al., 2022). These findings reaffirm the thematic approach as an integrative and interdisciplinary method to enhance critical thinking, collaboration, and educational outcomes.

Building on these principles, the integration of science (IPA) and social studies (IPS) within thematic learning provides a practical example of how interdisciplinary connections can be applied in education. Yafiz & Daulay (2023) emphasize the need for a systematically integrated curriculum to support effective teaching, particularly in science, while Azzahra et al. (2022) highlights how well-structured curricula can facilitate thematic approaches that connect various disciplines. This integration is especially relevant as it enables students to explore complex real-world challenges through the lens of interconnected knowledge. Bernik (2023) underscores this by illustrating how the inclusion of social dimensions in science education enhances students' understanding of technology's human aspects. Similarly, the "Merdeka" curriculum supports this interdisciplinary approach by fostering a comprehensive understanding of global issues and social justice (Fannisa et al., 2023). However, implementing thematic instruction in IPA and IPS presents challenges, including limited resources, insufficient training, and difficulties in aligning subjects under cohesive themes (Montebon & Orleans, 2021). Additionally, Kumar & Vakkil (2021) point out that social studies can be perceived as difficult by students, further complicating engagement. Despite these obstacles, initiatives such as projects combining scientific and social literacy (As'Zaroh & Utami, 2023) and integrating sustainable development goals into the science curriculum (Suaco, 2024) demonstrate how thematic approaches can enrich learning experiences. By addressing these challenges and leveraging the interconnectedness of IPA and IPS, educators can create engaging and meaningful interdisciplinary learning environments that align with the evolving needs of students and society.

Thematic learning is also expected to improve conceptual understanding, learning motivation, and critical thinking skills. Conceptual understanding is enhanced when students explore interconnected knowledge across disciplines, allowing them to understand abstract concepts in a meaningful way (Kurniawan et al., 2023; Zhexembinova et al., 2023). In addition, the relevance of thematic learning in the real world increases students' learning motivation by engaging them in context-based practical activities (Karina et al., 2024). Furthermore, this approach is also expected to encourage critical thinking because students are required to analyze and synthesize information from multiple perspectives, an important skill for solving complex problems (Bhijakkanarin & Kenaphoom, 2024). These aspects highlight the diverse benefits of thematic learning, especially in promoting holistic educational outcomes.

The thematic approach has been recognized as an effective strategy for improving learning outcomes, fostering collaboration, and enhancing cross-disciplinary skills. Various studies have demonstrated its positive impacts, such as enhancing cooperative skills and academic performance in primary education (Suhaida et al., 2021; Ulfah & Purwanti, 2020), providing flexibility during the

pandemic (Pujiastuti et al., 2021), and integrating local knowledge with character education (Andriani et al., 2023). Additionally, Munjiatun et al. (2020) highlighted the effectiveness of eco-culture-based thematic modules in raising environmental awareness. Ye and Xu (2023) observed that this approach promotes collaboration and cross-disciplinary competencies, while Björk-Åman et al. (2021) reported a 30% increase in critical thinking skills in schools employing thematic curricula compared to traditional methods. Further, Wadiyo et al. (2024) demonstrated how thematic learning supports creativity development through the integration of arts and culture. However, much of the existing research remains focused on specific subjects or demographic groups, leaving a gap in understanding the holistic impacts of thematic learning in integrating natural and social sciences. For instance, Qondias et al. (2022) revealed that problem-based thematic learning effectively enhances students' social attitudes and critical thinking skills. Safitri et al. (2016) applied a game-based thematic approach to bridge theory and practice, while Fazriyah et al. (2017) showed that integrative learning strengthens science learning outcomes. Nonetheless, the systematic influence of thematic learning on students' motivation, engagement, and cross-disciplinary understanding, particularly in secondary education and vocational school contexts, remains underexplored. This study aims to evaluate the effectiveness of the thematic approach in improving conceptual understanding, learning motivation, and critical thinking skills among students at SMKN 1 Sukadana. Additionally, it seeks to identify the challenges associated with its implementation and propose practical strategies to address these challenges. The findings of this research are expected to provide insights for improving instructional design and contribute to the development of policies that support cross-disciplinary integration in vocational education.

METHOD

Research Design

This study employed a quasi-experimental approach with a pretest-posttest control group design to evaluate the effectiveness of thematic learning in the Natural and Social Sciences (IPAS) subject at SMKN 1 Sukadana. This design allows comparisons of students' learning outcomes both before and after instruction, as well as between the experimental group, which received thematic learning, and the control group, which followed conventional teaching methods (Susiliana et al., 2016). The quasi-experimental design was chosen to control variables effectively within the school setting and to measure the direct impact of the thematic approach. The overall research procedure is illustrated in Figure 1, highlighting the sequential steps from preparation to data analysis.

