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TEACHING FRACTIONS FOR COMPETENCY DEVELOPMENT IN THE CONTEXT OF VIETNAM'S 2018 PRIMARY CURRICULUM

Duong Lam Thuy[1] and Uyen Nguyen Tu[2]

[1]Thai Nguyen University of Education, Faculty of Primary Education, Vietnam
duonglt@tnue.edu.vn
[2]Doi Can Primary School, Thai Nguyen, Vietnam
nguyentuuyen251220@gmail.com

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ABSTRACT

This study investigates the teaching of fractions in primary education within the framework of Vietnam's 2018 General Education Curriculum, which emphasizes competency development as a central goal. Fractions are recognized as one of the most challenging yet fundamental mathematical concepts for primary students, requiring not only procedural fluency but also problem-solving competence and the ability to apply knowledge in real-life contexts. The research employed a mixed-methods approach, combining classroom observations, student surveys, and pedagogical interventions with Grade 4 and 5 students in several primary schools in Thai Nguyen province. Findings reveal three major areas for competency-oriented fraction teaching: (1) strengthening basic fraction skills such as simplification, finding common denominators, and comparison; (2) improving students' proficiency in performing the four fraction operations (addition, subtraction, multiplication, and division); and (3) fostering the application of fraction knowledge to real-life problem-solving tasks. Classroom examples demonstrate that contextualized teaching, such as solving word problems involving sharing or measurement, not only enhanced computational accuracy but also promoted logical reasoning, perseverance, and student engagement. Overall, the results suggest that competency-based approaches to teaching fractions significantly improve both mathematical skills and broader competencies, aligning with the objectives of the 2018 Curriculum. The study provides practical implications for teachers and curriculum developers, highlighting the need to integrate real-world contexts and student-centered strategies into mathematics instruction at the primary level.

KEYWORDS: Fractions; Competency development; Problem-solving; Primary education; 2018 General Education Curriculum; Vietnam.

1. INTRODUCTION

Competency-oriented teaching and learning has become a central trend in global curriculum reform, emphasizing learners' ability to apply knowledge, solve problems, and adapt to real-life contexts. International frameworks highlight mathematical competence as a core twenty-first century skill

essential for academic success and lifelong learning (OECD, 2018; UNESCO, 2021). Within primary education, mathematics plays a foundational role in developing reasoning and problem-solving abilities.

Fractions are among the mathematical topics that are both fundamental and complex in primary education. They are introduced into the curriculum after students have learned whole numbers and serve as the foundation for acquiring subsequent knowledge of ratios and percentages. Because of this position, fractions are regarded as an important "bridge" in the primary mathematics curriculum, linking whole numbers with new types of numbers such as ratios, decimals, and percentages, while preparing students for more advanced mathematical concepts (Lamon, 2012; Siegler, Fazio, Bailey, & Zhou, 2013). However, fractions are also one of the most challenging topics for students, often leading to misconceptions in mathematical learning at higher levels.

In Vietnam, the 2018 General Education Curriculum (GEC) marked a significant shift from content-based instruction to competency-oriented teaching. Primary mathematics is expected not only to ensure computational fluency but also to nurture reasoning, communication, and problem-solving skills (Ministry of Education and Training [MOET], 2018). Despite this shift, evidence shows that students continue to face challenges in fraction learning, particularly in simplification, finding common denominators, performing operations, and applying knowledge in real-life contexts (Nguyen & Luong, 2022; Tho, 2022).

International studies suggest that strategies such as visual models, contextualized learning, and problem-solving approaches can improve students' understanding of fractions (Polya, 2004; Cai & Wang, 2021). Yet, empirical research in Vietnam remains limited, especially in examining classroom-level strategies that align fraction teaching with the competency-development goals of the 2018 GEC (London & Duong, 2023).

This study addresses this gap by investigating pedagogical strategies for teaching fractions to Grade 4 and 5 students in Vietnamese primary schools. It focuses on three dimensions: (1) strengthening basic fraction skills, (2) improving proficiency in operations, and (3) applying knowledge to real-life problem-solving. The findings provide empirical evidence for competency-oriented instruction and practical implications for teachers and policymakers to better align classroom practices with the goals of the 2018 curriculum.

