INVESTIGATING RELEVANT CONTEXTS FOR THE RME APPROACH IN PRIMARY SCHOOL TEACHER TRAINING: THE CASE OF SPORT ACTIVITIES FOR LEARNING MATHEMATICS

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Abstract

Learning mathematics should lead toward the enhancement of the mathematical literacy of students, which refers to the use of mathematics in real-life situations. As a means, contextual problems in mathematics education incorporate various contexts to demonstrate how mathematics relates to real life. Those problems are presented in textbooks or designed by teachers, who should be proficient in posing proper contextual problems. To do so, they should undergo training on teaching mathematics within the real-life context. The paper investigates the relevance of real-life contexts in the views of 58 prospective primary school teachers. The results indicate that the teacher trainees have a high preference for contexts like finance, nature and low preference for contexts like arts and construction, suggesting that the participants tend to prefer more general and familiar contexts than those that require specialized knowledge. Based on the results, the study proposes learning activities grounded in specific situations; thus, following the Realistic Mathematics Education (RME) approach. The designed learning activities, as a part of a training course developmental process, serve as the foundation for further research.

Keywords: teacher training, RME, interdisciplinary education, sport activities, contextual problems

1. Introduction

The purpose of mathematics education is to equip students with the ability to solve quantitative problems, teach them to identify various patterns, and stimulate their thinking skills. To give students a purpose for learning mathematics, it should be connected to a familiar context so that they can see the usefulness of mathematics in the world. The primary method for achieving this goal involves solving word problems. These problems refer to existing or imaginable contexts, are associated with the school setting, take the form of a combination of written or spoken text, and may be coupled with other forms of information, such as pictures, tables, graphs, etc. (Verschaffel et al., 2000). Besides word problems, contextualization of mathematics can be achieved by applying dramatization in education through role-playing or by working on projects. The educational approaches that highlight the importance of interconnecting the content to be learned with students' real-life experiences share a common philosophy rooted in situated learning. The situated learning frames learning as participation in socially organised practices rather than the mere acquisition of decontextualised knowledge (Lave & Wenger, 1991). In this view, context is not an “add-on” but constitutive of what is learned, because concepts and strategies develop through participation in communities of practice. Steaming from the same philosophy, two frameworks emerged, namely contextual teaching and learning (CTL) and realistic mathematics education (RME).

Contextual teaching and learning is an educational approach based on activities related to contexts pupils may have experience with or that are relevant to students. Similarly, the Realistic Mathematics Education emphasises learning mathematics as a human activity, using contexts which pupils can imagine (Freudenthal, 1991; Gravemeijer, 1999). The RME approach has been adapted in many countries, but slightly differing in details (Revina & Leung, 2019), while still declaring six distinguishable principles for teaching mathematics (Van den Heuvel-Panhuizen & Drijvers, 2014), namely the activity principle, the reality principle, the level principle, the intertwinement principle, the interactivity principle, and the guidance principle.

The RME approach makes learners more likely to become active participants in the learning process (Đokić, 2019) and understand mathematics compared to a conventional approach (Öksüz et al., 2022; Remiswal & Dorisno, 2021) and prepares them to tackle real-world problems (Koerunnisa et al., 2025). Moreover, connecting mathematics with a real-life context may help students to gain knowledge about that context (Jannah et al., 2021).

Over the years, a myriad of research on the RME approach has been carried out. The findings indicate a positive influence of the RME on primary school students, particularly in:

- Developing problem-solving skills in students (Nurjamaludin et al., 2021; Sutarni & Aryuana, 2023; Tumangger et al., 2024; Widana, 2021),
- Enhancing the learning outcomes of students in mathematics (Alim et al., 2024; Irdawati et al., 2019; Isnaintri et al., 2024; Simamora et al., 2024)
- Enhancing mathematical abilities (Juandi et al., 2022; Tamur et al., 2020), particularly by enhancing higher-order thinking skills (Ariati & Juandi, 2022), critical thinking skills (Cahyaningsih & Nahdi, 2021; D. Jannah et al., 2024; Koerunnisa et al., 2025), mathematical reasoning ability (Ariati et al., 2023), and communication abilities in mathematics (Putri et al., 2022),
- Developing mathematical literacy (Fauzan et al., 2024; Taqiya & Juandi, 2023),
- Increasing confidence of students in learning mathematics (Abdurohim et al., 2025; Karaca & Özkaya, 2017).

