

Designing Interdisciplinary Mathematics Learning Situations for Grade 4 Number and Operations: Evidence from Vietnamese Primary Schools

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ABSTRACT: Interdisciplinary mathematics education has become an important approach for promoting competency-based learning by connecting mathematics with authentic contexts and other school subjects. However, the effective design of interdisciplinary learning situations for primary mathematics remains insufficiently supported by systematic instructional guidance. This study aimed to investigate the current implementation of interdisciplinary teaching in Grade 4 mathematics, identify teachers' instructional needs, and develop a framework for designing interdisciplinary learning situations for the Number and Operations strand in Vietnamese primary schools. A mixed-methods approach was employed, involving surveys of 20 Grade 4 teachers and 60 students from two public primary schools in Hai Phong City, Vietnam. Data were collected through questionnaires, interviews, classroom observations, and descriptive statistical analysis. The findings indicate that although teachers recognized the educational value of interdisciplinary mathematics education, its classroom implementation remained limited. Major challenges included difficulties in designing authentic interdisciplinary learning situations, selecting appropriate integrated content, and organizing interdisciplinary learning activities. Based on these findings, the study proposes a systematic framework for designing interdisciplinary mathematics learning situations aligned with curriculum requirements, students' cognitive characteristics, and authentic learning contexts. The proposed framework provides practical pedagogical guidance for teachers and contributes to strengthening competency-based mathematics education in Vietnamese primary schools.

KEYWORDS: interdisciplinary mathematics education; interdisciplinary learning situations; number and operations; Grade 4 mathematics; Vietnamese primary schools

1. INTRODUCTION

Interdisciplinary education has become an important direction in contemporary curriculum reform because it enables students to connect knowledge across different subject areas and apply what they learn to authentic situations beyond the classroom. In mathematics education, interdisciplinary teaching moves beyond the traditional emphasis on procedural competence by encouraging learners to use mathematical knowledge to investigate, interpret, and solve problems situated in meaningful real-world contexts. Such an approach not only strengthens conceptual understanding but also contributes to the development of problem-solving, communication, collaboration, and knowledge-transfer competencies that are central to competency-based education (Beane, 1997; Jacobs, 1989; Goos et al., 2023).

At the primary level, interdisciplinary mathematics learning is particularly important because young learners tend to construct knowledge more effectively when mathematical concepts are connected with familiar experiences and learning activities from other disciplines. Rather than viewing mathematics as an isolated subject, interdisciplinary learning situations enable students to explore relationships among mathematics, science, social studies, language, ethics, and everyday life. These meaningful connections provide opportunities for students to understand the practical value of mathematics while developing higher-order thinking and the ability to transfer mathematical knowledge across different contexts (Maass et al., 2019; Drake & Reid, 2020).

In Vietnam, the 2018 General Education Curriculum identifies competency development as the fundamental orientation for teaching and learning. Within this framework, mathematics education is expected not only to develop students' mathematical knowledge and skills but also to foster mathematical modelling, problem solving, communication, reasoning, and the application of mathematics in real-life situations. The curriculum also encourages teachers to establish connections between mathematics and other learning areas through integrated and authentic learning activities. Consequently, designing interdisciplinary learning situations has become an important instructional strategy for improving the quality of primary mathematics education and supporting the implementation of competency-based teaching.

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Despite these curriculum expectations, evidence from the present study indicates that interdisciplinary teaching has not yet been implemented consistently in Grade 4 mathematics classrooms. The baseline survey conducted in two public primary schools revealed that although teachers generally recognized the educational importance of interdisciplinary teaching, classroom implementation remained relatively limited. Most teachers reported difficulties in identifying appropriate interdisciplinary content, designing authentic learning situations, organising interdisciplinary learning activities, and evaluating students' learning outcomes. Furthermore, many students demonstrated limited ability to apply mathematical knowledge to practical and interdisciplinary contexts, suggesting a considerable gap between curriculum expectations and current classroom practice. These findings indicate the need for systematic pedagogical guidance that can support teachers in designing and implementing interdisciplinary mathematics learning situations appropriate for primary education.