2. LITERATURE REVIEW

2.1 Competency-oriented teaching and learning in global education

Competency-oriented teaching and learning has emerged as a dominant paradigm in global education reform, shifting emphasis from the acquisition of factual knowledge to the development of learners' competencies in applying knowledge, solving problems, and adapting to changing contexts. This approach reflects a broader vision of twenty-first century education in which success is measured not merely by what students know but by what they can do with what they know (OECD, 2018). In this framework, mathematics education is recognized as central, as it fosters reasoning, logical thinking,

and problem-solving abilities that are transferable to various domains of life and work (UNESCO, 2021).

International research has highlighted that competency-oriented education provides students with more sustainable skills compared to traditional content-based models. For example, Voogt and Roblin (2012) demonstrated that competency-based curricula equip learners with the flexibility needed in rapidly changing societies. Similarly, Darling-Hammond et al. (2020) argued that competency development, rather than rote knowledge, is key to preparing students for global citizenship and lifelong learning. These findings align with the notion that education systems must integrate core competencies - such as creativity, communication, and critical thinking into subject-specific learning, including mathematics.

In mathematics specifically, competency-oriented approaches emphasize not only procedural fluency but also conceptual understanding and the ability to apply knowledge in real-life problem-solving (Niss & Højgaard, 2019). This perspective underpins current curricular reforms across countries, framing mathematics learning as a means of developing broader educational competencies. Such an approach directly informs the teaching of complex yet fundamental topics such as fractions, where success requires both mastery of procedures and the ability to transfer knowledge to authentic contexts.

2.2. Fractions in primary mathematics education

Fractions occupy a central yet challenging position in primary mathematics curricula worldwide. They are introduced after students master whole numbers and provide the foundation for subsequent concepts such as ratios, decimals, and percentages. For this reason, fractions are often described as a "bridge" between basic arithmetic and proportional reasoning, preparing students for higher-order mathematical learning (Lamon, 2012; Siegler, Fazio, Bailey, & Zhou, 2013). Research consistently shows, however, that fractions are among the most difficult topics for learners, with difficulties spanning from conceptual misunderstandings to procedural errors.

One of the main challenges is that fractions represent multiple meanings - part-whole relationships, measures, operators, ratios, and quotients - which can confuse learners if not explicitly addressed (Charalambous & Pitta-Pantazi, 2007). Students often rely on whole-number reasoning, leading to systematic errors such as comparing fractions based on numerators or denominators alone. Studies have shown that these misconceptions can persist into later years and negatively affect learning of ratios, percentages, and algebra (Ni & Zhou, 2005).

International studies have emphasized the need for innovative instructional strategies to support fraction learning. Visual models, such as number lines and area representations, have been shown to improve conceptual understanding (Clarke & Roche, 2009). Similarly, contextualized problem-solving activities help students connect fractions to real-life situations, increasing both motivation and comprehension (Cai & Wang, 2021). These findings suggest that effective teaching of fractions requires a balance between procedural fluency and deep conceptual understanding, integrated with opportunities for application in authentic contexts.

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2.3. Competency-oriented approaches to teaching fractions

Competency-oriented teaching emphasizes not only the mastery of procedures but also the development of deeper mathematical competencies such as reasoning, communication, and problem-solving (Niss & Højgaard, 2019). Within this framework, fractions provide a rich context for fostering these competencies because they require students to integrate conceptual understanding with procedural fluency and apply knowledge to authentic situations.

One influential framework for competency-oriented mathematics education is Polya's (2004) problem-solving model, which encourages students to understand problems, devise strategies, carry out solutions, and reflect on outcomes. When applied to fractions, this approach helps learners move beyond rote procedures to strategic reasoning, supporting the development of perseverance and metacognitive skills (Lester, 2013). Similarly, Behr et al. (2017) highlighted that fractions can be taught effectively through problem-solving and modeling activities that link classroom learning to real-life applications, thereby enhancing students' transferable competencies.

Recent studies have also shown that competency-oriented fraction teaching benefits from student-centered practices such as collaborative learning, exploratory tasks, and multiple representations. For instance, McMullen et al. (2015) demonstrated that integrating visual models with group discussions significantly improved students' fraction reasoning. These approaches align with global calls for mathematics education to focus on both conceptual depth and the ability to use mathematics in flexible and meaningful ways (OECD, 2018).

Taken together, the literature suggests that competency-oriented approaches to teaching fractions emphasize problem-solving, real-world applications, and student-centered learning. Such approaches not only improve students' fraction proficiency but also foster broader educational competencies that are consistent with the objectives of twenty-first century education.