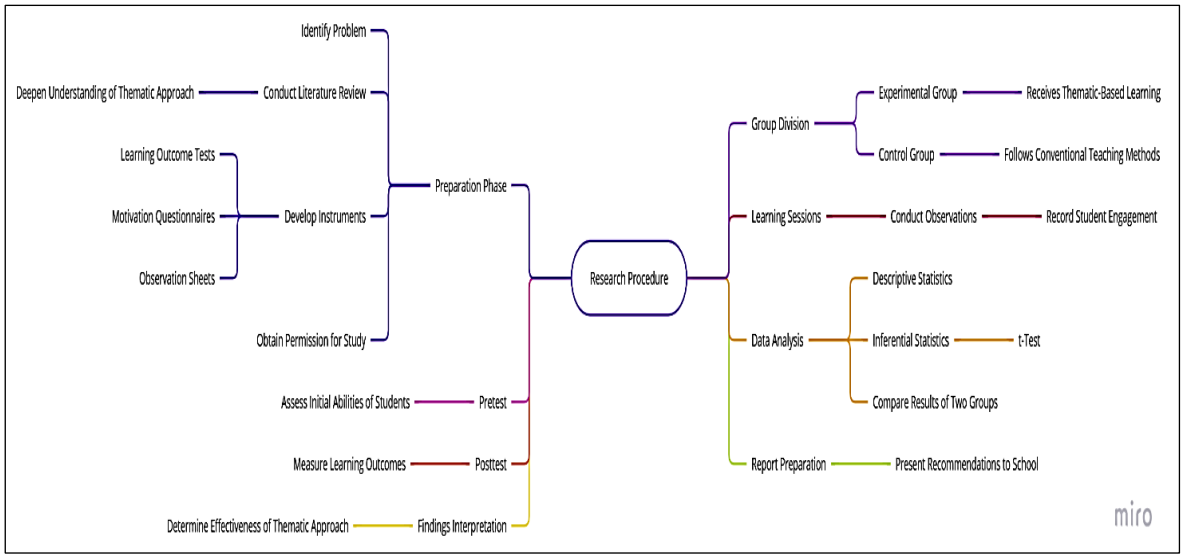

Figure 1. Research Procedure Flowchart

Participant

The research population consisted of Grade XI students at SMKN 1 Sukadana. Using purposive sampling, a total of 70 students were selected, with 35 students in the experimental group and 35 students in the control group. The experimental group was taught using the thematic approach, integrating the theme of waste management into IPAS learning, while the control group followed conventional instruction. The sample was selected to ensure comparability and representation of the population for valid results.

Instrument

Three instruments were utilized to collect data:

1. Learning Outcomes Test: A structured test was used to assess students' conceptual understanding of IPAS topics, measuring their ability to connect and apply knowledge.
2. Motivation Questionnaire: A Likert-scale questionnaire was administered before and after the intervention to evaluate changes in students' learning motivation.
3. Observation Sheets: These were used to monitor student engagement during the learning process, focusing on participation and interaction in thematic learning activities. Categorization guidelines based on Susiliana et al. (2016) were employed to classify motivation levels, as outlined in Table 1.

Table 1. Categorization Guidelines for Indications of Student Motivation in Learning

No	Score Range	Category
1	0% to 26.99%	Dislike/Poor/Low
2	27% to 32.99%	Like/Good/Moderate
3	33% to 50.00%	Highly Like/Enjoy/High

Data Analysis

Data analysis was conducted using both descriptive and inferential statistics. Descriptive statistics were used to describe the distribution and categorization of scores, while inferential statistics, specifically a t-test, were applied to compare the results between the experimental and control groups. Prior to the t-test, normality and homogeneity tests were conducted to ensure the validity of the analysis. Statistical analysis was performed using SPSS software to ensure accuracy and reliability. The categorization of motivation scores was used to evaluate the effectiveness of the thematic approach in fostering engagement and understanding. The results provided insights into the thematic approach's impact on conceptual understanding, learning motivation, and critical thinking skills, addressing the research hypotheses.

