



The Effects of Realistic Mathematics Education on Students' Math Self Reports in Fifth Grades Mathematics Course

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Abstract

The aim of this research is to analyze the effects of realistic mathematics education on students' self-reports on the 'numbers and operation' unit of the 5th grades mathematics course. For this reason, two classes were randomly identified. After seeing that the groups were equivalent using the Achievement Test of Group Equivalency (ATGE), Achievement Test of Learning Domain (ATLD) and Mathematics Self-Report Inventory (MSRI) were applied to both groups. The application was continued for 7 weeks until the end of unit. The experimental group was learned the unit using the Realistic Mathematics Education (RME) based activities. On the other hand, the control group was taught the unit using the course book suggested by the Ministry of Education. Learning area achievement test and mathematics self-report inventory were conducted again as posttests, and the results were evaluated by comparing them with the pre-test results. After this comparison, it was seen that self-reports of the students who were taught in accordance with the Realistic Mathematics Education were higher than the students who were taught by classical methods.

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Keywords: mathematics education, mathematics self-report inventory, realistic mathematics education (RME)

1. Introduction

Realistic Mathematics Education (RME) is a mathematics education approach developed under the body of Utrecht University, Freudenthal Institute in Holland by a Dutch mathematician and instructor, Hans Freudenthal in 1971 (Çakır, 2013). Hans

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Freudenthal argued that from a historical perspective, mathematics started with real-life problems and before being transformed into a formal system, the real life was turned into a mathematical format. Freudenthal added that rendering formal mathematics information prior to the practice stage was an anti-didactical learning method (Altun, 2006). Realistic Mathematics Education (RME) claims that mathematics is essential to be in close contact with child-oriented cases taking place in daily life, while the truth is “Realistic” as a term is far from reflecting a connection with the real world. Realism refers to real-case problems in students’ mind. Equally effective as the fantastic world of fables, the formal universe of mathematics can provide a problem-respondent context so long as it can fit into the “real category” in students’ minds (Demirdöğen and Kaçar, 2010). One of the key factors affecting any learning processes is motivation. Motivation can be defined as a myriad of intrinsic and extrinsic factors driving an organism toward action and determining the continuity and regularity of such actions as well as gaining an objective and direction to those behaviors. Motivation also refers to all mechanisms that enable them to properly function (Aydın, 2001). Individuals get motivated on the issues of self-sufficiency, problem solving, task accomplishment, making sense of the self and one’s surrounding and coping with a challenge. Students’ motivation toward learning and achievement has been a long-time neglected factor in professional education curriculums although it is recognized as the utmost critical component of the curriculums. One of the factors underlining the failure of a well-designed and implemented curriculum has been attributed to the low-motivational level of students taking the course (Gökcül, 2007). Regardless of a wealth of studies highlighting the significant effect of mathematics motivation on students’ mathematics achievement, it is well worth noticing that experimental studies in this domain pay heeds to mathematics achievement rather than students’ motivation.

Motivation theories are trying to reveal the energy or movement of the student against the activity and the relative in education (Pintrich and Schunk, 2002). The use of appropriate methods and techniques by the teachers in the elementary schools to attract them to the students will help to motivate the students and help them gain the desired level of concepts (Cavallo, Miller and Saunders, 2002). The expectation-value theory based on success motivation inspires many socio-cognitive constructs, and in recent years there have been many important studies on academic motivation within the framework of this theory. (Chouinard, Karsenti and Roy, 2007). According to Atkinson, as the level of subjective probability of expectation of success increases, the value of the incentive decreases and this causes the motivation to fall. Eccles et al., (1983) described students’ beliefs about expectations and mission values about mathematics and their academic performances, determination and choice, directly related to Atkinson’s (1957) theory of success motivation. Although the Math Anxiety scale (Richardson & Suinn, 1972), which is often used in research, measures the fear of mathematics, it appears that it is inadequate and fails to measure other values related to mathematics (Luttrell et al.,