Previous studies have consistently confirmed the educational value of interdisciplinary mathematics education. However, existing research has primarily focused on conceptual discussions of interdisciplinary learning, curriculum integration, or the educational benefits of connecting mathematics with other disciplines. Comparatively fewer studies have provided systematic frameworks that guide teachers through the process of designing interdisciplinary mathematics learning situations suitable for regular classroom instruction, particularly within the context of primary education. In addition, although several international studies have examined interdisciplinary mathematics learning, empirical evidence from Vietnamese primary schools remains relatively limited, especially regarding the Number and Operations strand, which forms the foundation of mathematical learning in primary education. Consequently, there remains a need for research that combines evidence from classroom practice with a systematic design framework capable of supporting teachers in implementing interdisciplinary mathematics education under authentic teaching conditions (Beane, 1997; Drake & Reid, 2020; Panqueban & Henríquez-Rivas, 2025).

Responding to these gaps, the present study investigates the current implementation of interdisciplinary teaching in Grade 4 mathematics and develops a systematic framework for designing interdisciplinary mathematics learning situations for the Number and Operations strand in Vietnamese primary schools. Grounded in evidence collected from teachers and students, the proposed framework aims to ensure curriculum alignment, educational feasibility, and practical applicability while supporting competency-based mathematics education. By integrating empirical evidence from Vietnamese classrooms with established theories of curriculum integration and interdisciplinary mathematics education, this study contributes practical pedagogical guidance for teachers and provides additional evidence supporting the implementation of interdisciplinary mathematics education in primary schools.

2. LITERATURE REVIEW

2.1. *Interdisciplinary Mathematics Education*

Interdisciplinary mathematics education is an instructional approach that enables students to construct mathematical understanding by establishing meaningful connections between mathematics and other subject areas while applying mathematical knowledge to authentic contexts. Rather than treating mathematics as an isolated discipline, this approach emphasizes the integration of mathematical concepts, reasoning, and problem-solving processes with knowledge derived from science, social studies, language, environmental education, and everyday experiences. Such integration supports students in recognizing the relevance of mathematics beyond classroom exercises and encourages them to use mathematical thinking to interpret and solve practical problems.

From the perspective of contemporary mathematics education, interdisciplinary learning should maintain the integrity of mathematical knowledge while creating opportunities for students to communicate mathematically, reason logically, and apply mathematics in diverse situations. Accordingly, effective interdisciplinary mathematics education does not simply combine learning content from different subjects; instead, it requires purposeful instructional design in which mathematics remains the central discipline and interdisciplinary contexts function as meaningful vehicles for developing mathematical understanding and competencies. This orientation is consistent with competency-based mathematics education, which emphasizes conceptual understanding, mathematical reasoning, problem solving, communication, and the application of mathematics to real-life situations (National Council of Teachers of Mathematics [NCTM], 2014).

Building upon this perspective, the present study conceptualizes interdisciplinary mathematics education as the pedagogical foundation for designing interdisciplinary learning situations in Grade 4 Number and Operations. These learning situations are expected to connect mathematical knowledge with authentic interdisciplinary contexts while preserving curriculum alignment and promoting students' mathematical competency development. Consequently, understanding the characteristics of interdisciplinary learning situations is essential for establishing an appropriate instructional framework, which is discussed in the following section.

2.2. *Interdisciplinary Learning Situations in Primary Mathematics*

Interdisciplinary learning situations in primary mathematics are structured instructional contexts in which students apply mathematical knowledge to investigate and solve meaningful problems that naturally connect mathematics with other learning domains. Unlike conventional mathematics exercises that primarily emphasize procedural practice, interdisciplinary learning

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situations encourage learners to explore authentic contexts, interpret information from multiple perspectives, communicate mathematical ideas, and justify their solutions through reasoning. These learning situations therefore provide opportunities for students to construct mathematical understanding while simultaneously recognizing the practical value of mathematics in everyday life.

Effective interdisciplinary learning situations should be carefully designed to ensure that mathematical learning objectives remain central throughout the instructional process. Authentic contexts and interdisciplinary connections are not intended to replace mathematical content but rather to support students in developing conceptual understanding through meaningful applications. Such learning situations should also be appropriate for students' cognitive characteristics, encourage active participation and collaboration, and create opportunities for learners to integrate prior knowledge when solving contextualized mathematical problems. Through these experiences, students become more capable of transferring mathematical knowledge across learning contexts while strengthening their problem-solving and reasoning competencies.