2.4. Vietnamese context: The 2018 General Education Curriculum

The introduction of the 2018 General Education Curriculum (GEC) in Vietnam marked a major reform, shifting from a content-based model to competency-oriented teaching and learning (MOET, 2018). This reform reflects Vietnam's commitment to aligning with international trends while addressing local needs for innovation in education (London & Duong, 2023). At the primary level, mathematics education is expected not only to build computational fluency but also to foster key competencies such as reasoning, communication, creativity, and problem-solving.

Fractions play an important role in this curriculum sequence. They are introduced in Grade 4 and extended in Grade 5, serving as a basis for the subsequent study of ratios, decimals, and percentages. However, studies have indicated that Vietnamese students continue to struggle with fractions despite curriculum innovations. Common challenges include conceptual misunderstandings, over-reliance on whole-number reasoning, and difficulties in transferring knowledge to authentic contexts (Nguyen & Luong, 2022; Tho, 2022). These findings suggest that while the 2018 GEC provides a competency-oriented framework, its implementation in classroom practice requires more empirical support and teacher training.

Scholars have also noted that teachers face challenges in translating the competency-based framework into practical instructional strategies. A lack of teaching resources, traditional assessment methods, and limited professional development opportunities often hinder effective implementation (Nguyen & Huynh, 2024). This creates a pressing need for evidence-based research to provide models of competency-oriented fraction teaching that can guide teachers in everyday practice.

Thus, the Vietnamese context reveals both opportunities and challenges. On the one hand, the 2018 GEC establishes a strong policy foundation for competency-oriented mathematics teaching. On the other, gaps in classroom-level research and practice highlight the importance of studies like the present one, which aim to demonstrate how fractions can be taught effectively to develop competencies in line with curricular goals.

2.5 Research gap and rationale for the study

Although competency-oriented teaching has been widely discussed in global education reform, there is still a lack of empirical studies focusing specifically on how fractions can be taught to develop mathematical competencies. International research emphasizes the effectiveness of strategies such as visual models, problem-solving frameworks, and contextualized tasks (Polya, 2004; Clarke & Roche, 2009; Cai & Wang, 2021). However, most of these studies have been conducted in Western or East Asian contexts, where curricula and classroom practices differ significantly from those in Vietnam.

In the Vietnamese context, the 2018 General Education Curriculum (GEC) provides a strong policy foundation for competency-based learning (MOET, 2018). Yet, evidence shows that students continue to struggle with fractions (Nguyen & Luong, 2022; Tho, 2022), and teachers often lack practical strategies to implement the competency-oriented approach effectively (Nguyen & Huynh, 2024). To date, few studies have systematically examined classroom-level interventions in fraction teaching that directly align with the objectives of the 2018 GEC (London & Duong, 2023).

This study seeks to address these gaps by investigating pedagogical strategies for teaching fractions to Grade 4 and 5 students in Vietnamese primary schools. It focuses on three dimensions: (1) strengthening problem-solving skills with basic fractions, (2) improving proficiency in performing fraction operations, and (3) developing the ability to apply fraction knowledge in real-life problem-solving tasks. By addressing these dimensions, the study provides empirical evidence on how competency-oriented teaching can be implemented in practice. The findings are expected to contribute both to theory and to practice, offering guidance for teachers, curriculum developers, and policymakers in Vietnam as well as in comparable educational contexts.

3. METHODS

3.1 Research design

This study employed a quantitative research design with a quasi-experimental approach, combining pre-test and post-test measures to evaluate the effectiveness of competency-oriented teaching strategies for fractions. The design was chosen because it allows researchers to examine causal relationships between pedagogical interventions and student learning outcomes in authentic classroom contexts

(Creswell & Creswell, 2018). Specifically, the study focused on three dimensions of competency development: (1) problem-solving with basic fractions, (2) performing operations with fractions, and (3) applying fraction knowledge to real-life problem-solving tasks.

The quasi-experimental design was considered appropriate because complete randomization of participants was not feasible within the school setting. Instead, intact classes of Grade 4 and Grade 5 students were assigned to either experimental or comparison groups. This approach ensured ecological validity while still allowing for systematic comparison of outcomes across groups (Cohen, Manion, & Morrison, 2018). By adopting this design, the study sought to generate empirical evidence on how competency-oriented teaching can be implemented effectively in primary mathematics classrooms.

3.2 Participants

The study involved 140 Grade 4 and Grade 5 students and 10 classroom teachers from two public primary schools in northern Vietnam. Students were divided into an experimental group (n = 72), which received competency-oriented instruction in fractions, and a control group (n = 68), which continued with traditional teaching methods. The teachers (n = 10) participated in validating and implementing the instructional strategies, providing feedback on their feasibility.