2010; Bindak, 2005) developed a mathematics anxiety scale for elementary school students in his study, and this scale only measured sentiments about anxiety, fear and anxiety about mathematics. The absence of studies that measure the expectations and values of students about mathematics and examine the interrelationships of these components is a major drawback. In Eccles, Barber and Jozefowicz (1998) study, it was found that female students had higher scores on reading tasks than male students, whereas male students were found to have higher scores on science and mathematics than female students. Handel's (1986) study of high-achieving students in grades 7 and 8 with a math achievement test score of 95 on the basis of modern expectation-value theory based on achievement motivation showed a significant difference in perceptions of usefulness between mathematics and boys, Male and female students had a higher proportion of male students perception of high utility value related to mathematics. Although Handel (1986) did not find a significant difference in perceptions of usefulness about mathematics among boys and girls in the survey conducted by high-achieving students in the 7th and 8th grade in the framework of modern expectation-value theory based on achievement motivation, the proportion of male students was found to be higher in the sense of high Practicality Value. In the researches made in recent years (Chouinard, Karsenti and Roy, 2007; Mason, 2003; Watt, 2000; Luttrell et al., 2010), it has been revealed that the belief that the values given to mathematics by girls and the expectation of success are at the same level with men and that there is no meaningful difference between mathematics achievement expectancy and value belief according to gender. In the research findings of Eccles et al. (1993), it was found that the positive beliefs about mathematics, reading, music and sports interest abilities decreased or decreased as the age and grade level of primary school students increased. In a three-year study conducted by Wigfield et al. (1997), the interest, usefulness, and beliefs of primary school students on task interest, mathematics, reading, music and sports activities were evaluated. In the study findings, as learners age and class levels grew, their interest in mathematics, reading, music and sports activities, interest and importance belief scores fell. In studies that take into account class and age levels, it has been observed that the beliefs of younger learners about achievement expectations and mission values are quite positive. As the age and class level of primary school students grow, expectations of success and beliefs of mission values become more negative and low. The reason for this is that primary school students' expectations of success as they grow older may stem from their more accurate and realistic attitude about their abilities and mission beliefs (Xiang, P., McBride, R., Guan, J. and Solmon, M., 2003).

In this study, based on the expectation-value theory grounded on achievement motivation among middle school students, it was aimed to apply a measurement tool (Akin, 2011) demonstrating the participants' mathematics self-reports. From this aspect, this research is valued in terms of providing insights on the functionality of current

mathematics programs (curriculums) in addition to manifesting students' attitudes towards mathematics course.

1.1. Problem Statement

“Does teaching numbers and operation unit of the 5th grade mathematics course via Realistic Mathematics Education method have any effects on mathematics self-reports of the students?”

2. Method

2.1. Model

The effects of teaching numbers and operation unit, which is the first unit in elementary education 5th grade mathematics course, via Realistic Mathematics on the mathematics self-reports of the students constituted the experimental dimension of this study. This dimension was executed via pretest - posttest control-grouped pattern. From the equivalent classes, a randomized selection was conducted to assign test and control groups and in both groups pretest and posttest measurements were applied.

2.2. Populations

The research population consisted of a total of 45 fifth graders having studied in Antalya city- Muratpaşa District X School during 2014-2015 academic year. Random selection was performed to choose one class as experimental group (n=23), and the next class as control (n=22) group. In order to determine selected academic achievement equivalency between test and control groups prior to the implementation stage, the students' 2013-2014 academic year mathematics course average scores were obtained initially on the basis of the students' average written exam scores. Arithmetic mean of the obtained scores was measured and the divergence computed in between was tested via unrelated samples t-test.

2.3. Limitations

This research is limited by

1. 2014-2015 academic year, 1st semester, numbers and operations unit,
2. Antalya city- Muratpaşa district, X school, 5th grade classes,
3. Data obtained from achievement test of group equivalency, achievement test of learning domain, mathematics self-report inventory.