The research mentions applying the RME approach across the primary mathematics curriculum (Kurnaedi et al., 2024; Prahmana et al., 2020). Namely, the application of the RME approach was specified in teaching fractions (Halimah & Kurniawati, 2022; Sembiring et al., 2008; Solomon et al., 2021), multiplication and division (Duyen & Loc, 2022; Setiadi, 2020; Trisnani & Sari, 2021), common divisor and multiple (Fachrurazi, 2017), ratio and proportion (Risdiyanti et al., 2024), addition and subtraction (Fauzi et al., 2021; Lubis, 2023; Zaranis, 2016), basic statistics (Hakim & Setyaningrum, 2024), and geometry (Trimurtini et al., 2020).

The RME is an approach that can be applied in primary mathematics using various means, such as board games with contextual problems (Fauzi et al., 2021; Laurens et al., 2017), traditional physical games (Peni, 2017), e-comics (Yulaichah et al., 2024), digital stories (Çopur & Tümkaya, 2024; Risdiyanti & Prahmana, 2021), ICT (Zaranis, 2016), textbooks (Van Zanten & Van den Heuvel-Panhuizen, 2021) and other emerging methods, such as audiobooks (Sari et al., 2023).

Regarding the context used in the RME when applied in primary mathematics, some studies are available. In arithmetic, mathematics is often delivered integrating buying-selling and banking activities (Rahayu et al., 2021). Besides, numeracy may be developed by integration of activities with an agricultural context (Cahyadewi et al., 2025). Another frequent context in teaching primary mathematics is culinary activities (Umasugi et al., 2022) that provide various opportunities for integrating arithmetic, geometry, and data handling.

Generally, any context imaginable for students can be used when applying the RME approach. However, the context may limit the mathematical topics to be learned and affect the

motivation level among different learners. This study aims to investigate the proper contexts applicable to the RME approach in training prospective primary school teachers as a base for designing a training course in teaching mathematics via the RME approach.

2. Methods

The purpose of this study is to investigate prospective primary school teachers' preferences for contexts that facilitate mathematics learning through the RME approach. Based on the results, learning activities based on a relevant context will be proposed. These can be viewed as a form of hypothetical learning trajectories, as they will consist of learning objectives and hypothesised learning processes expected from students (Simon, 1995). The initiative is part of a process to develop a training course for prospective primary school teachers, aiming to enhance their knowledge of applying the RME approach in primary mathematics education (see Chart *1*).

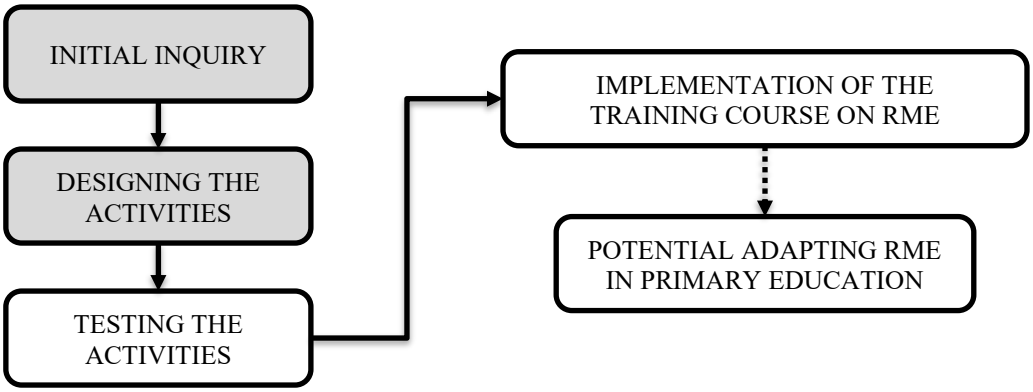

Chart 1. The course developmental process

The study covers the initial investigation, selection of the learning content, and development of activities. Two main research questions were formed beforehand:

- What real-based contexts are the most relevant for teacher trainees in terms of mathematics education?
- What kind of learning environment associated with a relevant context may be developed to support the learning of mathematics of teacher trainees, while simultaneously arming them with methods applicable in their future educational careers?