To ensure equivalence between groups prior to the intervention, a pre-test was conducted. Results showed no statistically significant difference ($p > .05$), indicating that the two groups had comparable mathematical competence at the outset.

Table 1. Sample characteristics and pre-test scores

Group	Number (n)	Gender Distribution (Male/Female)	Age Range	Role in Study	Pre-test Mean (SD)
Experimental group	72	34/38	9–11	Learned with competency-oriented exercises	7.28 (1.21)
Control group	68	31/37	9–11	Learned with traditional methods	7.14 (1.18)
Mathematics teachers	10	4 / 6	28–45	Validated and implemented the exercise system	-

The pre-test results indicate that the experimental group ($M = 7.28$, $SD = 1.21$) and the control group ($M = 7.14$, $SD = 1.18$) achieved nearly equivalent scores prior to the intervention. The small difference in mean values ($\Delta = 0.14$) is not statistically significant ($p > .05$), suggesting that both groups had a comparable level of mathematical competence at the outset. Moreover, the similarity in standard

deviations (1.21 vs. 1.18) shows that the distribution of student performance was equally consistent across the two groups. This equivalence provides a reliable basis for comparing post-test results, ensuring that any subsequent differences in learning outcomes can be attributed to the instructional interventions rather than pre-existing disparities.

3.3 Instruments

Three main instruments were employed in this study: a diagnostic test, an instructional intervention, and teacher reflection reports. The diagnostic test (pre-test and post-test) was developed based on the 2018 General Education Curriculum for Grade 4 and Grade 5 mathematics, focusing on three dimensions: (1) problem-solving with basic fractions, (2) performing operations with fractions, and (3) applying fractions to real-life problem-solving tasks. The test items were validated by experts, and reliability was ensured through pilot testing with Cronbach's alpha > 0.80, indicating high internal consistency (Field, 2018).

The instructional intervention consisted of competency-oriented fraction exercises designed in line with Polya's problem-solving model (Polya, 2004). These exercises emphasized conceptual understanding, procedural fluency, and application in authentic contexts. Teachers implemented these tasks in experimental classes after attending an orientation session conducted by the research team.

Teacher reflection reports were also collected to capture pedagogical challenges and perceptions of feasibility. These qualitative data complemented the quantitative results, offering a holistic perspective on the effectiveness of competency-oriented instruction.

Table 2. Research instruments

Instrument	Purpose	Validation / Reliability
Diagnostic test (Pre/Post)	Measure students' competence in fractions across three domains	Expert validation; Cronbach's α > 0.80
Instructional intervention	Provide competency-oriented fraction exercises	Designed based on curriculum & Polya's model
Teacher reflection reports	Collect teacher feedback on implementation and feasibility	Triangulated with student outcomes

The diagnostic test achieved Cronbach's α > 0.80, indicating good internal consistency. This suggests that the items were highly correlated and reliably measured students' fraction competence.

3.4. Data collection and procedures

Data collection was conducted in three main stages over a 12-week period.

1. Pre-test stage: All participating students completed a diagnostic test on fractions to establish baseline competence. The pre-test results confirmed that there were no significant differences between the experimental and control groups ($p > .05$).
2. Intervention stage: The experimental group received competency-oriented instruction on fractions, including activities designed around Polya's problem-solving model and contextualized exercises. Meanwhile, the control group was taught fractions using conventional methods, focusing on procedural drills and textbook exercises. Teachers in the experimental classes were trained beforehand to implement the instructional strategies consistently.
3. Post-test stage: At the end of the intervention, both groups took the same diagnostic test as the pre-test. The results were compared to evaluate the effectiveness of competency-oriented instruction. In addition, teacher reflection reports were collected to provide qualitative insights into classroom practices and challenges.

This systematic procedure ensured that data were collected consistently and that any observed differences in outcomes could be attributed to the instructional approach.

3.5 Data analysis

Data were analyzed using both descriptive and inferential statistics. First, descriptive statistics, including means and standard deviations, were calculated to summarize students' performance in the pre-test and post-test. This provided an overview of the distribution of scores across experimental and control groups.

Second, paired-sample t-tests were employed to examine within-group differences between pre-test and post-test scores. Independent-sample t-tests were then conducted to compare mean differences between the experimental and control groups. In addition, analysis of variance (ANOVA) was used to confirm group differences while controlling for possible confounding factors. Effect sizes (Cohen's d) were also calculated to determine the magnitude of differences (Field, 2018).

