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RESEARCH ARTICLE

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Effects of Realistic Mathematics Education on Students' Academic Performance

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Abstract: This study presents a learning experiment characterized by a sequence of actions based on the use of realistic mathematical education in teaching mathematics. The purpose of this study is to investigate the difference in student performance in mathematics after the introduction of realistic mathematics education and traditional education. The research was conducted with 43 students attending the 7th grade of lyceum "Bilim-Innovation" for girls in the city of Shymkent in the fourth semester of the 2021-2022 academic year. According to the scores obtained from the pre-test at the beginning of experiment and the post-test made after the application, it is seen that the lesson taught according to the Realistic Mathematics Education (RME) approach is significantly more effective than the traditional teaching approach among the achievements of the experimental and control groups. This study also discusses the theoretical basis of the intervention and proposes theoretical reasons for choosing Realistic Mathematics Education theory.

Keywords: realistic mathematical education, progress in mathematics, mathematical education and teaching

INTRODUCTION

One of the educational goals is for students to grow in the personal, social and educational fields and acquire the necessary skills. Today, it is impossible to be unaffected by updated mathematics syllabuses, updated course syllabuses, and studies that can contribute to our knowledge of mathematics, and they are prepared with great interest and enthusiasm.

Mathematics has a scientific common sense that follows a completely unique order. Mathematics, which we come across at each level of our formal training life, beginning from number from school and finishing at university, is likewise essential in our real life. In addition, mathematics additionally serves as a device for studying different branches of science (Laurens et al., 2017). Regarding the improvement of mathematics James and Ioan (2002) say that "Today, mathematics is greater exciting due to its effect on enterprise and social sciences. As new troubles arise, new techniques are needed", he talks this improvement process.

A researcher who defined knowledge of mathematics as "a conceptual system that can use the usual tools of human intelligence in an unusual way" states that "It was emphasized that the relationship between the real world and mathematics should not be ignored" (Livio, 2011). "The world of mathematics is nothing more than a reflection of real life in our minds. This is where every discovery about the world of mathematics gives us information about the real world. It is clear to give" (Rényi, 2006).

Given the evolution of mathematics and today's innovations, we need to contribute to the advancement of research in this direction, to our knowledge of math, and to show a match between our knowledge of the real world and our knowledge of mathematics.

The aim of mathematics education is to be critical of all kinds of problems by acquiring knowledge and skills that help individuals evaluate problems they may encounter in their real lives, inferring thoughts and connecting mathematics. It is to help you reflect. Concepts and operations used for execution (Altun, 2002). Students have a negative attitude towards mathematics because they find mathematics lessons difficult and fear they will not succeed in these lessons. Linking mathematics to real life will prevent such privative situations, increase success, and establish a positive attitude towards mathematics (Parveva et al., 2011).

Developed by the Organization for Economic Cooperation and Development (OECD) in 1997, the International Student Assessment Program (PISA) has been conducted every three years since 2000 and is applied internationally to assess student achievement levels of 15 years old students. The app evaluation areas are mathematics, science, and reading (Woodward, 2009). Despite the significant changes made to the educational approach in Kazakhstan, it appears that we have not been able to achieve the desired levels in the results of the international student assessment program (Mailybaeva et al., 2018).

The methodological instruction letter "On the specifics of the organization of the educational process in secondary schools of the Republic of Kazakhstan in the school year 2021-2022" (Letter, 2021) uses mathematical knowledge, skills, calculations, measurements, and graphic abilities acquired by students in order to improve basic mathematical knowledge in teaching "algebra", forming "geometry" are recommended to teach the skills necessary to solve practical tasks. Realistic mathematics education (RME) is also based on practical problem solving, starting with real problems as well as real contexts that demand mathematical abilities in many mathematical subjects questions of the International Assessment program (Mailybaeva et al., 2018).

The relevance of the work is the target of the Ministry of Education and Science of the Republic of Kazakhstan of the National Academy of Education (2021), to solve the problems identified according to the assignments of teaching math, algebra, geometry, orientation of knowledge of the students on mathematics modeling and the interpretation of mathematics patterns that declare real processes.

The aim of the study is to determine the influence of RME-based educational activities bounded with real life setups on students' academic achievement. Given that mathematics is an abstract subject and the need to understand the results achieved by the student, the goal of the study will be better expressed.

The research hypothesis: The use of a realistic method of teaching mathematics in the teaching of school mathematics programs will have a positive impact on the academic performance of students.

THEORETICAL BACKGROUND

In this chapter, interpretations and estimations have been provided focusing on mathematics and didactics of mathematics and RME. Example studies in the (inter) national literature were also discussed, which will provide a scientific source and input to the research and whose outcomes have been assessed.

What is Mathematics?