To investigate the context relevant to teacher trainees, a simple questionnaire with 10 items associated with different contexts was designed and shared among 58 prospective primary school teachers. The participation in the study was voluntary, and participants were informed about the purpose of the data collection. All participants whose data have been collected and analysed expressed their consent to process their answers for scientific purposes. The questionnaire was administered online via Google Forms. Participants were allowed to select any number of items offered. Moreover, they were given the option to list other contexts not included in the questionnaire provided.

The data collected by the form were exported and analysed in MS Excel software, using tools of simple descriptive statistics. Initially, the data was manually checked for any outliers. That resulted in the exclusion of three answers from further analysis because they included all options provided; thus, they did not show a particular preference among the options at all. The remaining 55 answers were coded, and a frequency table was created to serve as a basis for statistical analysis.

3. Results

The results show that participants express distinct preferences towards different contexts, which ought to be incorporated in teaching and learning mathematics (see Chart *2*).

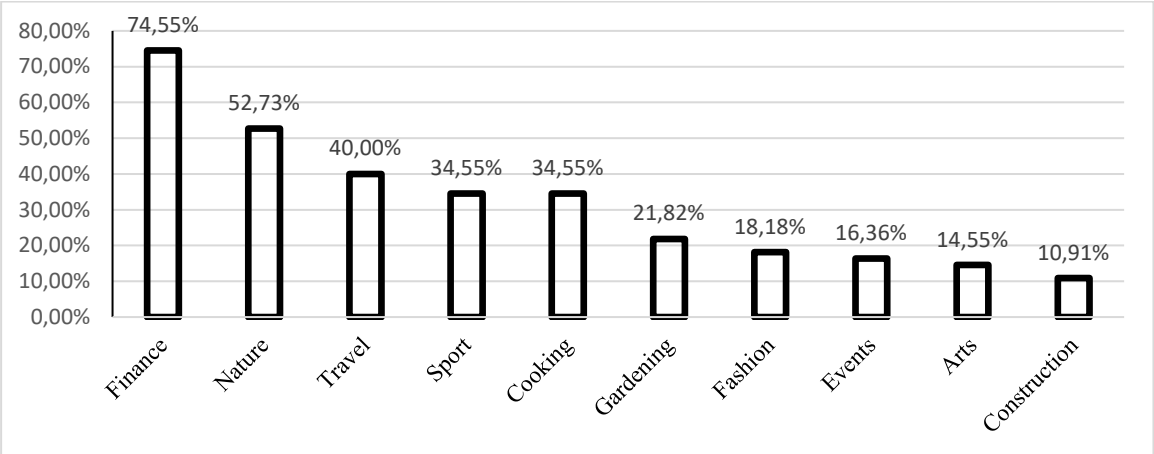

Chart 2. Context preference among prospective teachers in mathematics education

The overwhelming preference for Finance (74.55%) suggests that prospective teachers recognize financial literacy as both a key life skill and an accessible source of mathematical tasks. Everyday situations such as managing pocket money, shopping, or budgeting offer straightforward problem contexts for children, which may explain the high score. Also, these contexts are familiar to children and can be easily translated into classroom problem situations. The second most frequently selected context, Nature (52.73%), offers multiple natural contexts (e.g., animals, plants, landscape, weather) that may be associated with mathematical problem-solving activities in schools. Such context is likely familiar to pupils through their out-of-school experiences. The context of nature could also be linked to sustainability trends, increased environmental awareness, and the integration of science and mathematics in outdoor learning activities. Travel (40%) was selected by over two-fifths of respondents. This may be due to inherent mathematical affordances, such as measuring distances, planning routes, or working with time and cost (also related to the Finance context). In addition, travel-related contexts are often engaging for pupils, who may enjoy the imaginative aspect of "journeys" in problem tasks. The moderate representation of Sport and Cooking (both 34.55%) suggests that prospective teachers acknowledge the motivational power of these contexts, as both are concrete, experiential, and linked to measurement, counting, and proportional reasoning. Sport offers opportunities for elementary data handling and performance comparison, while cooking naturally involves fractions, proportions, and measurement. Gardening (21.82%) was less frequently chosen, which may reflect differences in personal experience. While gardening provides rich mathematical opportunities (growth rates, geometry of planting, measurement), it may not be perceived as universally relevant for teachers and pupils living in modern urban settings. On the other hand, gardening and farming are gaining popularity due to the search for organically grown products. Similarly, Fashion (18.18%), Events (16.36%), and Arts (14.55%) were ranked low. These areas might be undervalued because they are primarily associated with creativity and social activities rather than mathematics. However, each offers untapped potential: symmetry and patterns in fashion and arts, or scheduling and resource allocation in events. Finally, Construction was the least frequently chosen context (10.91%). This result could be attributed to limited familiarity or confidence with technical and spatial mathematics among participants. While construction contexts are rich in geometry and measurement,