Within the context of the present study, interdisciplinary learning situations constitute the principal instructional component for teaching the Grade 4 Number and Operations strand. Their design is expected to connect curriculum requirements with authentic classroom practice while supporting competency-based mathematics learning. Consequently, a coherent analytical framework is required to explain the relationships among instructional needs, learning situation design, classroom implementation, and expected learning outcomes, which forms the focus of the following section (English, 2016).

2.3. Analytical Framework of the Study

Building upon the theoretical perspectives presented above, this study adopts a practice-oriented analytical framework that links educational needs, instructional design, classroom implementation, and expected learning outcomes. The framework assumes that the effective implementation of interdisciplinary mathematics education depends on a systematic process beginning with the identification of instructional needs in authentic school settings, followed by the design of interdisciplinary learning situations that align with curriculum requirements and students' cognitive characteristics. These learning situations are subsequently implemented through student-centred instructional activities that encourage active participation, mathematical reasoning, collaboration, and the application of mathematical knowledge to meaningful interdisciplinary contexts.

The analytical framework further assumes that well-designed interdisciplinary learning situations function as the central mechanism connecting curriculum expectations with classroom practice. Their educational value is determined not only by the quality of instructional design but also by their feasibility for teachers and their capacity to support meaningful mathematical learning under regular teaching conditions. Consequently, the framework emphasizes the reciprocal relationship between instructional design and classroom implementation, in which evidence collected from educational practice provides the basis for evaluating and refining the proposed instructional approach.

Based on this perspective, the present study is organized into three interconnected phases. The first phase investigates the current implementation of interdisciplinary mathematics teaching and identifies teachers' instructional needs in Grade 4 Number and Operations. The second phase develops a systematic framework for designing interdisciplinary mathematics learning situations grounded in both curriculum requirements and empirical evidence. The final phase synthesizes the proposed instructional framework and discusses its educational implications for competency-based primary mathematics education. This analytical framework provides the theoretical foundation for the research methodology and guides the research design, data collection, and analysis procedures presented in the following section (McKenney & Reeves, 2021).

3. METHODS

3.1. Research Design

This study employed a mixed-methods research design to investigate the current implementation of interdisciplinary mathematics teaching in the Grade 4 Number and Operations strand and to provide an empirical foundation for developing interdisciplinary mathematics learning situations suitable for Vietnamese primary schools. The quantitative component focused on describing teachers' and students' perceptions of interdisciplinary mathematics education through structured questionnaires, while the qualitative component complemented these findings by exploring classroom practices, teachers' experiences, and instructional challenges through interviews and classroom observations. Integrating quantitative and qualitative evidence enabled the study to obtain a comprehensive understanding of the current educational context and to identify practical issues influencing the implementation of interdisciplinary mathematics teaching. This research design was considered appropriate because it allowed the triangulation of multiple data sources, thereby enhancing the credibility of the findings and providing a reliable basis for proposing pedagogically feasible learning situations aligned with curriculum requirements and authentic classroom conditions. Such an approach is widely recommended for educational research seeking to combine descriptive evidence with contextual interpretation (Creswell & Creswell, 2018).

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3.2. Participants and Research Context

The study was conducted in two public primary schools in Hai Phong City, Vietnam, where Grade 4 mathematics is taught in accordance with the 2018 Vietnamese General Education Curriculum. The research involved 20 Grade 4 teachers and 60 Grade 4 students who participated in the baseline investigation. The participating teachers provided information regarding their perceptions, instructional practices, and challenges related to interdisciplinary mathematics teaching, while the students contributed evidence concerning their learning experiences and engagement with interdisciplinary mathematics activities. The selected schools represented typical public primary education settings with comparable instructional conditions, allowing the study to capture authentic classroom practices within the Grade 4 Number and Operations strand. The research context was considered appropriate because it reflected the educational environment in which interdisciplinary mathematics learning situations are expected to be implemented under routine teaching conditions. Consequently, the collected evidence provided a reliable empirical basis for identifying instructional needs and informing the subsequent development of interdisciplinary mathematics learning situations suitable for Vietnamese primary schools (Shadish et al., 2002).