The responses to the question did not provide a complete definition, and there was no consistency in the definitions made to date. The main reasons given for this have been "the choice of sources for organizing science, the distinctions in the aims of teaching mathematics, and the different qualities in understanding of those involved in arithmetic at slightly different levels" (Altun, 1989, p. 183). About mathematics, he said: "In the 21st century, mathematics is a huge and varied subject. It encompasses such a wide range of activities that it is impossible to summarize all its facets under a single name" (Crilly, 2013, p. 9). Although Frenkel (2013) said, "Mathematics could be a way to reality and understand how the world works. It could be a common idiom that has become the gold norm of truth" (p. 16).

Mathematics Education

Teaching and training in mathematics is an activity that poses great challenges all over the world. Further, the mathematics instruction necessary to fulfill its purpose must be corresponding to the level of the students and not presented in a top-down fashion. At the end of a process that requires them to learn or feel the way they are, students escape from mathematics or turn into robots that process quickly and learn to check off one of four or five versions (Torun, 2015).

As for teachers, irreplaceable for teaching mathematics: "In the event that mathematics does not suppress the substitutes; in case it is taught by a teacher who is instructive, creates himself, can reflect his curiosity and education, and gets the subject in great detail, it is easy to have control over the pickups" (King, 2006). Also, looking at educational problems from a different perspective, Khurgin (1974) said: "I notice that the students in the school appreciate their teachers, not the subjects. Indeed, countless students are quick to ignore the only mathematics subjects they are intended for. What they keep in mind are some hypotheses that give them brain pain, some unclear images, interesting or emotional events …"

Realistic Mathematics Education (RME)

Before passing on to RME, it is utility to remember the statement: "We can understand nature only if we study the language and the signs it speaks to us, this language is mathematics and the symbols used are mathematical signs" (King, 2006). Understanding of nature, in 2013, once again underlined the need to learn this language, stating that "Mathematics teaches us to meticulously analyze reality, examine facts and follow them wherever they conduct" (Frenkel, 2013).

In describing RME, Hersh and John-Steiner (2010) use the phrase "One of the pains to number sensibility, mental mathematics and understanding of mathematical template children is RME, which was begun in the Netherlands by the famous mathematician Hans Freudenthal". Summarizing the life of the mathematician Freudenthal, who made productive endowments to the mathematics history, they said: "He is credited with single-handedly sparing the Netherlands scientific extension untapped in the world. Today, at least 75% of Dutch primary schools use RME-based reading materials" (Hersh & John-Steiner, 2010, p. 326).

Hans Freudenthal became a professor of applied mathematics at the University of Utrecht after emigrating from Germany to the Netherlands. Succeeding the Wiscobas project evolved in the Netherlands in 1968, an Institute for the Development of Math Education was established at Utrecht University in 1977, a real step forward. In September 1991 this institute was called the Freudenthal Institute (Hersh & John-Steiner, 2010). RME is a field-specific educational treatment and speculation to teaching mathematics, encompassing Freudenthal's views on math, first created and injected by this Freudenthal Institute in the 1970s.

By Zulkardi (2000), there are two important rules in RME:

1. Mathematics must be united to reality.
2. Mathematics is a human activity.

Some Studies on the RME Approach

In the study by Zulkardi et al. (2002), there is a four-year project study hold on the introduction of RME among 27 future mathematics teachers in India. In the completed project, there are explanations of the main features of RME, how teaching is carried out according to the RME approach, what kind of material should be used and how assessment should be carried out in an adapted lesson design to this approach. As a result of the work, it was established that RME positively influences the behavior of student teachers, that student teachers better understand the relations between theoretical knowledge and practice and that the milieu during the learning phase has a positive effect.

Indonesian researcher Fauzan (2002), in his study, tries to explain efficiency of RME approach for solving some mathematical problems in teaching. As part of the study, Indonesian primary school students took a ten-hour training course on "area and volume". Data was collected through observation, journal entries and interviews. When the findings were reviewed, it was stated that the RME method had a more positive effect on the training

process. Students indicated they appreciate the RME method and have experienced positive changes towards the mathematics course.

Kwon (2009) studied the influence of RME-assisted education on growing achievement in teaching differential equations with 43 students at Ewha Women's University. Control and experimental groups were formed in the study and one group used a traditional method and the other group applied the RME-supported method. In the auditorium where RME assisted teaching took place, the student's thoughts and symbols were used in teaching the unit. When the data was analyzed, it was seen that the group to which RME-supported education was applied scored higher. Consequently, it was concluded that RME-supported education will bring another area to the teaching of differential equations and that this method can promote to the success of undergraduate students and their mathematics education (Kwon, 2009).

