

Orienting the Development of Integrated Teaching Competence for Pre-service Mathematics Teachers in Contemporary Teacher Education in Vietnam

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ABSTRACT:

This study examines the development of integrated teaching competence among pre-service mathematics teachers in Vietnam within the context of ongoing educational reform. A mixed-methods approach was employed, combining questionnaire surveys with 80 fourth-year students, interviews with lecturers and in-service teachers, and document analysis of teacher education curricula. The findings indicate that pre-service teachers demonstrate a moderate level of competence, with stronger performance in identifying interdisciplinary connections but limitations in lesson design, teaching strategies, and the use of digital tools. The results also reveal a gap between policy expectations and actual implementation, particularly due to fragmented curriculum design, limited practicum opportunities, and insufficient integration of interdisciplinary approaches. Based on these findings, the study proposes orientations for improving teacher education programs through a more systematic, practice-oriented, and context-sensitive approach aligned with the requirements of competency-based education in Vietnam.

Keywords: Integrated teaching, pre-service mathematics teachers, teacher education, competency development, Vietnam.

1. Introduction

In recent decades, educational systems worldwide have undergone significant transformations, shifting from content-based approaches to competency-based education. This transition emphasizes learners' ability to apply knowledge in real-life contexts rather than merely acquiring theoretical understanding. Within this paradigm, integrated teaching has emerged as a key pedagogical approach, enabling students to connect knowledge across disciplines, foster problem-solving skills, and respond effectively to complex societal

challenges (Gravemeijer et al., 2017). In mathematics education, integrated teaching is particularly important as it helps bridge abstract mathematical concepts with practical applications and interdisciplinary contexts such as science, technology, and engineering.

In Vietnam, the implementation of the General Education Program 2018 has marked a fundamental reform in teaching and learning practices. The new curriculum adopts a competency-based orientation and promotes interdisciplinary integration in teaching. Consequently, mathematics teachers are

expected not only to possess strong subject knowledge but also to demonstrate the ability to design and implement integrated learning activities, apply flexible pedagogical strategies, and effectively use digital technologies (Nguyen et al., 2020; Cuong et al., 2020; Cuong et al., 2025). These new requirements pose significant challenges for teacher education institutions in preparing pre-service mathematics teachers to meet the demands of contemporary education.

However, existing studies indicate that pre-service mathematics teachers in Vietnam still face notable limitations in developing integrated teaching competence. Although they often demonstrate adequate content knowledge, their pedagogical content knowledge and ability to design interdisciplinary lessons remain insufficient (Phan et al., 2021). Furthermore, integrated teaching approaches, including STEM-oriented education, have not yet been systematically embedded in teacher education programs, leading to a gap between training and practical teaching requirements (Le et al., 2015; Nguyen et al., 2021; Vuong et al., 2025). This situation highlights the need for a more structured and comprehensive approach to developing integrated teaching competence.

In addition, the rapid advancement of digital technologies and the growing emphasis on STEM education have further reinforced the importance of integration in teaching. Research shows that the integration of technology can significantly enhance teaching competence and support innovative instructional practices in mathematics education (Tondeur et al., 2017; Samantray et al., 2024). These developments require pre-service teachers to integrate not only disciplinary knowledge but also technological and pedagogical competencies into their teaching practices.

Despite increasing attention to integrated teaching and teacher competence in both international and Vietnamese contexts, there remains a lack of comprehensive studies proposing systematic orientations for developing integrated teaching competence for pre-service mathematics teachers. Most existing

research focuses on individual aspects such as technology integration or STEM education, rather than offering a holistic framework aligned with the specific conditions of teacher education in Vietnam.

Therefore, this study aims to propose orientations for developing integrated teaching competence for pre-service mathematics teachers in contemporary teacher education in Vietnam. Specifically, the study seeks to (1) analyze the current situation and challenges in developing integrated teaching competence, (2) identify key factors influencing competence development, and (3) propose a set of orientations and a conceptual framework to support teacher education institutions in improving training quality. The findings of this study are expected to contribute to both theoretical understanding and practical implementation of competency-based teacher education in the context of ongoing educational reform in Vietnam.

2. Literature Review

2.1. Concept of Integrated Teaching

Integrated teaching has been widely recognized as an effective pedagogical approach in contemporary education, particularly in competency-based curricula. It refers to the process of connecting knowledge, skills, and values across different subject areas to create meaningful learning experiences for students. Depending on the level of integration, this approach can be categorized into multidisciplinary, interdisciplinary, and transdisciplinary models (Gravemeijer et al., 2017). While multidisciplinary teaching maintains subject boundaries, interdisciplinary and transdisciplinary approaches emphasize deeper connections and real-world problem-solving.

