International Journal of Education and Social Science Research

ISSN 2581-5148

Vol. 8, Issue.5, Sep-Oct 2025, page no. 240-254

To cite this article: Huong Le Thi Thu and Quynh Le Thi Nhu (2025). SOME APPROACHES TO APPLYING MATHEMATICS EDUCATION THEORY IN CONNECTION WITH REAL-LIFE CONTEXTS IN TEACHING THE TOPIC OF DECIMAL NUMBERS AND OPERATIONS WITH DECIMALS IN GRADE 5, International Journal of Education and Social Science Research (IJESSR) 8 (5): 240-254 Article No. 1146, Sub Id 1783

SOME APPROACHES TO APPLYING MATHEMATICS EDUCATION THEORY IN CONNECTION WITH REAL-LIFE CONTEXTS IN TEACHING THE TOPIC OF DECIMAL NUMBERS AND OPERATIONS WITH DECIMALS IN GRADE 5

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DOI : https://doi.org/10.37500/IJESSR.2025.8516

ABSTRACT

In the process of teaching Mathematics at the primary level, applying mathematics education theory in connection with real-life contexts plays a crucial role in helping students explore and acquire knowledge effectively and vividly. Particularly, in the topic of Decimal Numbers and Operations with Decimals, the integration of real-life applications through mathematics education theory brings significant benefits. Decimal numbers are not merely abstract mathematical concepts; they also have direct applications in everyday life. Based on an overview of the theoretical foundations of mathematics education in real-life contexts, this paper proposes several approaches for applying this theory to the teaching of decimal numbers and operations with decimals in Grade 5 in Vietnam.

KEYWORDS: Real-life Application, Realistic Mathematics Education, Primary School, Decimals

1. INTRODUCTION

Over the past decades, teaching mathematics in connection with real-life contexts has become a common trend in modern education. Many developed countries such as the Netherlands, the United States, the United Kingdom, and Australia have focused on innovating teaching methods, among which Realistic Mathematics Education (RME) stands out as a prominent model.

The RME model was initiated and developed at the Freudenthal Institute (Netherlands), emphasizing that mathematics instruction should originate from situations closely related to students' real-life experiences. According to the RME perspective, mathematics is a practical activity, and students should be engaged in the process of "reinventing" mathematical concepts through experiential activities, exploration, and solving real-world problems. Seminal works by scholars such as Van den Heuvel-Panhuizen (2003), Gravemeijer (1994), and Treffers (1987) have provided theoretical foundations and broad applications for this model.

Since as early as the late 16th century, the philosopher Francis Bacon (1561–1626), and possibly even earlier thinkers, advocated for the use of the "natural method" in teaching, that is, instruction based on real-life situations from daily living.

Beginning in 1990, the University of Arizona (USA) launched a program called "After-School," aiming to provide students with opportunities to engage in integrated activities in the fields of Science, Technology, Engineering, and Mathematics—commonly known as STEM. Within the program framework, students collaborated to discuss and solve problems relevant to their local environments and communities, through after-school sessions held at their schools.

Over the past three decades, experts from the Freudenthal Institute in the Netherlands have continued to build and refine a mathematics teaching approach known as Realistic Mathematics Education (RME). This method emphasizes that mathematics is highly practical and that students need to participate in experiential learning to discover and reconstruct mathematical knowledge through real-life-related situations (Van den Heuvel-Panhuizen, 2003). This approach, grounded in well-established theoretical frameworks, has also been widely applied in countries such as the United States and the United Kingdom (see Romberg, 2001). Teachers act as facilitators of learning through exploratory and applied activities, rather than merely transmitting knowledge passively.

In line with this orientation, the doctoral dissertation of Nguyen Thanh Thuy (2005) at the University of Amsterdam, Netherlands, conducted research and proposed solutions to support Vietnamese pre-service teachers in applying the theory and methods of Realistic Mathematics Education (RME), as well as the theoretical framework of Dimensions of Learning, within the educational context of Vietnam.