Bildircin (2012), in his study examined the impact of teaching the concepts of "length, area, and volume" according to the RME Education approach on the attitudes and performance of students towards math. For the quantitative part of the study, the sample consisted of 19 experimental groups and 18 control groups of 37 fifth-graders. As data collection tools, a mathematics achievement test (AT) to see student achievement, an attitude scale, and a student opinion sheet consisting of open-ended questions have been used in research to determine students' opinions of the RME approach. Research has found that teaching with activities prepared according to RME is more effective than traditional teaching when it comes to teaching the frames "length, area, and volume". However, considerable distinction was not found between two groups in students' attitude towards (Bildircin, 2012).

An examine posted by way of Kaylak (2014) applied RME approach to 7th grade students as a part of the discover areas of quadrilaterals module and tested the impact of this learning on students' success and mathematics potential. A total of 55 students took element in the look at, 28 of them in the experimental group and 27 in the control group. The success take a look at, which consisted of 12 questions, became used because the very last take a look at. In addition, earlier than and after education, a degree of ability in mathematics was used to determine the mathematics indicative attitudes of each group. At the same time as the members of the experimental group had been divided into groups in line with the precept of cooperation of the RME, deliberating that the students in the control group had degrees of interest and fulfillment. As a result, it became determined that the activity of finding the areas of quadrilaterals organized in accordance with the is effective in attaining student's fulfillment than conventional methods. However, whilst considering the mathematics attitudes of students, it became clear that there was no big distinction among the experimental and control groups (Kaylak, 2014).

Kasymova and Tashetov (2017) in their article proposed a technique of solving troubles in chances in college mathematics. They stated that further to fixing issues encountered within the auditorium, it's far beneficial to prepare an extracurricular course. This route is designed for one group every two weeks (Kasymova & Tashetov, 2017). The organization includes 7th grade students who need to have a look at mathematics for 3 years. In conclusion, the authors reviewed the problem of teaching the topic of "Interest" in excessive college and cited the sensible cost of the trouble of chances utilized in diverse fields of technological know-how and in real existence. Their concept is to layout the teaching method in that field it promotes the level of knowledge, abilities and skills important for students to be successful not most effective in arithmetic but also in other topics.

Basic Principles of Realistic Mathematics Education

In the scope of the basic principles of RME, King (2006) states that "It's essential to find troubles that are not only new, however additionally vital, and to study mathematical strategies to solve those problems; in any other case it may be created". Hersh and John-Steiner (2010), then again, kingdom of the students who are delivered to the brand new RME technique: "The belief of why they take a look at mathematics deepens children's intellectual capabilities. Mathematical instructions, which they name calculations, have to not be the primary intention. Either, a sturdy child who learns to suppose without remembering or ignoring numbers."

RME's basic principles are divided into several types in deal sources. van den Heuvel-Panhuizen (2003) tested the principles of the in six sections. The six primary ideas mentioned are explained in detail in this phase.

Activity principle: A pastime procedure in which the student himself is concerned is one of the most main methods of learning a mathematical idea. According to this precept, individuals must actively participate within

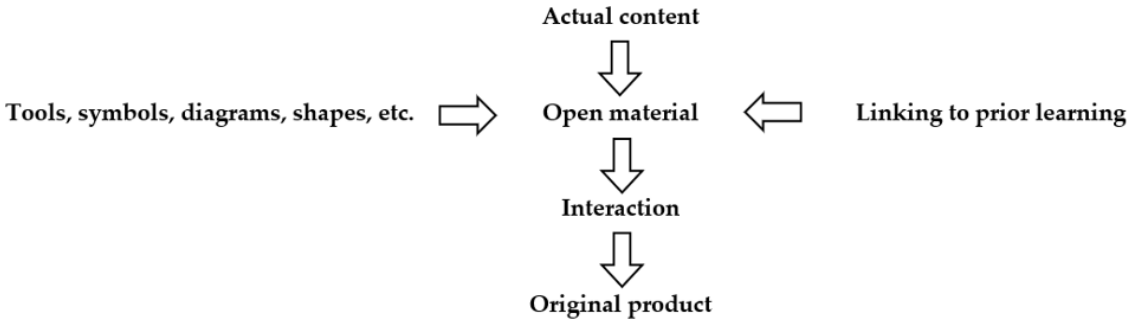

Figure 1. Model of preparation of course materials in RME (Zulkardi, 2002)

the education technique without the use of the geared-up expertise and understand that they're an energetic mastering member who develops all forms of mathematical tools, their own products and effective ideas (Kurt, 2015).

Reality principle: It needs to be ensured that students use their own knowledge, experience and equipment and comprehend that they need to learn mathematics due to the fact it's far useful. As opposed to beginning with sure abstractions or definitions, mathematics coaching needs to be began with wealthy mathematical situations so that forgetting will not be brief (Uygur, 2012). The student ought to be able to see mathematics as beneficial, beneficial and helpful as feasible.