prospective teachers may feel less prepared to integrate such content into primary-level mathematics teaching.

In summary, the results show a clear preference for contexts that are perceived as highly practical (finance, travel) or directly observable in everyday life (nature, sport, cooking). Contexts requiring more specialized knowledge or less present in daily routines (construction, arts, fashion) were given limited preference. The results indicated that not all contexts are equally favourable. Applying the Pareto principle (the 80:20 rule), based on the participants' answers, the vital contexts for learning mathematics using the RME approach are finance, nature, travel, sport, and cooking (see Chart *3*).

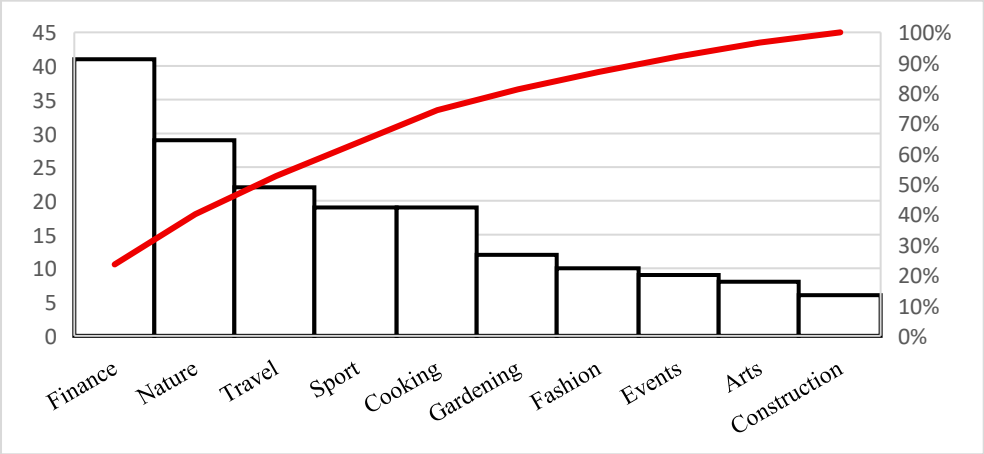

Chart 3. The Pareto chart of the obtained results

Based on the results, the study proposes learning activities using the concept of sport, one of the vital ones. For the general popularity, suitability for a wide range of population, and technical availability, the following activities have been proposed, combining mathematics and realistic situations occurring in table tennis.

3.1. Activities design

Professional training for prospective primary school teachers differs worldwide. The general requirements, however, ask for earning contextual and pedagogical knowledge, whereas the contextual knowledge should be greater than that of the primary school students. The teachers should be mathematically literate, thus operate with whole numbers, decimals, fractions, percentages, and be able to solve problems involving these and elementary equations, measurement and geometry, combinatorics, probability, and statistics. Based on this premise, the following activities have been designed.

Learning activity 1: Players engage in a rally, bouncing a ball on the table from one side to the other. They aim to keep the ball on the table as long as possible, counting the number of times the ball passes over the net in the middle of the table. Players individually count the number of successful strokes aloud or by inner voice. If they are tasked with recording the total number of strokes, the estimate can be obtained by multiplying the number of their own successful strokes by 2. The activity can also be a basis for further data recording and handling, involving probability and statistics.
Learning objectives: Count numbers starting from 1. Multiply the whole number by 2.

Learning activity 2: In a match based on the official rules, players are supposed to switch serving every two serves. Sometimes players may lose track of who is supposed to serve next.

This can be determined by the divisibility of the sum of the score in the game by 4. If the sum of the scores is divisible by 4 or yields a remainder of 1, the next serving player is the one who started serving in the game. Players sum up the score and must determine the remainder after dividing the sum by 4. Doing so should enhance their arithmetic knowledge and demonstrate a direct use of mathematics in solving a real-life situation. Further, potential methods can be discussed with students if players switch in serving after three, four, or more serves.
Learning objectives: Add two whole numbers. Divide whole numbers by 4.