In mathematics education, integrated teaching aims to bridge abstract mathematical concepts with practical applications in science, technology, engineering, and everyday life. This approach is closely associated with STEM education, which promotes the integration of

multiple disciplines to enhance students' problem-solving abilities and creativity (Le et al., 2015). Research has shown that integrated teaching can improve students' engagement, conceptual understanding, and ability to transfer knowledge across contexts (Galadima et al., 2019).

Furthermore, the integration of digital technologies has expanded the scope of integrated teaching. Technology-enhanced learning environments enable teachers to design interactive and interdisciplinary learning activities, thereby fostering deeper understanding and collaboration among learners (Drijvers, 2015). As a result, integrated teaching is increasingly considered a key component of modern educational practices.

2.2. Integrated Teaching Competence

Integrated teaching competence is a complex construct that encompasses the knowledge, skills, and attitudes required for teachers to design and implement integrated learning experiences effectively. It is grounded in the broader concept of teacher competence, which includes subject matter knowledge, pedagogical knowledge, and the ability to adapt teaching to diverse learning contexts (Santagata & Sandholtz, 2018).

Several frameworks have been proposed to conceptualize integrated teaching competence. One influential perspective is the Technological Pedagogical Content Knowledge (TPACK) framework, which emphasizes the integration of content knowledge, pedagogical knowledge, and technological knowledge in teaching (Tondeur et al., 2017). This framework highlights the importance of teachers' ability to combine multiple domains of knowledge to support effective teaching in technology-rich environments.

In the context of integrated teaching, competence can be structured into several key components: (1) interdisciplinary content knowledge, (2) pedagogical strategies for integration, (3) instructional design skills, (4) assessment competence, and (5) the ability to

use digital tools to support learning. Studies indicate that pre-service teachers often struggle with integrating these components, particularly in designing interdisciplinary lessons and applying appropriate teaching strategies (Samantray et al., 2024).

Moreover, integrated teaching competence is not developed solely through theoretical instruction but requires experiential learning, reflection, and continuous practice. Teacher education programs therefore play a crucial role in providing opportunities for pre-service teachers to develop and apply this competence in authentic teaching contexts.

2.3. Teacher Education and Competency Development

The development of teaching competence has become a central focus of teacher education worldwide. Competency-based teacher education emphasizes the alignment of learning outcomes, instructional processes, and assessment methods to ensure that pre-service teachers acquire the necessary competencies for professional practice (Loughran et al., 2016). This approach requires a shift from knowledge transmission to active learning, where pre-service teachers engage in problem-solving, collaboration, and reflective practice.

Research suggests that effective teacher education programs integrate theoretical knowledge with practical experiences, such as teaching practicum, micro-teaching, and school-based training. These experiences allow pre-service teachers to apply their knowledge in real classroom settings and develop their professional competence (Toom et al., 2015). In addition, the use of digital technologies and innovative teaching methods has been shown to enhance the development of teaching competence by providing diverse learning opportunities (Farjon et al., 2019).

Another important aspect of competency development is the role of reflective practice. Reflection enables pre-service teachers to critically evaluate their teaching and continuously improve their professional skills.

Studies indicate that structured reflection activities can significantly contribute to the development of pedagogical competence and professional identity (Toom et al., 2015).

However, developing integrated teaching competence requires more than general teaching competence. It involves the ability to connect multiple domains of knowledge and adapt teaching strategies to interdisciplinary contexts. Therefore, teacher education programs need to adopt comprehensive approaches that explicitly address the development of integrated teaching competence.

2.4. Context of Vietnam

In Vietnam, teacher education has been significantly influenced by recent educational reforms, particularly the implementation of the General Education Program 2018. This reform emphasizes competency-based learning and interdisciplinary integration, requiring teachers to adopt new teaching approaches that promote active learning and real-world application of knowledge.

Despite these reforms, several challenges remain in the preparation of pre-service mathematics teachers. Research indicates that while pre-service teachers in Vietnam generally possess strong content knowledge, they face difficulties in applying pedagogical knowledge and designing integrated lessons (Phan et al., 2021). Additionally, the integration of STEM education and digital technologies in teacher education programs is still limited and not systematically implemented (Nguyen et al., 2020; Nguyen et al., 2021).