Level principle: In this principle, the need of discovering the competencies pondered in the activities carried out, being able to reflect on consideration on the sports executed, growing strategies and achieving from one level to the next with interplay is emphasized (Kaylak, 2014).

Principle of interrelationship: It is far from a fact that the achievements and subjects of the arithmetic course progress in concord with every other, indivisible and cumulative manner. In step with this principle, the realization that mathematics getting to know departments are not separated from every different, that a large attitude is required, and that the achievements are essentially interrelated (Bildircin, 2012). For example, so as for college kids to expect the dimensions of the flag, they should have not simplest measurement, but also content and concepts including ratio-proportionality, houses of the circle, geometry, and similarity.

Interaction (cooperation) principle: Teaching and learning process is a social activity. in keeping with this precept, students have to be supplied the possibility to proportion their know-how, strategies and innovations with every different. Consequently, students may be together in study room corporations, percentage and check their discoveries, think differently with the aid of seeing the techniques and solutions of others, and pass ahead of their own way instead of following the identical path (Cansiz, 2015).

Guidance principle: In teaching mathematics students need to rediscover arithmetic and direct the gaining knowledge of technique under the guidance of the teacher. According to Freudenthal (1991), that allows you to increase the effectiveness of guidance, the programs have to have chances suitable for the preferred goals, content richness need to be created and getting to know environments have to furnished, which can offer students with different perspectives that could manual them (Memnun, 2011).

Lesson Design in Realistic Mathematics Education

There was developed course designs of a few researchers in appliance with the RME approach with the aid of the use of three stages of shape (van den Heuvel-Panhuizen, 1996; Zulkardi, 2002).

Grade level: In this level, the instructions are prepared in step with all of the features of RME. In direction layout and inside the mastering manner, students ought to be "endorsed to supply mathematical tools consisting of symbols, diagrams, drawings, situations, and conceptual models; the students should receive the feasibility to have interaction as an energetic participator and in affirm with the standards of RME for the duration of the technique" states the importance of sophistication stage (Streefland, 1990). On this manner, it is aimed that the student will be capable to provide independently and discover their very own studying ways. There is developed a model for the instruction of RME course materials shown in **Figure 1** (Zulkardi, 2002).

Table 1. Percentages and interest achievement test specification table

Subjects	Gains	Number of Questions
Percentage calculations	Explain relationships between fractions and percentages	1, 2, 6, 16
	Calculates percentages used in shopping and commerce	3, 4, 7, 8, 9, 12, 15, 17, 18, 19
Interest calculations	Makes simple interest calculations	5, 10, 11, 13, 14, 20

When **Figure 1** is examined, the application order of Zulkardi (2002) in designing a lesson may be seen in precis form. it's miles viable to explicit this order as follows:

1) A real place to begin is adapted to the material at hand,
2) Hyperlinks are established among clues and beyond learning,
3) Students produce new fashions as a collection in the light of the available facts, and
4) During the course, students are provided to socialize with each other, talk, and paintings collectively.

Lesson level: This stage, which is likewise utilized inside the feel of popular degree, focuses on horizontal mathematization. Cansiz (2015) said that "A constrained variety of locally produced substances are applied to put in force the real line and keep it in existence." The students may be supplied with their personal fashions by way of assisting the materials with one-of-a-kind and unique materials at the theoretical stage.

Theoretical level: While horizontal mathematization is attempted to be found out at the elegance and path degree, the focus on the theoretical level is "vertical mathematization". All activities at the previous degrees, along with development and layout, educational discussions, and exercise within the lecture room, are appropriate materials for this degree (Gozkaya, 2015). As a result, preferred acquisitions and definitions are achieved via symbolizing impartial of materials. Further, a transition to a summary environment is finished via an actual-lifestyles physical model.

METHODS

In this study, a full design with pretest-posttest, that is one of the quantitative techniques of research, was used. Experimental research is a suitable studies layout for reason and effect (Balci, 2011). However, it is accurately desired as opposed to plastic in instructional materials.

Working Group

The pattern of the studies is the 7th grade students in the City of Shymkent. The experiment became performed with a complete of 48 college students within the 7A with 22 students and the 7B with 21 college students. Class 7A became chosen as experimental group and 7B as the control group.

Data Collection Tools

As a collection tool, the Achievement Test (AT) associated with percentage and interest, prepared by the researcher. Further, worksheets and activities have been developed by researcher to be used within the experimental group concerning the 7th grade percent and interest subject. Similarly, the opinion form prepared by Ersoy (2013) became applied to determine the evaluations of the experimental group students approximately RME.