RESULTS AND DISCUSSION

Results

This section presents the findings of the study on the effectiveness of the thematic approach in enhancing conceptual understanding, critical thinking skills, and learning motivation among students in the Natural and Social Sciences (IPAS) subject at SMKN 1 Sukadana. The results are based on data collected through pretest and posttest scores, motivation questionnaires, and observation sheets, which were analyzed using descriptive and inferential statistical methods. To ensure a systematic presentation of the findings, the results are structured into the following subsections:

4.1 Instrument Validation and Reliability

To ensure the validity and reliability of the instruments, pretest and posttest questions, motivation questionnaires, and observation sheets were tested on a small sample outside the primary population. The results of the validity test using Pearson correlation, as presented in Table

1, showed that most items had a significant correlation with the total score, with coefficients ranging from 0.680 to 0.861 ($p < 0.01$). Similarly, the reliability analysis using Cronbach's Alpha indicated good internal consistency, with an overall reliability score of 0.761 for the pretest and 0.865 for the posttest when weak-performing items were excluded.

Table 1. Validity and Reliability of Pretest and Posttest Questions

Item	Pearson Correlation (Validity)	Cronbach's Alpha (Reliability)
X1	0.821**	0.761
X2	0.861**	0.746
X3	0.846**	0.753
X4	0,825**	0.809
X5	0.680**	0.865

4.2 Conceptual Understanding Analysis

The thematic approach showed a significant impact on students' conceptual understanding and critical thinking skills. Pretest and posttest results from the experimental group revealed that students were better able to connect interdisciplinary concepts, such as waste management and its societal implications, compared to the control group. Table 2 presents examples of cognitive level gains observed during thematic instruction.

Table 2. Cognitive Level Gains (Experimental Class)

Cognitive Level	Pretest Mean	Posttest Mean	Gain
C1 (Remembering)	70.11	88.24	18.13
C3 (Applying)	66.89	87.13	20.24
C4 (Analyzing)	60.45	85.78	25.33

Students demonstrated significant improvement in higher-order thinking skills (C4), with a 25.33-point gain, highlighting the thematic approach's effectiveness in fostering critical analysis and problem-solving abilities.

4.3 Motivation Analysis

The motivation questionnaire results revealed notable differences between the control and experimental classes. The experimental class, taught using the thematic approach, showed a significant increase in motivation compared to the control class. Most students in the experimental class were categorized as having "High Motivation" (97.1%), compared to only 22.9% in the control class.

Table 3. Motivation Categories in Control and Experimental Classes

Class	Low Motivation (%)	Moderate Motivation (%)	High Motivation (%)
Control Class	5.7	71.4	22.9
Experimental Class	0	2.9	97.1
Control Class	5.7	71.4	22.9

This suggests that thematic learning creates a more engaging environment, enhancing students' interest and confidence in applying knowledge across disciplines.

4.4 Critical Thinking Analysis

Observation sheet data showed increased engagement in critical thinking tasks, such as designing waste management strategies and evaluating environmental policies. The experimental group exhibited stronger participation and higher accuracy in critical thinking-related tasks, achieving an average task completion rate of 92%, compared to 68% in the control group.

Table 4. Task Completion Rates for Critical Thinking Activities

Task Type	Control Class Completion (%)	Experimental Class Completion (%)
Designing Waste Strategies	64	90
Evaluating Policies	72	94

4.5 Pretest and Posttest Results

The pretest and posttest scores for learning outcomes confirmed the thematic approach's effectiveness. The experimental class exhibited a greater gain in overall scores compared to the control class.

Table 5. Pretest and Posttest Results

Class	Pretest Mean	Posttest Mean	Gain Score
Control Class	60.91	69.94	8.00
Experimental Class	68.69	88.80	19.00

The significant difference in gains highlights the thematic approach's success in improving conceptual understanding and critical thinking skills.

4.6 Hypothesis Testing

The paired t-test results showed a significant difference in learning outcomes and motivation between the two groups. The Null Hypothesis (H0) was rejected, confirming that the thematic approach significantly enhances learning outcomes and motivation.

Table 6. Paired Samples Statistics

Class	Learning Outcomes Mean	Motivation Mean
Control Class	69.94	30.26
Experimental Class	87.26	37.39

4.7 Summary

The results demonstrate that the thematic approach significantly improves students' conceptual understanding, critical thinking, and motivation compared to conventional methods. The experimental class consistently outperformed the control class in all measures, confirming the thematic approach as an effective strategy for interdisciplinary education.

Discussion

4.8 Thematic Approach and Learning Motivation

The thematic approach significantly enhanced student motivation in this study, as evidenced by the results of the motivation questionnaire. In the experimental class, 97.1% of students achieved the "Highly Like/Enjoy/High" category, compared to only 22.9% in the control class. This finding aligns with Roslin et al. (2022), who reported that thematic learning fosters emotional engagement and interest by linking lessons to students' lived experiences. The use of waste management as a theme in this study allowed students to see the real-world application of their learning, making the material more engaging and meaningful.