Qualitative data from teacher reflection reports were analyzed thematically to complement the quantitative findings. This triangulated approach strengthened the interpretation of results by combining statistical evidence with insights from classroom practice (Creswell & Creswell, 2018).

4. RESULTS

The results of the intervention are presented in three dimensions of competency development: basic problem-solving with fractions, performing operations, and applying fractions to real-life problem-solving tasks. Descriptive statistics (means and standard deviations) and inferential tests were used to compare learning outcomes between the experimental and control groups.

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Table 3. Comparison of post-test scores between experimental and control groups

Competency dimension	Experimental group (n=72) Mean (SD)	Control group (n=68) Mean (SD)	t-value	p-value
Problem-solving with basic fractions	8.12 (1.05)	7.36 (1.14)	3.52	<.01
Performing operations with fractions	8.25 (1.08)	7.41 (1.12)	3.84	<.01
Applying fractions to real-life tasks	7.98 (1.10)	7.02 (1.15)	3.67	<.01

The results show that the experimental group significantly outperformed the control group in all three dimensions ($p < .01$). The largest improvement was observed in performing operations with fractions, where the mean difference was 0.84 points.

Qualitative evidence from teacher reflection reports supported these findings. Teachers observed that students in the experimental group demonstrated higher engagement, were more confident in explaining their reasoning, and could transfer their knowledge to real-life contexts more effectively. For example, one Grade 5 class successfully applied fractions to calculate ingredient proportions in a cooking activity, illustrating the potential of competency-oriented teaching to foster authentic problem-solving skills.

5. DISCUSSION

The findings of this study provide strong evidence for the effectiveness of competency-oriented teaching in the domain of fractions at the primary level. Students in the experimental group significantly outperformed those in the control group across three dimensions: solving basic fraction problems, performing operations, and applying knowledge in real-life contexts. These results align with international studies highlighting the challenges of fraction learning and the benefits of instructional approaches that emphasize conceptual understanding, procedural fluency, and contextualized applications (Lamon, 2012; Siegler et al., 2013; Cai & Wang, 2021).

First, the improvement in problem-solving with basic fractions suggests that competency-oriented strategies help students overcome misconceptions commonly associated with whole-number reasoning. This is consistent with the work of Ni and Zhou (2005), who found that direct attention to conceptual understanding reduces systematic errors.

Second, the significant gains in performing fraction operations confirm the effectiveness of structured problem-solving approaches, such as Polya's model, in strengthening procedural skills while maintaining a focus on reasoning. Similar outcomes were reported by Charalambous and Pitta-Pantazi (2007), who demonstrated that multiple representations and structured tasks enhance both accuracy and flexibility in fraction operations.

Third, the improvement in applying fractions to real-life tasks illustrates the practical potential of competency-oriented teaching. Teachers reported that students were able to connect classroom learning with authentic experiences, such as calculating proportions in cooking or dividing resources in group projects. This finding echoes the call from Darling-Hammond et al. (2020) for educational practices that integrate knowledge and application, preparing learners for the demands of twenty-first century skills.

From a Vietnamese perspective, the study provides empirical support for the 2018 General Education Curriculum's emphasis on competency development. While previous studies have identified difficulties in implementing competency-based instruction due to limited resources and training (Nguyen & Luong, 2022; Nguyen & Huynh, 2024), the present findings show that with appropriate instructional design and teacher support, meaningful improvements in student learning can be achieved.

6. CONCLUSION

This study examined the effectiveness of competency-oriented teaching strategies for fractions in Grade 4 and Grade 5 within the context of Vietnam's 2018 General Education Curriculum. By combining diagnostic testing, instructional interventions, and teacher reflections, the findings demonstrate that competency-oriented approaches significantly enhance students' abilities in three key areas: solving basic fraction problems, performing fraction operations, and applying fractions to real-life contexts.

The results provide empirical evidence that, when appropriately designed and supported, competency-oriented teaching can overcome long-standing challenges in fraction learning. This contributes both to theoretical discussions on mathematics education and to practical guidance for classroom implementation.

The study suggests that professional development for teachers, the integration of contextualized tasks, and systematic support for curriculum alignment are essential for scaling competency-based instruction. These findings have implications not only for Vietnam but also for other educational systems facing similar challenges in mathematics teaching and learning.

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