Achievement Test

At the first stage, the researcher prepared 30 AT questions. A pilot application of a AT was applied to 65 8th grade students studying at a secondary school in Turkestan. As a result of the analysis, 10 questions were removed and an AT of 20 questions was obtained. Three mathematics teachers were consulted to ensure the validity of the content. After that, the necessary measures were taken and an AT of 20 questions was created. An AT specification table (**Table 1**) was prepared.

After the application, items with an item-total correlation of 0.30 and more are well-distinguished by students, items between 0.20-0.30 can be usen in the test if it is deemed necessary, or the item should be corrected, and items with a lower than 0.20 will not be used in the test (DiBattista & Kurzawa, 2011). It was revealed that it is manifested

Table 2. Percentages and outcomes of achievement test item analysis for the subject of interest

Item No	Item Total Correlation	(Under 27% – Upper 27%)
Q1	0.208	2.894
Q4	0.233	3.631
Q5	0.381	5.899
Q8	0.389	6.159
Q9	0.356	5.749
Q10	0.343	7.370
Q11	0.324	4.051
Q12	0.354	5.365
Q14	0.341	6.844
Q15	0.220	2.802
Q16	0.544	8.951
Q18	0.389	7.895
Q19	0.313	5.370
Q20	0.298	4.782
Q21	0.425	7.823
Q22	0.310	4.508
Q24	0.464	7.844
Q25	0.298	4.508
Q27	0.221	3.522
Q28	0.474	7.522

by a t-test between diseases and often occurs between diseases by 27%. With the common element of date and t-test, **Table 2** is in this application list.

By the results of the analysis of items, since the item 2, 3, 6, 7, 13, 17, 23, 26, 29, and 30 questions' discrimination index was less than 0.200, and researcher decided to exclude these questions from the test. Since the index of discrimination of questions 1, 4, 15, 20, 25, and 27 are in the range from 0.2 to 0.3, these questions were mended and comprised in the test. Since the discrimination indices for the other 14 questions were above 0.3, these items were left native in the test. As a result of statistics, KR-20 turned out to be equal to 0.762. Thus, the 7th grade percentage and interest AT, consisting of 20 questions, has acquired its final form.

Mathematics Worksheets

There have been prepared worksheets for experimental group to recognize the situation and clear up in the lesson. Eight worksheets were prepared and five of them related to the percentages, whilst others associated with the interests. Worksheets consist of the troubles associated with real life, that are student solving these troubles can believe wherein to use mathematical expertise. When appearing tasks, the trainer simplest directs the scholars and the students determine on their own. Once they had questions that they had the opportunity to speak about with friends.

Activities

Also, prepared activities for experimental group to apprehend the topic vs. From the six activities, four of them have been prepared with regards to percentage and others had been organized with reference to interest. For the duration of the implementation of the activities, the instructor only guided the students. It is aimed that scholars find a positive method or their personal answers as a result of activities. whilst the activity was finished, the children have been requested whether there has been a well-known solution approach and the solutions had been discussed.

Mathematics Opinion Form

To the experimental group students, a five-item opinion form developed by Ersoy (2013) was utilized, to decide the students' evaluations about the effectiveness of RME method. Within the opinion form, it became asked what their notion about the RME method, whether they preferred the usage of the approach and the reasons for this. In addition, it turned into attempted to accumulate information about the advantages of the method, whether or not the students need to educate once more with this technique.

Data Collection Process

After establishing the experimental group and control groups, AT was used as a pre-test on these groups. The 7A and 7B classes at Shymkent's "Bilim-Innovation" lyceum for girls were notified about the research before it began. The experimental group received RME-supported instruction, while the control group received conventional training. Daily life issues were used to introduce material to the experimental group. Each of these issues represented a genuine challenge for the learner. Definitions, background knowledge, and sample analyses were all included in the instruction given to the control group. The definitions and background knowledge on the topic were found by themselves of students during the RME-supported instruction. The pre-test was administered to the groups in the beginning of research. The first group-working classes were held on April 1. Throughout the course of the study, the lessons were delivered to the control group using the standard teaching methodology. The RME-supported teaching methodology was used to deliver the lessons to the experimental group. The experimental group used lesson plans created in accordance with RME, and the researcher himself delivered the lessons in both groups. In the experimental group, four to five students were divided into groups after first learning about RME.

Real-world issues are introduced to the pupils at the start of the class by writing them on the board. Students were divided into groups and instructed to solve issues collaboratively. The pupils were given enough time at this point to ponder, solve difficulties, work together, and understand the scenarios that will be presented in the tasks.

Students were invited to pose related problems as a second phase. The challenges the students generated were presented to their peers in class during a discussion, which allowed everyone to come up with solutions.