Also in 2005, Reidar Mosvold's doctoral dissertation focused on connecting mathematical content with real-life situations and everyday experiences. The author emphasized the role of personal and social historical contexts in shaping mathematical ideas. Over the past decade of educational reform, mathematics in daily life has become a central theme. Learners are encouraged to form mathematical concepts through personal thinking by placing mathematics in practical problem-solving contexts, thereby enhancing motivation and learning effectiveness.

According to Javier Diez-Palomar (2006), students often struggle to relate mathematics to real-world issues. Due to age and limited life experience, they typically access mathematics through numerical expressions or formal problems, lacking connection to real-life situations.

Numerous studies have shown that when teachers integrate mathematical knowledge with real-world and historical contexts, student learning outcomes improve. Students tend to perceive mathematics as an abstract subject with little relevance to daily life. Therefore, the teacher's role in creating relatable, life-based contexts is essential.

Research and teaching practices involving mathematical modeling and its applications have made significant advances in recent decades. Authors such as Blum and Niss (2007), and Stillman (2007), have provided substantial evidence for the effectiveness of this model in international educational literature.

Specifically, Werner Blum (1992) addressed the teaching of mathematics through application and modeling; meanwhile, Blum and Niss (1991) discussed how mathematics can be applied to solve real-world problems. Gloria Stillman (2012) and Edwards I. (2007) also addressed the processes of applying modeling in lower secondary education.

The 2018 General Education Curriculum for Mathematics in Vietnam clearly reflects elements aligned with the RME approach in several aspects:

Regarding curriculum design philosophy, the first emphasis is on “practicality, modernity, and streamlining,” aimed at meeting students' needs to explore the surrounding world and their interests and preferences. It also aims to enhance applicability and connections to real-life, other subjects, and educational activities.

Regarding content, the curriculum is designed to link closely with real-life contexts: all knowledge strands are oriented toward application, with approximately 35% of instructional time dedicated to experiential and practical activities.

Regarding teaching methods, the curriculum emphasizes leveraging students' personal experiences and promoting active participation. Teachers are encouraged to implement a constructivist approach—students actively explore, discover knowledge, and apply it to real-life situations (MOET, 2018, p. 32).

2. RESULTS

2.1. Theory of Realistic Mathematics Education (RME)

2.1.1. Some Concepts

The concept of "reality" in Realistic Mathematics Education (RME) can be understood as the entirety of human activities in daily life—including routines, labor, learning, play, and more. It does not only refer to situations that are actually occurring (i.e., "real-life"), but also includes scenarios that students can imagine, visualize, and find meaningful in the learning process.

The Theory of Realistic Mathematics Education (RME) is both a theory of mathematics education and an orientation for designing mathematics curricula. At the core of RME is the principle that students should learn mathematics through life-related contexts (learning in context). This requires a shift away from traditional teaching methods toward the organization of learning activities that challenge students, promote active participation, and gradually foster problem-solving thinking—enabling them to act as "real mathematicians" (Freudenthal, 1984).

A **real-life situation** refers to a scenario that students may encounter in everyday life or can realistically imagine, in which they are required to act, analyze, make decisions, or solve a specific task.

A **real-life context** refers to the environment or specific conditions associated with a real-life situation. A context may encompass multiple situations and is often simplified in textbooks.

A **real-life task** is a requirement or problem that students need to solve within a specific situation. This is where mathematics is applied directly.

A **real-life problem** is a mathematical problem that contains a real-life task, requiring students to apply mathematical knowledge (and sometimes interdisciplinary knowledge) to solve it. These problems are typically embedded in real-life contexts.

2.1.2. Some Principles of the Theory of Realistic Mathematics Education (RME)

The Theory of Realistic Mathematics Education (RME) is built upon five core principles that guide the design of mathematics teaching activities in ways that align with how student approach, understand, and apply mathematical knowledge in real-life situations. These five principles are:

Use of context – Learning begins in meaningful, realistic situations that are relevant to students' lives.