Furthermore, there is a lack of coherence between university training and school practice, which affects the development of teaching competence. Opportunities for pre-service teachers to engage in integrated teaching during practicum are often insufficient, leading to a gap between theoretical knowledge and practical application. This issue highlights the need for stronger collaboration between universities and schools in teacher education.

Given these challenges, it is necessary to develop a systematic framework for enhancing integrated teaching competence among pre-service mathematics teachers in Vietnam. Such a framework should align with the requirements of educational reform while addressing the specific conditions of teacher education institutions.

3. Research Methodology

3.1. Research Design

This study adopts a mixed-methods approach in order to capture both the breadth and depth of integrated teaching competence among pre-service mathematics teachers. The combination of quantitative and qualitative methods is considered appropriate, as the research not only seeks to describe the current situation but also to understand the underlying factors influencing competence development.

The quantitative component focuses on identifying general patterns in students' self-assessment of their integrated teaching competence. Meanwhile, the qualitative component aims to provide more nuanced insights from lecturers and in-service teachers regarding the actual implementation of integrated teaching and the challenges encountered in practice. By combining these two strands of data, the study ensures a more comprehensive and balanced interpretation of the research problem.

3.2. Participants

The participants in this study were selected to reflect different perspectives within the teacher education system.

The first group consisted of ten lecturers who are currently teaching pedagogical courses related to mathematics teacher education. These lecturers were drawn from several institutions, including Thai Nguyen University of Education, Hanoi National University of Education, Hanoi Pedagogical University 2, and Tay Bac University. Their experience in designing and delivering pedagogical content provided valuable

insights into how integrated teaching is addressed in training programs.

The second group included eighty fourth-year students majoring in Mathematics Education at Thai Nguyen University of Education. These students had already completed most of their coursework and participated in teaching practicum, which enabled them to reflect on their own competence in organizing integrated teaching activities.

The third group comprised ten in-service mathematics teachers from selected high schools in Thai Nguyen province, namely Luong Ngoc Quyen High School, Thai Nguyen High School, and Ngo Quyen High School. These teachers had direct experience in supervising student teachers during practicum and were therefore able to comment on the practical readiness of pre-service teachers.

3.3. Data Collection Methods

Data were collected through three main methods: questionnaire survey, interviews, and document analysis.

The questionnaire was administered to pre-service teachers to gather information about their perceived competence in integrated teaching. The items were designed to cover several aspects, including the ability to connect mathematical knowledge with other disciplines, to design integrated lessons, and to use appropriate teaching strategies and digital tools.

In addition to the survey, semi-structured interviews were conducted with both lecturers and in-service teachers. Rather than using a fixed set of questions, the interviews allowed for flexibility so that participants could elaborate on their experiences and perspectives. This helped

to reveal issues that might not be fully captured through the questionnaire.

Document analysis was also carried out to examine relevant training materials and curriculum documents. This step provided contextual information about how integrated teaching is formally incorporated into teacher education programs.

3.4. Data Analysis

The quantitative data obtained from the questionnaires were processed using descriptive statistics. Mean scores and standard deviations were calculated to identify the general level of integrated teaching competence among pre-service teachers and to compare different aspects of competence.

For the qualitative data, a thematic analysis approach was employed. Interview transcripts were carefully reviewed and coded, with recurring ideas grouped into broader themes. These themes focused on key issues such as strengths and limitations in current training, factors affecting competence development, and suggested directions for improvement.

The findings from both quantitative and qualitative analyses were then compared and interpreted together.

4. Findings

4.1. Current Situation of Integrated Teaching Competence

The results from the questionnaire survey reveal that pre-service mathematics teachers demonstrate a moderate level of integrated teaching competence across different dimensions. Table 1 presents the descriptive statistics of the main components of integrated teaching competence.

Table 1. Descriptive statistics of integrated teaching competence (n = 80)

Components of competence	Mean	SD	Level
Identifying interdisciplinary connections	3.62	0.54	Fairly good
Designing integrated lesson plans	3.21	0.58	Average

Applying integrated teaching strategies	3.18	0.56	Average
Using digital tools in integrated teaching	3.05	0.60	Average
Assessing students in integrated learning contexts	3.12	0.57	Average
Overall competence	3.24	0.52	Average

The findings indicate that students are relatively confident in identifying interdisciplinary connections ($M = 3.62$), but show lower levels of competence in designing and implementing integrated teaching activities. In particular, the use of digital tools and assessment in integrated contexts remains limited.