2.4. Data Collection Tools

2.4.1. Achievement Test of Group Equivalency

To develop Elementary Education 4th grade Achievement Test of Group Equivalency (ATGE) Mathematics course curriculum of the fourth graders was analyzed and the curriculum was classified as per course acquisitions. A total of 31-question multiple choice test, composed of minimum one question item for each single acquisition, was devised. 31-question multiple choice test form covering all objectives was implemented among 228 fifth graders in sum, excluding the students in population. Difficulty indexes and discriminatory power indexes of the items were computed via Microsoft Excel and Statistica program. In the item selection process, particular attention was paid to select the items of whose difficulty level was on average degree and discriminatory value was above 0.25 (Turgut, 1984; Tekin, 1993). As the attainability level with respect to acquisitions was analyzed, the percentage of correct answers for the test questions and frequency values were contrasted with the 70% critical value (Büyüköztürk, 2010). To investigate whether a pre-relation existed between the behaviors mentioned, tetrachrotic correlation coefficients were harnessed. The better one of the two items measuring the same behavior was selected based on these criteria and the final format of 25-item Achievement Test of Group Equivalency was hence devised. At the end of the conducted analyses, average item difficulty of the test was measured as 0.49 and KR20 reliability coefficient was measured as 0.75. It was then concluded that the final format of 25-item Achievement Test of Group Equivalency of whose validity and reliability tested was effective in measuring pre-designated acquisitions and also exhibited a high level of reliability value. The devised test was also utilized in comparing group equivalency. Its application among the population was actualized during the third week of September in 2014-2015 academic year.

2.4.2. Achievement Test of Learning Domain (ATLD)

In order to monitor the achievement processes of the students and develop an achievement test for elementary education 5th grade Mathematics course 1st unit (numbers and operation) the curriculum was analyzed and program acquisitions were designated. In line with designated acquisitions, a table of specifications was created and minimum 2 question items were stated to meet each single acquisition. Based on the developmental features of 5th grade students in middle school, the question items were designed as four-choice questions. To ensure the content validity of the measurement tool, expert views were taken to validate whether the item had the desired quality to measure target acquisitions; whether these items fit into spelling rules; or the items fit into semantic and content validity; whether the distractors matched the item; or the correct response fit into the item; or proved to be scientifically accurate, and technical specifications of the overall test and test items were organized thus. Within the

framework of views of the experts specialized in the measurement and evaluation in education and elementary education teaching of mathematics, necessary corrections were made on the item list. A 50-question multiple-choice achievement test covering all the acquisitions were applied among a total of 102 sixth-grade students; excluding the experimental group population who had studied these units earlier. Difficulty indexes and discriminatory power indexes of the items were computed via Microsoft Excel and Statistica program. In item selection process, particular attention was paid to select the items whose difficulty level was in average degree and discriminatory value was above 0.25 (Turgut, 1984; Tekin, 1993). As the attainability level with respect to acquisitions was analyzed, the percentage of the correct answers for the test questions and frequency values were contrasted with the 70% critical value (Büyüköztürk, 2010). To investigate whether a pre-relation existed between the cited behaviors, tetrachrotic correlation coefficients were harnessed. The better one of the two items measuring the same behavior was selected based on these criteria and the final format of 25-item Achievement Test of Group Equivalency was then devised. At the end of the conducted analyses, average item difficulty of the test was measured as 0.49 and KR20 reliability coefficient as 0.75. It was then concluded that the final format of 25-item Achievement Test of Group Equivalency of whose validity and reliability was tested and proved not only to be effective in measuring pre-designated acquisitions but also exhibited a high reliability value.

2.4.3. Mathematics Self Report Inventory (MSRI)

Developed by Akin (2011), Mathematics Self report Inventory (MSRI) based on expectation-value theory of Eccles et al.'s (1983) achievement motivation is a measurement tool designed to identify mathematics self-reports of second grade students of elementary education. Consisted of 33 items, the tool was collected under five dimensions defined as; “interest value”, “practicality value”, “achievement value”, “personal value” and “achievement expectations”. Accordingly, the definitions of these dimensions are;

Interest Value: It relates to the pleasure a student derives while performing an activity or sympathy that a student cultivates to the topic involving a particular task or activity (Eccles and Wigfield, 2002).

Practicality Value: Practicality value relates to the extent that an individual's performed task can meet his/her present and future objectives (career objectives etc.) (Eccles and Wigfield, 2002) and this concept aims to measure the significance and necessity of one task for the individual.