Use of models – Students' progress from informal, context-based strategies to more formal mathematical understanding through the development and use of models.

Promotion of students' own constructions – Encouraging learners to create their own mathematical strategies and representations fosters deep conceptual understanding.

Emphasis on interaction – Classroom dialogue, peer discussion, and teacher-student interaction are essential in the learning process.

Intertwinement of learning strands – Different areas of mathematical content are integrated and developed together, rather than taught in isolation.

*2.2 **Some Instructional Strategies for Teaching the Topic of Decimal Numbers and Operations with Decimals in Grade 5 Based on the Theory of Realistic Mathematics Education (RME)***

2.2.1. Orientation for Proposing Instructional Strategies

- The strategies must support students in **exploring, constructing, and applying mathematical knowledge and skills in a solid and meaningful way**.

- The strategies should contribute to the development of students' ability to **connect mathematics with real-life contexts**, enabling them to recognize practical applications of school mathematics.

- The strategies must be **appropriate to learners' cognitive abilities** and demonstrate practical feasibility.

International Journal of Education and Social Science Research

ISSN 2581-5148

Vol. 8, Issue.5, Sep-Oct 2025, p no. 240-254

- The strategies should be **effective and contribute to innovating teaching methods** in general education settings.

2.2.2. Some Specific Instructional Strategies

Strategy 1: Designing Real-Life Situations to Connect with the Lesson in the Introduction Phase

Step 1: Identify Learning Objectives

Clearly define the learning goals related to decimal numbers and the four operations with decimals, based on the Grade 5 Mathematics curriculum (according to the 2018 General Education Curriculum). Based on these objectives, the teacher designs real-life situations that are suitable for students' level, cognitive characteristics, and the actual conditions of the school and learners.

Also, determine the intended purpose of using the situation in the lesson: whether to support the formation of new knowledge, practice computational skills with decimals, or apply mathematical knowledge in real-life contexts.

Step 2: Select a Real-Life Context

Choose a familiar and practical context for Grade 5 students—for example, calculating shopping costs, measuring in daily life, or managing simple finances. Ensure the context is appropriate to students' cognitive levels, experiences, and cultural backgrounds, and that it facilitates effective instructional organization.

Step 3: Design the Real-Life Situation

Construct a concise, clear, and understandable situation that is closely connected to students' daily lives.
The situation should encourage students to apply their knowledge of decimal numbers and operations to solve a specific problem, while also developing critical thinking and life skills.

Step 4: Evaluate and Adjust the Real-Life Situation

Evaluate the role of the situation in the lesson (introduction, concept formation, practice, application) and its potential to develop students' mathematical competencies and life skills.

Gather feedback from colleagues and subject-matter experts to refine the situation.

Pilot the situation with a small group of students to observe their level of comprehension, engagement, and ability to apply knowledge.

Revise or redesign the situation based on evaluation results and feedback to ensure suitability and effectiveness.

Example 1: In the lesson "Comparing Decimal Numbers"

Step 1: Identify Learning Objectives

Students recognize how to compare decimal numbers and determine which is greater, smaller, or equal.

International Journal of Education and Social Science Research

ISSN 2581-5148

Vol. 8, Issue.5, Sep-Oct 2025, p no. 240-254

Develop students' mathematical reasoning and communication skills through observation and comparison of real-world numbers.

The goal of the situation is to engage students and help them realize the practical need for comparing decimal numbers in daily life.

Step 2: Identify the Real-Life Context

The context involves observing temperature readings at different times of the day in the students' local area.

Step 3: Develop the Real-Life Situation

Situation title: "Comparing Temperatures"

The weather forecast from Vietnam Television reported that the temperature yesterday (Monday) was 26.7°C, while today's temperature (Tuesday) is 27.5°C. So, which day had the higher temperature?

Step 4: Evaluate and Adjust the Situation

This situation is appropriate for the introductory phase, helping students easily access the lesson and recognize the importance of comparing decimal numbers.