3.3. Development of Interdisciplinary Mathematics Learning Situations

Following the baseline investigation, interdisciplinary mathematics learning situations were developed to address the instructional needs identified in Grade 4 mathematics teaching. The development process was guided by the objectives of the Vietnamese General Education Curriculum, particularly the Number and Operations strand, while considering teachers' instructional practices, students' learning characteristics, and authentic situations relevant to primary education. The proposed learning situations were designed to maintain mathematics as the core discipline while incorporating interdisciplinary contexts that support meaningful learning and the application of mathematical knowledge in everyday situations. Throughout the development process, emphasis was placed on curriculum alignment, cognitive appropriateness, instructional feasibility, and opportunities for students to engage actively in mathematical reasoning and problem solving. Rather than introducing additional curriculum content, the learning situations were intended to enrich existing mathematics lessons by connecting mathematical concepts with authentic interdisciplinary experiences. This systematic development process provided the pedagogical foundation for the instructional framework proposed in the present study and ensured that the learning situations were theoretically grounded while remaining practical for implementation in Vietnamese primary classrooms (Plomp & Nieveen, 2013).

3.4. Instruments and Data Collection

Data were collected using multiple complementary instruments to ensure a comprehensive understanding of the current implementation of interdisciplinary mathematics teaching in Grade 4. Structured questionnaires were administered to teachers and students to obtain quantitative information regarding perceptions, classroom practices, learning experiences, and challenges associated with interdisciplinary mathematics education. Semi-structured interviews with selected teachers provided additional qualitative evidence concerning instructional difficulties, professional needs, and recommendations for improving interdisciplinary teaching practices. Classroom observations were conducted to document the organization of learning activities, students' participation, and the ways in which interdisciplinary elements were incorporated into mathematics lessons under authentic teaching conditions. The combination of these instruments enabled the study to examine the research problem from multiple perspectives while enhancing the credibility of the collected evidence through methodological triangulation. Data collection was conducted systematically throughout the baseline investigation and generated the empirical evidence required for developing interdisciplinary mathematics learning situations appropriate for the Grade 4 Number and Operations strand in Vietnamese primary schools (Johnson & Onwuegbuzie, 2004).

3.5. Data Analysis

The collected data were analyzed using both quantitative and qualitative approaches to provide a comprehensive understanding of the current implementation of interdisciplinary mathematics teaching in Grade 4. Quantitative data obtained from the questionnaires were coded, organized, and summarized using descriptive statistical techniques, including frequencies, percentages, and mean scores, to identify patterns in teachers' perceptions, classroom practices, implementation challenges, and students' learning experiences. Qualitative data derived from interviews and classroom observations were analyzed through thematic analysis to identify recurring themes and explain the quantitative findings within their educational context. The integration of quantitative and qualitative evidence enabled the study to interpret the current situation from multiple perspectives while increasing the credibility and trustworthiness of the findings. The analytical results were subsequently synthesized to identify instructional needs and provide an empirical basis for developing interdisciplinary mathematics learning situations appropriate for the Grade 4 Number and Operations strand in Vietnamese primary schools. This analytical strategy is consistent with established mixed-methods research procedures that emphasize the complementary use of descriptive statistics and qualitative interpretation in educational research (Tashakkori & Teddlie, 2010).

4. RESULTS

4.1. Teachers' Perceptions of Interdisciplinary Mathematics Education

Table 1. Teachers' Perceptions of Interdisciplinary Mathematics Education (N = 20)	Important (%)	Less important (%)	Not important (%)
Applying knowledge to solve real-life problems	80	15	5
Increasing students' interest and attention	90	5	5
Reducing learning load through integration	85	10	5
Strengthening connections among subjects	80	15	5
Developing students' competencies	90	5	5

Table 1 presents teachers' perceptions of interdisciplinary mathematics education in Grade 4. The findings indicate that teachers generally held positive views regarding the educational value of interdisciplinary teaching. The highest levels of agreement were reported for increasing students' learning interest and attention and supporting the development of students' competencies, with 90% of teachers identifying these aspects as important. Furthermore, 85% considered interdisciplinary teaching an effective approach for reducing learning load by integrating educational content into mathematics lessons. In addition, 80% believed that interdisciplinary teaching helps students apply mathematical knowledge to real-life situations and strengthens connections among school subjects. Although the overall responses were positive, a small proportion of teachers still regarded several aspects as less important or not important, indicating differences in teachers' understanding and readiness to implement interdisciplinary mathematics teaching. These findings suggest that teachers generally acknowledge the educational potential of interdisciplinary mathematics education; however, further professional support is required to strengthen consistent implementation in classroom practice. This pattern is consistent with previous research showing that teachers commonly recognize the value of interdisciplinary mathematics education while requiring stronger pedagogical support for effective implementation (Goos et al., 2023).