Learning activity 3: Players in the group stage of the tournament play against each other. The progress of players into the K.O. stage is determined by the number of wins and the rate of winning and losing games in the matches played. Considering the second situation, it must be compared to determine which rate yields the greater coefficient. To compare the ratio of won and lost games, they may be instructed to look for the simplest form, find a common denominator (possibly the least common multiple), and convert them to equivalent fractions. Further, the scores of players can be compared considering the games, sets, and points, which provide much material for mathematical activities.
Learning objectives: Construct a ratio to compare quantities. Compare ratios (fractions) using various methods.

Learning activity 4: Players engaged in long-term contests are rated based on the percentage of games won. Similarly, the players can be assessed after each match by the percentage of rallies won. This suggests recording the scores of their games and matches, which can also be utilised in various data handling activities.
Learning objectives: Convert between fractions, decimals, and percentages. Visualise and interpret data that uses percentages.

Learning activity 5: The players are divided into multiple groups based on their success rate. After they play each other in the groups, the percentage of matches won is calculated. To create a ranking of all players based on the results, each group is allocated a particular coefficient that is further used to produce the final combined ranking. Players compute it using linear functions to determine how good a player must be in a lower league to match the ranking of a player from a higher league. During the learning process, they learn how to visualise functions and interpret line charts.
Learning objectives: Find the value of y in a simple linear function when x is known. Draw a function line. Find the critical values (intercepts of graphs) comparing two or more functions.

Learning activity 6: After each player has played enough matches for their ranking to be determined, they can calculate the probability of winning against any player by applying the Bradley-Terry model or the Elo rating. During a tournament, some students pretend to be analysts. Their role is, among other possible things, to determine the probability of winning for players. In their calculations, they use the ratings of players when inserting them into formulas.
Learning objectives: Calculate formulas using two variables. Determine probability. Understand the function concept.

Learning activity 7: Players attempt to complete a specific task, e.g. hit the target positioned on the table. They have a certain number of attempts. Each player may have a different number of attempts. Expressing who was more precise in shooting cannot be obtained from absolute numbers, but they must come with another option – the ratio. To compare the success of players, they need to express their successful attempts using ratios and percentages. Further, data can be visualised and probability can be determined.

Learning objectives: Construct a ratio to compare quantities. Compare ratios (fractions) using various methods. Graphically visualise data involving percentages.

Learning activity 8: Players are asked to hit the target on the table from different distances. At each distance, they are given the same number of attempts, and their successful shots are recorded. Next, the discussion on proportionality between the distance and the successful shots can be held. Namely, questions like "how many shots would you score if you were twice the current distance from the target?" can be addressed to students. This would lead to creating functions, making predictions, evaluating these predictions and so on.
Learning objectives: Graphing functions. Identifying trends. Making predictions and evaluating predictions.

4. Conclusion

Research findings over the years demonstrate the effectiveness of the RME approach in enabling meaningful mathematics learning, as the literature review in this paper presents. The approach proposes that students' understanding should originate from contexts that are relevant to them. The present study examined the preferences of prospective primary school teachers for relevant contexts in the RME approach (research question 1). The vital contexts were revealed, namely finance, nature, travel, sports, and cooking. Therefore, these contexts may be proper for training prospective teachers to apply the RME in teaching mathematics. The training may consist of two parts: experiencing curriculum materials and developing curriculum materials, as teachers praise using the RME approach when they participate in developing curriculum materials (Sembiring et al., 2008). To familiarise trainees with the RME approach, several activities stemming from situations occurring in sports, particularly table tennis, were proposed, which will be further tested for feasibility in a teacher training course on the RME (research question 2). The proposed learning activities are hands-on or directly linked to physical activities that students would participate in. Designing them also fills a gap, as there is a lack of research documenting the use of sports activities for learning mathematics. The learning activities tend to be authentic; therefore, they may enhance the motivation and interest of students in learning mathematics. It is also believed that the potentially successful application of the learning activities among prospective teachers would teach them a strategy for using the RME approach and foster their appreciation and understanding of mathematics.

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