Teachers should observe students' reactions and collect feedback from colleagues to refine the wording of questions or visual aids to ensure engagement and comprehension.

Strategy 2: Organizing Real-Life Experiential Activities Related to Decimal Numbers and Decimal Operations

Step 1: Select an Experiential Theme

Based on the mathematics curriculum, students' characteristics, and the actual conditions of the school, teachers select a suitable experiential theme. The theme should be concise, clear, and accurately reflect the activity content while capturing students' interest from the beginning.

Step 2: Define the Objectives of the Experiential Theme

Teachers should answer key questions to identify the objectives:

- What knowledge and skills will this theme help students develop?
- What will students be able to do after completing the activity?
- What qualities and competencies will be fostered through this experiential activity?

Step 3: Plan the Content for the Experiential Theme

Based on the selected theme and defined objectives, and considering available facilities, student capabilities, and school context, the teacher builds a detailed content plan for the experiential activities. The content should be fully listed to serve as the foundation for activity design and implementation.

Step 4: Design and Implement the Experiential Activities

Using the planned content, the teacher designs specific activities, estimates time, location, and prepares tools, equipment, and other necessary resources. The experiential activity may take place in the classroom or outdoors, on or off school grounds, depending on the nature of the activity and real-world conditions.

Example 2: Experiential Activity – "Decimals and Health: Discover Your BMI"

Step 1: Select the Experiential Theme Title

The theme "Decimals and Health: Discover Your BMI" is chosen to help students recognize the importance of decimals in calculating personal health indicators, while connecting mathematical knowledge to real-life health care practices.

Step 2: Define the Learning Objectives

Students learn how to accurately measure height (in meters) and weight (in kilograms), and record the data in decimal form (e.g., 1.65 m; 52.3 kg).

Develop mathematical competencies such as decimal calculation, modeling, logical reasoning, problem-solving, and mathematical communication.

Foster awareness of personal health, honesty in recording data, and a sense of responsibility in analyzing results.

Step 3: Identify the Activity Content

Students practice measuring height using a ruler marked in centimeters and weight using a health scale with 0.1 kg precision.

Record measurements in decimal form (e.g., height: 1.62 m; weight: 48.7 kg).

Use the BMI formula to calculate personal BMI using decimal operations.

Compare the result with the standard BMI classification chart:

Below 18.5: Underweight

18.5 – 24.9: Normal

25 – 29.9: Overweight

Above 30: Obese

Discuss the meaning of BMI and other health-related factors such as diet and physical activity.

Step 4: Plan and Implement the Experiential Activity

a) Preparation:
Students prepare recording sheets and pens.

The teacher prepares a precision health scale (accurate to 0.1 kg), a height ruler (with centimeter markings), a BMI classification chart, and instructional materials on measurement and calculation procedures.

b) Location:
The activity is conducted in the classroom or school infirmary—any space with adequate measuring tools and comfort for students to carry out the activity.

c) Activity Procedure:
Introduction: The teacher explains the purpose of the activity, introduces the concept and significance of BMI, and highlights the role of decimals in health-related calculations.

Group Formation: Students are divided into small groups (5–6 students). Each group receives measuring tools and recording sheets.

Measurement:
Students take turns measuring each member's height using the ruler, recording results in meters and decimals (e.g., 1.58 m).

Measure weight using the health scale and record in kilograms and decimals (e.g., 49.3 kg).

International Journal of Education and Social Science Research

ISSN 2581-5148

Vol. 8, Issue.5, Sep-Oct 2025, p no. 240-254

Image of students measuring height and weight to calculate their BMI

Calculation:

Students calculate their BMI using the formula

Classification and Discussion:

Compare BMI results with the classification chart to determine each student's health status.

Discuss the meaning of BMI, factors affecting weight and health, and ways to maintain a healthy body weight.

Presentation of Results:

A representative from each group presents their group's measurements, BMI calculations, and comments on the health status of group members.