Worksheets created for each of the themes in the percentage and interest unit were given to the students in the third stage. With the worksheets, the students began to work through the issues by focusing on the subject's ideas. Since there was no rivalry between the groups, the students who figured out the challenges first aided their own friends in the group before assisting their friends in the other groups who required assistance. The lecture began with definitions of the topic in the control group. The teacher then answered the practice problems, and the solutions were then posted on the board for the pupils to solve. The following topic was introduced when the teacher and the pupils had satisfactorily solved the sample questions. The subjects were covered using the textbook in the control group. Both groups received education for four weeks.

Analysis of Data

The study used the SPSS package program to examine the data obtained from the accomplishment test and the attitude test. The analysis employed two separate tests. The variable we are interested in is virtually not bell-shaped. This is frequently referred to as not normally distributed in statistics. Consequently, Mann-Whitney U-test and Wilcoxon signed-rank test were applied to the analysis in this study.

Mann Whitney U-significance test's level was set at $p < 0.05$, while Wilcoxon signed-rank test's significance level was set at $p < 0.01$. KR-20 reliability coefficient was investigated for the accomplishment test reliability.

The experimental group of students were given an opinion form after the application and were then surveyed using the RME method to get their opinions on the topics of percentage and interest. Following the gathering of the opinion forms from the students, the responses each student provided to the form's five questions were reviewed. Following that, these responses were separated into positive and negative categories, and their quality was assessed by using examples from the mostly student-provided responses.

RESULTS

Alignment of Working Group

After randomly assigned to experimental and control group students, their pre-test scores on achievement and attitude were compared to see if the two groups were comparable. As a pre-test before to the application, the AT was administered to the experimental group and the control group, and the students' pre-test results were analyzed using Mann Whitney U-test. **Table 3** provides the outcomes that were attained. The mean rank of the students in the experimental group was 21.00, while the mean rank of the students in the control group was 23.05, according to **Table 3**. It appears that there is no statistically significant difference between the groups ($p > 0.05$). Based on this finding, it may be concluded that the two groups were equally successful prior to the experimental process.

Table 3. Mann Whitney U-test results regarding pre-test achievement scores of groups

Groups	n	Rank Average	Rank Sum	U	p
Experimental	22	21.00	463.00	208.00	0.589
Control	21	23.05	485.00		

Table 4. Wilcoxon signed-rank test results regarding the pre-test and post-test achievement scores of the experimental group

Post-/Pre-Test	n	Rank Average	Rank Sum	Z	p
Negative Rank	0	0.00	0.00	-4.126	0.000
Positive Rank	22	11.60	254.00		
Equal	0				

Table 5. Wilcoxon signed-rank test results regarding the pre-test and post-test achievement scores of the control group

Post-/Pre-Test	n	Rank Average	Rank Sum	Z	p
Negative Rank	4	7.14	28.60	-2.479	0.014
Positive Rank	14	10.19	143.50		
Equal	3				

Table 6. Mann Whitney U-test results regarding the post-test achievement scores of the groups

Groups	n	Rank Average	Rank Sum	U	p
Experimental	22	26.24	578.00	139.00	0.024
Control	21	17.58	368.00		

Findings Related to Achievement Test

The groups' pre- and post-test results were compared once application was complete, and differences were looked at. The results of the pre- and post-test of the groups were used to conduct Wilcoxon signed-rank test for this purpose. **Table 4** contains the results of Wilcoxon signed-rank test utilizing the pre-and post-test scores of the students in the experimental group.

After the application, pre- and post-test scores of the students in the experimental group are substantially different ($p < 0.01$), according to an analysis of **Table 4**. It is obvious that the difference favors the positive rankings, or the post-test score, when the mean rank and sums of the difference scores are considered.

Wilcoxon signed-rank test was run to see whether the differences between the control group's pupils' pre-and post-test results were meaningful. **Table 5** provides the outcomes that were attained.

Analysis of **Table 5** reveals that the difference between the test results of the control group students before and after the application is statistically significant ($p < 0.05$).

The question: "Was there a significant difference between the post-test scores of the students in the experimental and control groups?", was finally answered using Mann Whitney U test. **Table 6** provides the outcomes that were attained.

Table 6 shows that the experimental group's mean rank was 26.24, whereas the control group's mean rank was 17.58. It was discovered that there was a statistically significant difference between these two groups ($p < 0.05$). The group in which RME was applied had greater accomplishment scores than the group in which RME was not applied, as shown by the mean rank.

Findings on Attitude Test

The findings of the pre- and post-test for two groups were compared once the application was complete to see whether there had been any changes. With respect to the results of the pre- and post-tests for each group, Wilcoxon signed-rank test was used. **Table 7** contains Wilcoxon signed-rank test findings.