4.2. Current Classroom Implementation of Interdisciplinary Mathematics Teaching

Table 2. Current Classroom Implementation of Interdisciplinary Mathematics Teaching (N = 20)

Practice	Frequently (%)	Occasionally (%)	Never (%)
Using interdisciplinary situations in mathematics textbooks	15	60	25
Connecting mathematics with other subjects	45	45	10
Designing authentic interdisciplinary learning situations	20	55	25
Organising interdisciplinary learning tasks	20	50	30
Organising collaborative group activities	60	30	10
Designing application activities	25	55	20

Table 2 summarises teachers' current classroom implementation of interdisciplinary mathematics teaching in Grade 4. The findings indicate that interdisciplinary practices have been introduced into mathematics instruction; however, their implementation remains inconsistent across different instructional activities. The practice reported most frequently was organising collaborative group activities, with 60% of teachers indicating that they regularly encouraged students to discuss and solve learning tasks together. Similarly, 45% of teachers frequently connected mathematical knowledge with other school subjects, suggesting an initial effort to promote interdisciplinary learning. In contrast, practices that require more advanced instructional design were implemented less regularly. Only 15% of teachers frequently exploited interdisciplinary situations available in mathematics textbooks, while merely 20% regularly designed authentic interdisciplinary learning situations or organised interdisciplinary learning tasks. These findings demonstrate that teachers tend to adopt relatively accessible forms of interdisciplinary teaching, whereas activities involving the systematic design of interdisciplinary learning situations remain limited. The results highlight the need for a structured pedagogical framework that supports teachers in designing and implementing interdisciplinary mathematics learning situations more effectively. This finding is consistent with previous research indicating that teachers often recognise the importance of interdisciplinary instruction but require practical design guidance to implement it consistently in classroom practice (Drake & Reid, 2020).

4.3. Challenges in Implementing Interdisciplinary Mathematics Teaching

Table 3. Teachers' Challenges in Implementing Interdisciplinary Mathematics Teaching (N = 20)

Challenge	Agree (%)	Uncertain (%)	Disagree (%)	Mean
Lack of knowledge of the design process	80	15	5	2.75
Difficulty identifying appropriate integrated content	70	20	10	2.60
Difficulty using textbook situations	65	25	10	2.55
Difficulty designing authentic interdisciplinary situations	85	10	5	2.80
Lack of instructional resources	75	15	10	2.65
Insufficient preparation time	65	25	10	2.55
Students' participation difficulties	55	35	10	2.45
Difficulty assessing learning outcomes	60	30	10	2.50

Table 3 presents the major challenges reported by teachers when implementing interdisciplinary mathematics teaching in Grade 4. The results reveal that teachers experienced considerable difficulties in designing and organizing interdisciplinary learning situations despite recognising their educational value. The highest-rated challenge was designing authentic interdisciplinary learning situations ($M = 2.80$), with 85% of teachers agreeing that this was a major obstacle. The second highest challenge concerned insufficient understanding of the instructional design process ($M = 2.75$; 80% agreement). Teachers also reported limited instructional resources ($M = 2.65$) and difficulties in identifying appropriate content for integration ($M = 2.60$). Additional barriers included using textbook situations effectively, limited preparation time, assessing students' learning outcomes, and supporting students during interdisciplinary activities. Although students' participation received the lowest mean score ($M = 2.45$), more than half of the teachers still considered it a challenge. Overall, the findings indicate that the principal barriers are associated with teachers' instructional design capacity rather than their awareness of interdisciplinary education. These findings support previous research suggesting that successful interdisciplinary mathematics teaching depends on sustained professional learning and practical pedagogical support for teachers (English, 2016).