Conclusion:

The teacher emphasizes the importance of using decimal numbers in health-related calculations and encourages students to apply mathematical knowledge in daily life, especially in caring for their own health and that of their families.

The teacher may offer small rewards to groups with strong presentations or excellent teamwork.

Strategy 3: Designing a Project-Based Learning Activity Related to Decimal Numbers and Decimal Operations

Step 1: Choose a Project Theme and Content

ISSN 2581-5148

Vol. 8, Issue.5, Sep-Oct 2025, p no. 240-254

The teacher selects a theme aligned with the learning objectives of the curriculum that is also highly practical, allowing students to easily connect it to real-life situations. The theme should spark curiosity and interest, providing opportunities for students to express creativity and critical thinking.

Step 2: Define Project Goals and Requirements

Clearly identify the knowledge, skills, and attitudes students are expected to develop upon completing the project. These objectives guide the project activities and serve as the basis for assessment.

Step 3: Develop a Project Implementation Plan

Break the project into specific activities, assign tasks to individual students or groups, and determine the timeline and necessary resources to ensure the project is carried out effectively.

Step 4: Establish Evaluation Criteria

Create clear, specific criteria for evaluating both the final product and the project implementation process, ensuring that assessment is objective and transparent.

Step 5: Collect and Process Information

Students gather relevant data and information related to the project theme from various sources such as books, the internet, interviews, and real-life observations. They then analyze, process, and synthesize the information logically and systematically to support the next stages.

Step 6: Implement the Project

Students carry out the planned activities, collaborate in groups, and apply their acquired knowledge and skills to solve the tasks defined in the project.

Step 7: Finalize the Project Product

Based on the implementation results and feedback from the teacher or peers, students revise and refine the final product to improve its quality.

Step 8: Present the Project Product

Students prepare and present their projects to the class or group, using formats such as oral presentations, reports, posters, videos, or other creative forms. Through this, they share their process, outcomes, and lessons learned, while practicing communication and presentation skills.

Step 9: Evaluate and Reflect

The teacher and students evaluate the overall project process and outcomes based on the established criteria. The evaluation focuses not only on the final product but also on the working process, creativity, and teamwork. Finally, both teachers and students reflect and draw lessons learned to improve future projects, enhancing the quality of teaching and learning.

c) Example:

Project-Based Learning Example: “Decimal Learning Tools”

ISSN 2581-5148

Vol. 8, Issue.5, Sep-Oct 2025, p no. 240-254

Step 1: Select Content and Define the Project Theme

The theme "Decimal Numbers and Decimal Operations" is designed for Grade 5 students, aiming to help them read and write decimal numbers, identify their structure (whole part, decimal part, tenths, hundredths, thousandths, etc.), express measurement quantities in decimal form, and perform addition, subtraction, multiplication, and division with decimals.

Decimal learning tools are educational aids or materials designed to help students become familiar with and better understand the decimal number system. Teachers may introduce or encourage students to propose ideas for such tools, such as:

Decimal Place Value Chart: helps break down decimal numbers into units, tens, hundreds, and decimal places like tenths, hundredths, and thousandths.

Decimal Value Card Set: includes cards or small blocks with different values and place positions, assisting students in visualizing and performing operations with decimals more easily.

Decimal Flipbook: a set of cards or a small book where each card represents a digit in a decimal number; students can flip or change the cards to form various decimals, helping them understand the number structure.

From here, the teacher proposes the project theme: **"Design and Create Decimal Learning Tools"**. Students are divided into balanced groups and allowed to choose the type of tool they want to make. For example:

- Group 1: Create a decimal flipbook
- Group 2: Create a decimal value card set
- Group 3: Create a decimal place value chart

Step 2: Define Project Requirements

The teacher guides students to focus on the following learning goals:

Read and write decimal numbers; understand the structure of decimals including whole number part, decimal part, and decimal places.

Perform addition, subtraction, multiplication, and division with decimals.

Create decimal learning tools using simple materials such as cardboard, colored paper, etc.