Table 7. Wilcoxon signed-rank test results regarding the pre-test and post-test attitude scores of the experimental group

Post-/Pre-Test	n	Rank Average	Rank Sum	Z	p
Negative Rank	6	7.59	45.60	-2.632	0.009
Positive Rank	16	12.98	208.50		
Equal	0				

Table 8. Wilcoxon signed-rank test results regarding the pre-test and post-test attitude scores of the control group

Post-/Pre-Test	n	Rank Average	Rank Sum	Z	p
Negative Rank	11	9.19	103.00	-0.676	0.498
Positive Rank	7	10.00	70.00		
Equal	3				

Table 9. Mann Whitney U-test results regarding the post-test attitude scores of two groups

Groups	n	Rank Average	Rank Sum	U	p
Experimental	22	27.83	613.00	104.00	0.002
Control	21	15.80	335.00		

Analysis of **Table 7** reveals a significant difference between the experimental group students' pre- and post-test scores at the conclusion of the application ($p < 0.01$). It is clear that the observed difference is in favor of the positive rankings, or the post-test score, when the mean rank and sums of the difference scores are examined.

The significance of the changes in the pre- and post-test scores of the students in the control group was evaluated using Wilcoxon signed-rank test. **Table 8** provides the outcomes that were attained.

Analysis of **Table 8** reveals that there is no statistically significant change between the pre- and post-test scores of the control group students following the application ($p > 0.01$).

When the application was complete, Mann Whitney U-test was used to determine whether there was a significant difference in the post-test scores of the students of the groups. The outcomes are displayed in **Table 9**.

When **Table 9** is studied, it is seen that the experimental group's mean rank is 27.83, whereas the control group's mean rank is 15.80. It was determined that there was a statistically significant difference between the groups ($p < 0.050$). The group in which RME was administered had higher attitude ratings toward mathematics than the group in which RME was not applied, it became obvious from the analysis of the mean rank.

Information Gleaned from Opinion Form

The data received from the opinion form were analyzed by dividing them into positive and negative categories for each question.

Student opinion on the first question: What are your views on realistic mathematics education?

Positive answers

It is excellent since it facilitates our daily lives. The questions now have much more fun. As a group, I believe it's much better.

I enjoy the class and don't grow tired with it as a result.

Friends of ours who had never been to class joined the group and took a seat at the board. It seemed like a lot of fun.

Before, I couldn't grasp mathematics, but now I can.

I began studying more since it was so detailed. I increased my standing up.

It will probably be necessary in our day-to-day lives.

Negative answers

When some buddies created noise, it was difficult for me to comprehend, but it was fantastic because I had fun.

When the replies are studied, it becomes apparent that the students' responses to the first question are favorable and that they have good opinions about RME. Many students reported that the majority of them found the lesson enjoyable and that this manner allowed even their friends who never attended lessons. Due to the distractions throughout the class, two students said they did not grasp portions of it.

Student opinion on the second question: Do you like teaching lessons with realistic mathematics education? Why?

Positive answers

Yes. I can better comprehend that method.

Yes. Because the group's knowledgeable friends assisted us when we were unable to find the answers to the questions.

I acquired a variety of problem-solving methods. I enjoyed myself while learning.

Yes. Because of the attendance of our friends who had never taken the class, I really enjoyed it.

Negative answers

The mathematics worked extremely well on occasion and poorly on sometimes. because I did not want to hang out with one girl in my group.

Analysis of the second question's responses shows that the majority of the responses are favorable. It is evident that a student who voiced disapproval grumbled about being in the same group as a buddy with whom he had previously had difficulties. The applied strategy is typically well-liked by the students, according on the replies offered when taken as a whole.

Student opinion on the third question: What are the benefits of RME supported teaching for you?

Positive answers

We avoid being taken advantage of when shopping thanks to it.

While shopping, I didn't comprehend the label discounts; now I do.

In a group, I comprehend things more clearly.

I go to a better lesson, where we learn with affection.

I seek friends advice on issues I don't comprehend.

Negative answers

The students did not share any unfavorable thoughts on this question.

Analysis of the third question's responses reveals that the participants were happy with the lesson's teaching strategy. Students claimed that using this strategy made mathematics easier to understand, more enjoyable, easier to apply to their daily lives.

Student opinion on the fourth question: Would you like to learn again with RME supported teaching method? Why?

Positive answers

Yes, I'd adore doing it. because learning is a lot of fun.

At first, I didn't like it, but later, I did.

Yes, I would since we don't even comprehend what happened in class.

A lot. With this approach, I began to comprehend more.

Negative answers

I would want to be in a different group.

No, since I'm not good at math.

When the responses were evaluated, it became apparent that most students desired to use this style once more, however some of them had unfavorable emotions for a variety of reasons. When the causes of these reactions were examined, it became clear that one student's dissatisfaction with his group was due to the presence of his friend in the group, and that some students were adversely affected by the noise during activities and in-group discussions and expressed negative thoughts.