4.4. Students' Learning Experiences in Interdisciplinary Mathematics Lessons

Table 4. Students' Learning Experiences in Interdisciplinary Mathematics Lessons (N = 60)

Statement	Agree (%)	Uncertain (%)	Disagree (%)	Mean
Interested in mathematics lessons connected with real life	65.0	28.3	6.7	2.58
Enjoy mathematics linked with other subjects	61.7	28.3	10.0	2.52
Actively participate in mathematics activities	60.0	30.0	10.0	2.50
Confident to express ideas	50.0	36.7	13.3	2.37
Actively discuss with classmates	58.3	31.7	10.0	2.48
Enjoy collaborative group activities	71.7	21.6	6.7	2.65
Enjoy authentic mathematical problems	65.0	26.7	8.3	2.57
Interested in interdisciplinary learning tasks	58.3	31.7	10.0	2.48
Understand mathematics better through authentic situations	63.3	28.3	8.3	2.55
Wish to participate in more such lessons	73.3	20.0	6.7	2.67

Table 4 summarises students' learning experiences in interdisciplinary mathematics lessons. The findings indicate that students generally responded positively to mathematics lessons incorporating interdisciplinary and authentic learning contexts. The strongest agreement was observed for students' willingness to participate in more interdisciplinary mathematics lessons (73.3%, $M = 2.67$), followed by their preference for collaborative group activities (71.7%, $M = 2.65$). Approximately two-thirds of the students reported greater interest in mathematics lessons connected with real-life situations (65.0%) and authentic mathematical problems (65.0%), while 63.3% indicated that authentic situations helped them understand mathematical concepts more effectively. More than half of the participants also expressed positive attitudes toward interdisciplinary mathematics tasks, active participation, and classroom discussion. Nevertheless, students showed relatively lower confidence in expressing their ideas during lessons ($M = 2.37$),

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suggesting that opportunities for mathematical communication should be further strengthened. Overall, the findings demonstrate that interdisciplinary learning situations created positive learning experiences and encouraged active engagement among Grade 4 students. These findings are consistent with previous research indicating that authentic interdisciplinary learning environments enhance students' motivation, participation, and meaningful mathematical learning (Furner & Kumar, 2007).

5. DISCUSSION.

5.1. Teachers' Positive Perceptions of Interdisciplinary Mathematics Education

The findings of this study indicate that primary school teachers generally hold positive perceptions of interdisciplinary mathematics education and recognize its potential to enhance students' learning experiences and competency development. Rather than viewing interdisciplinary teaching as an additional instructional requirement, most teachers considered it an effective pedagogical approach for connecting mathematical knowledge with authentic contexts, increasing students' learning motivation, and fostering the development of essential competencies. These findings suggest that teachers have largely accepted the educational philosophy underpinning competency-based curriculum reform, particularly the expectation that mathematics learning should extend beyond procedural knowledge and support students' ability to apply mathematical thinking in meaningful situations.

However, positive perceptions alone do not necessarily ensure successful classroom implementation. Teachers' recognition of the educational value of interdisciplinary mathematics education represents an important prerequisite for instructional innovation, but this recognition needs to be accompanied by sufficient professional knowledge, curriculum understanding, and instructional design competence. The present findings therefore imply that teachers' attitudes constitute a favourable foundation for educational change, while their capacity to transform these beliefs into effective classroom practice remains an important area for professional development.

These findings are consistent with the study by Sánchez-Mendías et al. (2024), which reported that teachers' positive attitudes toward mathematics education are closely associated with instructional quality and highlighted the importance of strengthening teachers' professional competence through continuous training. Likewise, the study by Broza et al. (2025) found that both in-service and pre-service teachers expressed favourable perceptions of interdisciplinary mathematics instruction and acknowledged its potential to increase students' engagement, creativity, and meaningful learning. At the same time, the authors emphasized that successful interdisciplinary teaching depends on adequate instructional support, collaborative planning, and access to appropriate professional learning opportunities. Together, these studies reinforce the present findings by suggesting that positive teacher perceptions provide an essential starting point for interdisciplinary mathematics education, but sustainable implementation requires systematic professional support that enables teachers to design and facilitate high-quality interdisciplinary learning experiences.

5.2. The Gap Between Teachers' Perceptions and Classroom Practice

Although teachers in the present study expressed positive perceptions of interdisciplinary mathematics education, the findings revealed a noticeable gap between their pedagogical beliefs and their actual classroom practices. While teachers generally acknowledged the educational value of interdisciplinary teaching, classroom implementation remained limited to relatively accessible instructional activities, such as making connections between mathematics and other subjects or organizing collaborative group work. In contrast, instructional practices requiring more sophisticated pedagogical competence—particularly designing authentic interdisciplinary learning situations and organizing interdisciplinary problem-solving activities—were implemented much less consistently. This discrepancy suggests that teachers' positive attitudes alone are insufficient to bring about meaningful changes in classroom practice. Instead, successful implementation depends on teachers' ability to translate educational beliefs into well-designed learning experiences that align with curriculum objectives and students' learning needs.