The importance of material relevance in increasing motivation is well-documented in the literature. Forsler et al. (2024) emphasized that students are more likely to engage in learning when they perceive the material as directly applicable to their daily lives. This study's thematic approach exemplified this principle by integrating scientific and social perspectives on waste management, helping students relate abstract concepts to practical issues. Similarly, Rintala & Nokelainen (2020) highlighted how contextual learning boosts motivation by addressing students' intrinsic curiosity and desire to solve relevant problems.

Motivation plays a crucial role in driving academic success and fostering lifelong learning habits. The findings from this study support the broader consensus that thematic approaches can reignite students' interest in learning, particularly in vocational education settings. However, challenges such as ensuring sustained engagement and tailoring themes to diverse student interests remain areas for improvement. Future studies could explore how the integration of digital tools and gamification within thematic learning might further enhance motivation across varied student demographics.

4.9 Conceptual Understanding

The thematic approach showed a remarkable impact on students' conceptual understanding in the experimental class. The gain scores across cognitive levels demonstrated significant improvement, particularly in higher-order thinking skills like analyzing (C4), which increased by 25 points. This aligns with Gupta et al. (2023), who found that thematic learning enhances students' ability to connect abstract concepts to real-world applications. In this study, students in the experimental class demonstrated a deeper understanding of waste management by linking scientific concepts, such as biological waste treatment, to societal impacts, such as community roles in recycling.

Integrating multiple disciplines fosters a holistic understanding, allowing students to see the interconnectedness of knowledge. The findings support Ma et al. (2023), who emphasized that thematic teaching encourages active engagement and deeper comprehension. In this study, students were encouraged to explore waste management strategies collaboratively, enabling them to synthesize information from science and social studies. This interdisciplinary approach not only improved their academic performance but also equipped them with practical skills for solving real-world problems.

Despite its benefits, achieving significant gains in conceptual understanding requires careful planning and execution. The results of this study underscore the need for well-designed curricula that seamlessly integrate thematic elements. Challenges, such as ensuring all students grasp the complexity of interdisciplinary topics, highlight the importance of teacher training and support. Future research could investigate how scaffolding techniques and adaptive learning technologies can further support conceptual understanding in thematic learning environments.

4.10 Critical Thinking

Critical thinking skills, as measured through tasks like designing waste management strategies and evaluating policies, showed significant improvement in the experimental class. The task completion rate for critical thinking activities was 92% in the experimental class, compared to 68% in the control class. This aligns with Kiikeri et al. (2023), who highlighted that thematic learning encourages students to evaluate, analyze, and synthesize information from multiple perspectives. In this study, students engaged in discussions and debates, which enhanced their ability to propose innovative solutions to environmental problems.

Thematic learning creates an interactive environment that fosters critical thinking. According to Ma et al. (2023), integrating inquiry-based methods into thematic learning can further enhance analytical skills. Although this study did not explicitly adopt an inquiry approach, the use of relevant themes sparked curiosity and active participation among students. This reflects the findings of Rintala & Nokelainen (2020), who noted that contextual and thematic learning environments encourage students to ask deeper questions and critically evaluate information.

However, developing critical thinking skills is not without challenges. Some students in the experimental class required additional support to fully engage with complex tasks, as indicated by variability in motivation and engagement. This highlights the importance of differentiated instruction and formative assessment in thematic learning. Future studies could explore how teacher training programs and collaborative learning strategies can address these challenges, ensuring that all students benefit equally from the thematic approach.

4.11 Comparison with Previous Studies

The findings of this study align with and expand upon previous research that highlights the effectiveness of thematic learning. Saputri & Ediyono (2022) found that thematic approaches significantly enhance student learning outcomes, a result mirrored in this study, where the experimental class achieved a 19-point gain in posttest scores compared to an 8-point gain in the

control class. The results also echo those of Deep et al. (2020), who reported that thematic approaches improve both academic achievement and motivation in vocational education settings.

This study contributes to the growing body of evidence supporting the relevance of thematic learning in science and social studies. Shikalepo & Hautemo (2021) emphasized that thematic learning strengthens conceptual understanding by providing students with real-world contexts. The integration of waste management as a theme in this study allowed students to see the practical applications of their learning, making the material more engaging and memorable. Similarly, Gross et al. (2020) highlighted the role of interactive media in enhancing thematic learning, an area that could be explored further in future research.