To further interpret these results, interview data from lecturers and in-service teachers were analyzed. The qualitative findings reveal that the observed limitations are not due to a lack of awareness, but rather a lack of practical experience and structured training.

First, lecturers emphasized that integrated teaching is mainly introduced in pedagogical courses at a conceptual level. Students are able to explain the meaning of interdisciplinary integration; however, they are rarely required to design or implement integrated lessons in a systematic manner. As one lecturer noted: "Students understand the concept of integration, but when they are asked to design a lesson, they tend to return to traditional subject-based approaches."

Second, interviews indicate that opportunities for practice are limited. Activities such as micro-teaching and coursework assignments do not consistently require interdisciplinary lesson

design. As a result, students lack the procedural knowledge necessary for applying integrated teaching in real contexts.

Third, in-service teachers confirmed these findings through observations during practicum. They reported that pre-service teachers often focus on delivering mathematical content rather than integrating it with other disciplines or real-life situations. One teacher stated: "They can teach mathematics clearly, but when asked to connect it with physics or real-life contexts, they become hesitant or oversimplify the lesson."

Additionally, teachers noted that students show low confidence in using digital tools within integrated teaching, which corresponds with the lowest mean score in Table 1 ($M = 3.05$).

Overall, the combined evidence from survey and interviews indicates that pre-service teachers possess conceptual awareness but limited practical competence, highlighting a significant gap in current training.

4.2. Factors Affecting Competence Development

The combination of survey data and qualitative findings identifies several key factors influencing the development of integrated teaching competence.

Table 2. Factors affecting integrated teaching competence

Factors	Mean	SD	Level
Curriculum design	3.15	0.55	Average
Teaching methods	3.09	0.58	Average
Practicum experience	3.02	0.60	Average
Institutional support	3.11	0.57	Average
Overall	3.09	0.56	Average

Among these factors, practicum experience received the lowest mean score ($M = 3.02$), indicating that students have limited opportunities to apply integrated teaching in real classroom settings.

Interview data provide further clarification of these results.

Regarding curriculum design, lecturers pointed out that integrated teaching is not systematically embedded across courses. Instead, it is introduced in isolated modules, leading to fragmented learning experiences for students.

Regarding teaching methods, both lecturers and students highlighted the continued dominance of lecture-based instruction. This limits opportunities for active learning, collaborative design, and experimentation with integrated teaching approaches.

Regarding practicum experience, in-service teachers emphasized that school contexts often prioritize curriculum completion, leaving little room for student teachers to implement integrated lessons. As a result, practicum does not fully support the development of integrated teaching competence.

Regarding institutional support, participants noted limited coordination between universities and schools. There is no structured mechanism to guide or evaluate integrated teaching during practicum, which reduces the effectiveness of training.

4.3. Insights from Document Analysis

The document analysis of teacher education curricula, course syllabi, and training materials provides additional evidence to support the findings.

The analysis shows that integrated teaching is formally acknowledged but not systematically operationalized in training programs.

Specifically:

Integrated teaching is mentioned in course descriptions, but there is no clear framework defining its structure or progression.

Learning outcomes related to integration are often general and lack measurable indicators.

Course content focuses primarily on subject-specific pedagogy, with limited emphasis on interdisciplinary design.

Assessment criteria do not explicitly evaluate integrated teaching competence.

Furthermore, practicum guidelines do not include specific requirements for implementing integrated teaching. This confirms the gap identified in both survey and interview data.

Overall, document analysis highlights a lack of coherence between policy intentions and actual implementation. While integrated teaching is promoted at the policy level, it has not yet been effectively translated into structured training practices.

5. Discussion

The findings of this study provide important insights into the development of integrated teaching competence among pre-service mathematics teachers, particularly within the context of educational reform in Vietnam. Overall, the results reveal a consistent pattern: while pre-service teachers demonstrate a relatively solid conceptual understanding of integrated teaching, their ability to implement such approaches in practice remains limited.

From a theoretical perspective, the moderate level of competence ($M = 3.24$) reflects a partial alignment with competency-based education, which has been increasingly emphasized in Vietnam following the implementation of the General Education Program 2018. This reform promotes interdisciplinary integration and requires teachers to move beyond traditional content transmission toward competency-oriented teaching. However, the findings suggest that this shift has not yet been fully realized in teacher education programs. Pre-service teachers are able to recognize interdisciplinary connections, but they lack the pedagogical and practical skills needed to design and implement integrated lessons effectively.