The gap identified in this study may also reflect the complexity of interdisciplinary mathematics teaching in primary education. Designing meaningful interdisciplinary learning situations requires teachers to integrate curriculum content across different subjects while maintaining the integrity of mathematical concepts and ensuring that learning activities remain cognitively appropriate for primary school students. Such instructional demands extend beyond general pedagogical knowledge and require teachers to possess curriculum integration competence, instructional design skills, and practical teaching experience. Consequently, even teachers who strongly support interdisciplinary education may encounter considerable challenges when attempting to implement it effectively in everyday classroom practice.

These findings are consistent with the study by Broza et al. (2025), which reported that although both pre-service and in-service teachers demonstrated favourable attitudes toward interdisciplinary instruction, many experienced uncertainty when translating interdisciplinary principles into classroom practice because of limited instructional experience and insufficient opportunities for collaborative lesson planning. Similarly, Sánchez-Mendías et al. (2024) emphasized that teachers' instructional competence plays a more decisive role than positive attitudes alone in determining the quality of mathematics teaching. Their findings indicate that continuous professional learning, curriculum-oriented training, and sustained instructional support are essential for enabling teachers to transform positive educational beliefs into effective classroom practices. Taken together, these studies support the present findings

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by highlighting that bridging the gap between teachers' perceptions and classroom implementation requires systematic professional development, practical instructional resources, and institutional support capable of strengthening teachers' competence in designing and facilitating interdisciplinary mathematics learning.

5.3. Challenges in Designing Interdisciplinary Mathematics Learning Situations

The findings of this study suggest that the greatest challenge faced by teachers is not their willingness to adopt interdisciplinary mathematics education but their capacity to design meaningful interdisciplinary learning situations that are pedagogically effective and practically feasible. Developing interdisciplinary learning situations requires teachers to integrate mathematical concepts with authentic contexts while maintaining curriculum coherence, aligning learning objectives, and ensuring that learning activities remain appropriate for students' cognitive development. Such instructional design demands considerably more than subject knowledge alone; it requires teachers to make informed pedagogical decisions regarding content integration, task sequencing, classroom interaction, and assessment. Consequently, teachers may recognise the educational value of interdisciplinary instruction yet still experience considerable difficulty when attempting to design learning situations suitable for regular classroom practice.

Another important issue emerging from the present study is the lack of systematic instructional guidance to support teachers throughout the design process. In many cases, teachers relied primarily on textbook examples or personal teaching experience rather than a structured design framework. As a result, interdisciplinary activities often remained at the level of simple content connections instead of developing authentic learning situations that promote mathematical reasoning, problem solving, and knowledge transfer. These findings indicate that improving interdisciplinary mathematics education requires more than encouraging teachers to adopt innovative instructional approaches; it also requires providing them with practical design models, curriculum-aligned instructional resources, and sustained professional learning opportunities.

The present findings are consistent with Plomp and Nieveen (2013), who argued that effective educational innovation should be supported by systematic design principles developed through iterative analysis, design, implementation, and refinement. Likewise, McKenney and Reeves (2021) emphasized that educational design research serves as an effective approach for addressing authentic classroom problems because it integrates theoretical knowledge with practical instructional design. Their work highlights that successful educational innovations depend on the continuous refinement of instructional designs based on evidence from classroom practice. This perspective reinforces the present study by supporting the development of a structured framework for designing interdisciplinary mathematics learning situations that is both theoretically grounded and practically applicable within Vietnamese primary schools.

5.4. Educational Implications

The findings of the present study have several important implications for improving interdisciplinary mathematics education in Vietnamese primary schools. First, the positive attitudes demonstrated by teachers indicate that favourable conditions already exist for promoting interdisciplinary instruction. However, the findings also suggest that educational reform should extend beyond encouraging teachers to adopt innovative teaching approaches. Greater attention should be directed toward strengthening teachers' professional competence in designing interdisciplinary mathematics learning situations that effectively integrate curriculum content with authentic learning contexts. Systematic professional development programmes should therefore focus on instructional design, curriculum integration, classroom implementation, and assessment strategies that are appropriate for primary mathematics education.