Achievement Value: Achievement value relates to the significance extent of aptly performing any commissioned task (Eccles and Wigfield, 1995).

Personal value: Eccles et al., defined personal value as a critical component value (Eccles et al., 1983). Personal value refers to the negative conception of the task; in

addition to the feeling of anxiety about being successful or failing and worries about task performance level, it relates to the effort paid for the need of achievement and opportunities forsaken for selected decisions (Eccles and Wigfield, 2002).

Achievement Expectations: Faith toward achievement expectations relates to a student's idea/conception in his/her ability of accomplishing present, long and short term potential tasks (Eccles et al., 1983). Five-point Likert scale was utilized in the inventory. Reliability coefficient (Cronbach Alfa coefficient) was measured as 0.87 by the researcher having devised the inventory.

2.5. Data Collection

The research was carried out in Antalya/Muratpaşa district X middle school 5/D and 5/E classes after the official permissions were obtained. The 5/E class was designated as the experimental group and the 5/D class was designated as the control group by random assignment. Math self-report inventory (MSRI) and achievement test of learning domain (ATLD) were applied as pre-tests to the experimental group and the control group before the experimental process. Lectures in both classes were conducted by a teacher regularly trained by the researcher. National and international studies on realistic mathematics education have been reviewed. Interrelation has been provided with the Freudenthal Institute, which is studying on realistic mathematics education in Holland. After cooperation with the institute, resources and activities were reviewed. The lesson plans and activities related to the numbers and operations unit have been prepared in line with the realities of mathematics education and the attainments of the Ministry of Education. After expert opinions were taken, 15 activities were prepared with the principles of RME. Attention has been paid to the creation of an environment in which students can work, experiment, and communicate with each other during the activities prepared based on RME. In this process, which is called horizontal and vertical mathematization, reaching the knowledge about the mathematics of the students themselves was aimed. In the experimental group, the attainment of the mathematical process is to ensure that students deal with everyday problems with realistic mathematical education approach. At the end of the lessons based on realistic mathematics education, "Let's evaluate ourselves" section of the textbook were given as homework. The lessons in the control group were processed by following the current teacher's manual book. Activities in the course book have been done and the sections "Let's evaluate ourselves" at the end of the chapter have been given as homework. The study lasted for 7 weeks at the end of the first unit. MSRI and ATLD were applied again as posttests after the experimental process applied to the experimental and the control groups.

2.6. Data Analysis

To detect if pretest-posttest scores students received from achievement test of learning domains and self-report inventory significantly varied with respect to groups, all collected data were analyzed via unrelated samples t-test. Therefore, as to identify if a significant difference existed between pretest-posttest scores within the test and control groups themselves, related samples t-test was applied. In the comparison of the significance level between average scores, their effect size was also measured. In measuring the effect size for statistical methods (single group t-test, related samples t-test, etc.) that computed the difference between average scores of two groups, Cohen's *d* formula (Cohen, 1988) is a widely popular method. To make computations via Cohen's *d* formula, it is required to obtain groups' average scores and blended standard deviation information. Without taking notice of Cohen's *d* value that could potentially receive a value between $-\infty$ and $+\infty$ the effect size of 0.2 was interpreted as “small”, “medium” for 0.5 and “large” for 0.8 (Büyüköztürk, Bökeoğlu and Köklü, 2009). In social sciences and behavioral sciences it is suggested to accept effect size 0.5 as (medium) (Cohen, 1988). A statistically significant difference or smallness of the effect size computed for the relation indicates that a relation existed between variables or a difference was seen between groups; however, this relation or difference was most probably too insignificant to hold value in practice stage. On the other hand, Cohen's *d* value is also used to predict sampling size. Small size effects obtained via Cohen's *d* formula indicated the necessity for a larger sampling size (Özsoy and Özsoy, 2013). In the interpretation of the results for all analyses, 0.05 significance level was the accepted value.

3. Findings

In order to detect if pretest-posttest scores students received from achievement test of learning domains and mathematics self-report inventory significantly varied with respect to groups, the collected data were analyzed via unrelated samples t-test. Hence, to identify whether or not a significant difference existed between pretest-posttest scores within the test and control groups themselves, related samples t-test was applied.