This gap between theory and practice can be understood in relation to the current structure of teacher education in Vietnam. Although integrated teaching is introduced in pedagogical courses, it is often presented at a conceptual level without sufficient opportunities for practical application. This situation reflects a broader challenge in Vietnamese education, where reforms at the policy level are not always consistently translated into classroom practice. As indicated by the interview data, pre-service teachers tend to revert to traditional subject-based teaching approaches, especially when they lack experience and support.

Furthermore, the findings highlight the critical role of practicum in developing integrated teaching competence. In the Vietnamese context, practicum is often constrained by rigid curricula, time pressure, and an emphasis on completing prescribed content. These conditions limit opportunities for pre-service teachers to experiment with interdisciplinary teaching approaches. As a result, practicum does not fully function as a space for innovation and professional growth, but rather as a setting for reinforcing conventional teaching practices.

Another important issue identified in this study is the lack of coherence in curriculum design within teacher education institutions in Vietnam. Integrated teaching is not systematically embedded across courses, leading to fragmented learning experiences. This finding is consistent with previous studies in Vietnam, which point to the limited integration of STEM education and digital technologies in teacher training programs. The absence of clear learning outcomes and assessment criteria related to integrated teaching further weakens the effectiveness of competency development.

In addition, the limited use of digital tools in integrated teaching reflects ongoing challenges in digital transformation within Vietnamese education. Although digital technologies are increasingly available, their pedagogical integration remains insufficient. Pre-service teachers often lack both the confidence and the competence to use technology as a tool for

interdisciplinary learning. This issue highlights the need to strengthen the integration of technological, pedagogical, and content knowledge in teacher education programs.

The results from document analysis further confirm that there is a mismatch between policy intentions and actual implementation. While national educational policies strongly emphasize integrated and competency-based teaching, these orientations have not been fully operationalized in training curricula. This lack of alignment reduces the effectiveness of reforms and creates difficulties for pre-service teachers in developing the required competencies.

Overall, the findings suggest that the development of integrated teaching competence in Vietnam requires a more systematic and practice-oriented approach. It is not sufficient to introduce theoretical concepts; teacher education programs must provide structured opportunities for practice, reflection, and application in authentic contexts. Moreover, stronger collaboration between universities and schools is essential to ensure that training aligns with real classroom conditions.

In this sense, the Vietnamese context highlights a key challenge for many education systems undergoing reform: the need to bridge the gap between policy, training, and practice. Addressing this challenge is crucial for improving the quality of teacher education and for ensuring the successful implementation of integrated and competency-based teaching in schools.

6. Conclusion

This study investigated the development of integrated teaching competence among pre-service mathematics teachers in Vietnam using a mixed-methods approach that combined questionnaire surveys, interviews, and document analysis. The findings reveal that while pre-service teachers demonstrate a moderate level of competence and possess a clear conceptual understanding of interdisciplinary integration, their ability to design and implement integrated teaching activities remains limited.

The study identifies several key challenges. First, there is a significant gap between theoretical knowledge and practical application, particularly in lesson design, teaching strategies, and the use of digital tools. Second, practicum experiences are not sufficiently structured to support the development of integrated teaching competence, limiting opportunities for experimentation and innovation. Third, teacher education programs lack coherence in integrating interdisciplinary approaches, as reflected in fragmented curriculum design, traditional teaching methods, and unclear assessment criteria.

Furthermore, the study highlights a mismatch between policy expectations and actual implementation. Although integrated teaching is strongly emphasized in Vietnam's educational reforms, it has not been systematically operationalized in teacher education programs. This lack of alignment reduces the effectiveness of training and creates difficulties for pre-service teachers in developing the competencies required for contemporary teaching.

Based on these findings, the study suggests several implications for improving teacher education in Vietnam. It is necessary to redesign curricula to embed integrated teaching systematically, enhance practicum experiences with a focus on interdisciplinary practice, and promote active and experiential learning approaches. In addition, stronger collaboration between universities and schools should be established to ensure that training reflects real classroom contexts. The integration of digital technologies should also be strengthened to support innovative and flexible teaching practices.

Despite its contributions, this study has some limitations. The sample size is relatively limited and focuses on a specific institutional context, which may affect the generalizability of the findings. Future research should expand the scope of participants and examine the effectiveness of specific intervention models for developing integrated teaching competence.

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