Second, the proposed framework for designing interdisciplinary mathematics learning situations provides a practical pedagogical reference that can support teachers in translating curriculum expectations into meaningful classroom practice. Rather than introducing additional learning content, the framework demonstrates how existing mathematics lessons can be enriched through carefully designed interdisciplinary contexts that encourage mathematical reasoning, problem solving, collaboration, and knowledge transfer. Such an approach may contribute to narrowing the gap between curriculum policy and classroom implementation while supporting the broader goals of competency-based education.

Finally, the findings also highlight the importance of institutional support for sustainable educational innovation. Schools, curriculum developers, and teacher education institutions should collaborate to provide teachers with high-quality instructional resources, opportunities for collaborative lesson design, and continuous professional learning communities. These initiatives may strengthen teachers' confidence and instructional capacity while promoting the long-term implementation of interdisciplinary mathematics education.

These implications are consistent with Darling-Hammond et al. (2020), who emphasized that effective educational innovation requires learning environments that actively support students' cognitive, social, and emotional development through authentic and meaningful learning experiences. Similarly, the OECD Learning Compass 2030 (OECD, 2019) highlights the importance of designing learning experiences that enable students to integrate knowledge, develop key competencies, and apply learning in complex real-world situations. Together, these perspectives reinforce the present study by demonstrating that interdisciplinary

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mathematics learning situations represent a practical pathway for advancing competency-based mathematics education in Vietnamese primary schools.

6. CONCLUSION

This study investigated the current implementation of interdisciplinary mathematics teaching in the Grade 4 Number and Operations strand in Vietnamese primary schools and developed a pedagogically grounded framework for designing interdisciplinary mathematics learning situations. Using a mixed-methods approach, the study examined teachers' perceptions, classroom implementation, instructional challenges, and students' learning experiences to provide an evidence-based understanding of the current status of interdisciplinary mathematics education.

The findings reveal four major issues. First, teachers generally recognized the educational value of interdisciplinary mathematics education and expressed positive attitudes toward its contribution to competency-based learning. Second, despite these favourable perceptions, the implementation of interdisciplinary teaching in classroom practice remained inconsistent, with teachers tending to adopt relatively simple forms of interdisciplinary integration rather than systematically designing authentic interdisciplinary learning situations. Third, teachers encountered considerable challenges in designing, organizing, and assessing interdisciplinary learning activities, particularly because of limited instructional guidance and insufficient professional support. Finally, students demonstrated positive learning experiences in interdisciplinary mathematics lessons, indicating that authentic and context-based learning situations have considerable potential to enhance learning engagement, participation, and meaningful mathematical understanding. The principal contribution of this study lies in the development of a systematic framework for designing interdisciplinary mathematics learning situations for the Grade 4 Number and Operations strand. Unlike studies that primarily discuss the theoretical benefits of interdisciplinary education, the present study integrates empirical evidence from Vietnamese primary schools with curriculum requirements to propose a practical instructional framework that can support teachers in designing interdisciplinary mathematics lessons. Consequently, the study contributes both context-specific evidence from Vietnam and practical pedagogical guidance for competency-based primary mathematics education.

The findings also have important implications for educational practice. Teacher education institutions, school leaders, and curriculum developers should strengthen professional development programmes that focus on interdisciplinary instructional design, curriculum integration, and authentic mathematics learning. In addition, greater collaboration among teachers should be encouraged to facilitate the sharing of interdisciplinary teaching experiences and instructional resources. Such initiatives may contribute to narrowing the gap between curriculum expectations and classroom practice while promoting sustainable implementation of interdisciplinary mathematics education.

Several limitations should be acknowledged. The study was conducted in only two public primary schools with a relatively small sample of teachers and students, which may limit the generalizability of the findings. Furthermore, the study focused exclusively on the Grade 4 Number and Operations strand and did not evaluate the long-term effectiveness of the proposed interdisciplinary learning situations. Future research should therefore involve larger and more diverse samples across different educational contexts, examine additional mathematics content domains, and investigate the long-term impact of interdisciplinary mathematics learning situations on students' mathematical competencies and broader learning outcomes.

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