Develop real-world problem-solving skills, self-directed learning, and communication and collaboration competencies.

Foster qualities such as diligence, responsibility, proactiveness, and team spirit.

Step 3: Develop the Project Implementation Plan

The teacher guides students in discussions to identify:

Knowledge and Skills Required:

Mathematics: Apply operations with decimals to calculate measurements for the tools.

Technology – Engineering: Select and use basic materials like cardboard, scissors, glue, and colored paper to create the tools.

Art: Creatively design, display, and present the products, and explain their intended use.

Project Scope: Small-scale project.

Time Allocation: 2 class periods.

Expected Products: Decimal learning tools (flipbook, value card set, decimal chart).

Working Methods and Task Assignment:

Each group elects a group leader and a secretary. The leader organizes discussions and assigns specific tasks to team members.

Materials Needed:

Each group prepares tools such as scissors, pencils, rulers, markers, hole punchers, spiral binders, glue, tape, cardboard, colored paper, craft paper, stickers, etc.

Step 4: Develop Product Evaluation Criteria

The teacher supports students in creating a rubric or evaluation form based on criteria that align with the project's learning goals.

Step 5: Collect and Process Information

Students collect information by observing sample items (flipbooks, card sets, decimal charts), researching online, consulting with the teacher, measuring and analyzing data to develop ideas for the design, size, materials, decoration, and use of their group's decimal learning tool.

Step 6: Implement the Project

Group sub-teams carry out assigned tasks:

Design Team: Sketches the shape, size, and color scheme of the learning tool.

Engineering Team: Determines the actual measurements, proportions, and dimensions of components to ensure both functionality and aesthetics.

Logistics Team: Prepares necessary materials, prioritizing commonly available and recyclable items.

Construction Team: Plans the tool-making steps and coordinates with other teams during execution.

Art Team: Designs decorations based on drafts, selects color schemes, and uses illustrations or stickers.

Evaluation Team: Prepares brief user guides, including sample operations or use cases to help students practice decimal operations effectively.

Step 7: Finalize the Product

The Construction Team cuts, assembles, and glues components to create the tool.

International Journal of Education and Social Science Research

ISSN 2581-5148

Vol. 8, Issue.5, Sep-Oct 2025, p no. 240-254

The Art Team decorates the final product.

The Evaluation Team tests the tool, gathers feedback, and adjusts the design or usage instructions for optimal effectiveness.

→ This process is carried out collaboratively, with constant communication and mutual support among group members.

Step 8: Present the Product

The teacher sets up a display space for each group. A group representative presents and introduces the decimal learning tool and demonstrates how to use some of its features.

Step 9: Evaluate the Project

Students conduct self-evaluation of their group's performance and provide peer feedback to other groups using an evaluation rubric.

Groups also test each other's products, provide evaluations, and engage in discussion. The teacher summarizes the key mathematical concepts learned, provides overall assessment, and facilitates reflection on what worked well and what could be improved.

3. CONCLUSION

The instructional strategies proposed in this study have contributed to enhancing teaching effectiveness and helping students develop the ability to apply mathematical knowledge and skills to solve real-life problems. However, these strategies have so far only been assessed through initial practical implementation, primarily based on qualitative evaluation. Quantitative assessments have not yet been conducted, which limits the persuasiveness and evidence of feasibility.

To further improve the application of the Theory of Realistic Mathematics Education (RME) in teaching decimals, it is essential to organize professional development programs for teachers. These programs should aim to raise awareness and improve skills in designing competency-based lesson plans that foster students' practical problem-solving abilities.

Teachers should actively create opportunities for students to engage in discussion, collaboration, and independent problem-solving involving real-world scenarios with decimal numbers. This approach promotes deeper thinking and the ability to apply knowledge effectively.

It is also important to strengthen the use of experiential learning activities, small-scale projects, or real-life situations, both inside and outside the classroom, to support students in connecting mathematical concepts with their everyday lives.

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