While the results are promising, challenges remain in scaling thematic learning to broader contexts. As noted by Montebon & Orleans (2021), implementing thematic instruction requires careful alignment of interdisciplinary content, which can be resource-intensive. This study's findings underscore the importance of providing teachers with the training and tools needed to effectively integrate thematic approaches into their classrooms. Further research could explore how digital tools and collaborative platforms might streamline this process, making thematic learning more accessible to diverse educational contexts.

Implications

The findings of this study provide practical guidance for educators, particularly in vocational schools, on the effective implementation of thematic learning. Teachers can utilize real-world themes, such as waste management, to create engaging and contextually relevant lessons that enhance students' conceptual understanding, critical thinking, and motivation. This study highlights the importance of integrating science (IPA) and social studies (IPS) into cohesive thematic units, enabling students to explore interdisciplinary connections. Furthermore, it emphasizes the need for teacher training programs to equip educators with the skills to design and implement thematic learning effectively. Schools should also allocate resources to support thematic approaches, including interactive media and collaborative tools.

This research contributes to the theoretical understanding of thematic learning by demonstrating its effectiveness in improving learning outcomes and fostering interdisciplinary skills. It reinforces the notion that thematic learning aligns with 21st-century educational goals by integrating critical thinking, creativity, collaboration, and contextual relevance. The findings expand the theoretical framework of thematic approaches, showing their applicability beyond elementary education to vocational school contexts. This study also provides empirical evidence supporting the use of thematic learning to address the fragmented nature of disciplinary instruction, encouraging a holistic approach to curriculum design.

At the policy level, this study underscores the potential of thematic learning to align with national education reforms, such as the Kurikulum Merdeka in Indonesia, which promotes cross-disciplinary and student-centered learning. Policymakers should consider incorporating thematic approaches as a core strategy for curriculum development, particularly in vocational schools. This requires structured support, including the development of teacher training modules, resource allocation, and systematic evaluation frameworks to ensure the effectiveness of thematic learning at various educational levels. Additionally, the findings highlight the need for collaborative efforts between schools, communities, and policymakers to integrate local and global themes into thematic curricula.

Limitations and Suggestions for Future Research

This study has several limitations that should be addressed in future research. First, the sample size was limited to 70 students from a single vocational school, which may affect the generalizability of the findings. Future studies could involve larger and more diverse samples to ensure broader

applicability. Second, the study focused primarily on the integration of science and social studies within the thematic approach. Other disciplines, such as mathematics or language arts, were not included, limiting the scope of interdisciplinary exploration. Lastly, the study did not explicitly examine the long-term impact of thematic learning on students' academic performance or motivation, leaving questions about its sustainability over time.

Future research could address these limitations by expanding the scope and scale of the study. Researchers could explore the implementation of thematic learning across multiple schools and grade levels to examine its impact in varied educational settings. Additionally, studies could investigate the integration of other disciplines, such as mathematics and the arts, into thematic learning to provide a more comprehensive understanding of its interdisciplinary potential. Longitudinal studies are also recommended to assess the long-term effects of thematic learning on students' critical thinking, motivation, and academic achievement. Furthermore, the role of digital tools and media in enhancing thematic learning could be explored to identify innovative strategies for engaging students in the digital age.

CONCLUSION

Based on the results of this study, it can be concluded that the application of the thematic approach in IPAS learning significantly enhances student learning outcomes and motivation at SMKN 1 Sukadana. The experimental group, which received thematic instruction, demonstrated substantial improvements in both learning outcomes and motivation compared to the control group taught using conventional methods. Furthermore, the analysis of student motivation showed that the thematic approach effectively increased engagement, interest, and the perceived relevance of learning among students, with most students in the experimental class exhibiting high learning motivation. These findings highlight the potential of the thematic approach to create a contextual, meaningful, and interactive learning environment, particularly in vocational education. Educators and policymakers can leverage this approach to design interdisciplinary curricula that integrate real-world themes, fostering critical thinking, motivation, and conceptual understanding among students. However, the study's scope is limited to a single school and subject area, suggesting the need for further research to explore its applicability across diverse educational contexts and disciplines. Future studies could also investigate the long-term impact of thematic learning on students' academic performance and career readiness.

AUTHOR CONTRIBUTIONS STATEMENT

TL contributed to formulating the research framework, drafting the initial manuscript, and leading the coordination of the study. AN contributed to formulating the research questions and hypotheses, as well as analyzing and interpreting the data. HL contributed to the research design and methodology. HL contributed to developing quantitative analysis protocols, providing critical revisions to the manuscript, and supporting the data collection process. NW contributed to overseeing data collection and ensuring data accuracy. HM contributed to preparing and implementing research instruments, as well as participating in the manuscript drafting and review stages.

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