Student opinion on the fifth question: How has your thoughts on mathematics changed after the training with RME?

Positive answers

I had always enjoyed math, and I began to love it even more.

I now find mathematics to be enjoyable.

My enthusiasm for mathematics grew.

I've stopped having stupid ideas. I feel comfortable with mathematics now. I'm confident enough to stand on the board.

Negative answers

My thoughts haven't really altered.

When the responses to the fifth question were examined, it became evident that the use of this strategy had had a favorable impact on the students' attitudes about math. Some students were heard saying things such, "I enjoyed the instruction, it was fun, and I liked mathematics anyhow." It was noted that the student who responded negatively also had unfavorable opinions on other courses.

DISCUSSION

The findings of the experimental group before and after testing differ significantly, according to the statistical analyses performed. Pre- and post-test outcomes in the control group differ, and when we compare them, we can see that the RME methodology is far more successful than the conventional approach. The efficiency of the RME-supported teaching approach in mathematics sessions was also evaluated by the researchers Ersoy (2013) and Bildircin (2012), who obtained results that demonstrated the usefulness of RME. These experimental work's results are somewhat linked to those of Ersoy (2013) and Bildircin (2012).

Fauzan (2002) in his research work made analyzes on the results of the experimental and control groups, and in order to find out the opinions of the students in the experiment, he made a survey for the students of the experimental group. His investigation demonstrated the efficacy of RME. Through observation and interviews with the experimental group, both groups also discovered that they appreciated the RME method and that the students found it helpful (Fauzan, 2002).

According to research works, there is a statistically significant difference between the academic achievement retention scores of the group that participated in activities created using Can's (2012) Realistic Mathematics Education approach and the group that participated in constructivist activities (Tunali, 2010). Similar to this, Ersoy (2013) concluded that the teaching approach supported by Realistic Mathematics Education improved student achievement and had a favorable impact on retention.

However, based on the case of this study being conducted in a girls' lyceum, there is a possibility that gender distribution may influence the results of the analysis. In the future, it can be thought that more research is needed in this direction in order to better understand whether this will affect the results.

CONCLUSION

The purpose of this study was to analyze the impact of teaching 7th grade mathematics using the RME technique on students' success as well as to find out what the students thought about this method of instruction. The achievement pre-test results applied to the experiment group and control group were assessed at the beginning of the application, and it was evident that there was little difference between the two groups in terms of achievement

scores, but fairly close. It can be proven that the experimental 7A and control 7B groups are comparable in this instance. The analyses revealed that there was a substantial difference between the experimental group's pre- and post-test scores. As a result, it can be said that the RME-based instruction was successful.

Do the students of control group's pre- and post-test achievement scores differ? The analyses performed to address the question show that there is a sizable difference. It is obvious that the average is greater, and the difference is more noticeable in the experimental group. In this instance, we may conclude that the RME's influence on the experimental group is greater than the effect of the approach used in the present program when applied to the control group. At the conclusion of instruction, both groups' success rates increased, but the experimental group's success rate increased more than the control group's, whose success rate increased as a result of the use of the teaching strategy recommended by the present curriculum.

The RME approach was generally well-liked by the students, they enjoyed it, it helped them overcome their anxieties about math, and they wanted to use it in the classroom, according to the results of the opinion form used with the experimental group. The facilitation of the students' learning process and an improvement in their collaboration have both been seen when lessons are taught in groups. Additionally, it was noted that some students, however marginally, had an unfavorable attitude of the RME approach. However, it might be stated that these issues have more to do with the application design than the RME's capabilities.

The students also noted that even when information is not repeated in class, students retain it, and this demonstrates the effectiveness of the RME method. Many students solve the worksheet questions quickly using proportion and mental calculations.

RECOMMENDATIONS

The research has shown that using the RME approach has a good impact on students' attitudes, achievements, and retention of the material they have learnt. The following suggestions can be made in light of these findings.

- A research may be done to find out how much RME knowledge new mathematics instructors have, and courses can be developed to give in-service training on the technique.
- Studies with undergraduate mathematics students or the material of a different course might be used to demonstrate this strategy.
- Lesson plans should be created in advance by teachers who plan to apply the RME approach in their classes. It requires a lot of time. The length of the lesson may be changed more readily with the preparations that need to be made. Additionally, rather of focusing on answering students' queries, teachers should take on the role of guides in the classroom and encourage students to work through problems on their own.
- If students are aware about RME prior to beginning the application, the instructional process will be more effective
- To gain the opinions of the students on how the subjects taught will help them in their everyday lives, appropriate discussion spaces can be built.
- Additionally, the RME technique may be applied with groups at various levels and in a variety of topic areas, allowing future study to evaluate how it affects students' academic progress in subjects other than algebra.

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