3.1. Research Findings

Problem statement of the research was “does teaching numbers and operation unit of the 5th grade mathematics course via realistic mathematics education method has any effects on mathematics self-reports of the students?” Accordingly, to detect if pretest-posttest scores students received from mathematics self-report inventory significantly varied with respect to the groups, the collected data were analyzed via unrelated samples t-test.

Pretest-posttest scores students received from mathematics self-report inventory were analyzed independently for the dimensions of “interest value”, “practicality value”, “achievement value” and “personal value”.

Results of the analysis on **Interest value** were presented in Table 3.1 and Table 3.2.

Table 3.1

The comparison of Pre-Test Interest Value Scores of Test and Control Groups

Group	N	X	S	sd	T	P
Test	23	3.44	0.67	43	-0.921	0.362
Control	22	3.64	0.79			

At the end of the t-test results, significance value of the pretest interest scores was measured above 0.05 ($p=0.362 > 0.05$) indicating that average interest value scores of the groups presented insignificant difference.

Table 3.2

The comparison of Posttest Interest Value Scores of the Test and Control Groups

Group	N	X	S	sd	t	p
Test	23	4.27	0.38	43	11.830	0.000
Control	22	3.19	0.17			

Since at the end of the t-test results, the significance value of posttest interest scores was below 0.05 ($p=0.000 < 0.05$). It is detected that a significant difference existed between average interest value scores of the groups. Arithmetic mean of the interest value posttest scores of the experimental group ($\bar{X}=4.27$) was higher than arithmetic mean of the control group ($\bar{X}=3.19$). At the same time, the measured Cohen d value demonstrated that the difference between average scores has around 3.66 standard deviation. According to the effect size correlation (0.87) value that is the equivalent of the computed Cohen d value the program implemented for this variable has a “large” effect size. It was thus concluded that self-report inventory interest value scores of the group significantly differed in favor of the experimental group having received Realistic Mathematics Education.

Upon the experimental process that manifested that with respect to self-report inventory interest value scores of the test and control groups, the experimental group proved to be more successful; it was then aimed to unveil the relation between pretest-posttest scores within the test and control groups themselves. To reveal whether a significant difference existed between the test and control groups within themselves,

related samples t-test analysis was conducted and the results of this analysis were as tabulated in Table 3.3 and Table 3.4.

Table 3.3

The comparison of the Pretest – Posttest Interest Value Scores of the Experimental group

Group	N	X	S	sd	t	p
Pretest	23	3.44	0.67	22	-6.933	0.000
Posttest	23	4.27	0.38			

At the end of t-test, it was concluded that the significance value of pretest-posttest interest value score of the test was below 0.05 ($p=0.000 < 0.05$); thereby indicating that not a significant difference existed between interest value average scores of both groups. Arithmetic mean ($\bar{X}=4.27$) of the experimental group's interest value, the posttest scores is above the arithmetic mean ($\bar{X}=3.44$) of pretest score. Besides, the computed Cohen d value points that there is approximately 1.52 standard deviation between average scores. According to effect size correlation (0.60) value that is the equivalent of computed Cohen d value, the program applied for this variable has “medium” effect size. It was thus concluded that the self-report inventory interest value scores of the experimental group significantly differed in favor of posttest scores.

Table 3.4

The comparison of the Pretest – Posttest Interest Value Scores of the Control Group

Group	N	X	S	sd	t	p
Control (pre)	22	3.64	0.79	21	2.783	0.011
Control (post)	22	3.19	0.17			

It was detected at the end of the conducted t-test that the control group's pretest-posttest interest value scores had a significance value below 0.05 ($p=0.011 < 0.05$); thereby indicating that not a significant difference existed between average interest value scores of the group. The arithmetic mean of ($\bar{X}=3.19$) the control group's posttest scores of the interest value was lower than the arithmetic mean ($\bar{X}=3.64$) of the pretest score. Moreover, the computed Cohen d value shows that the difference between average scores has circa 0.78 standard deviation. According to effect size correlation (0.36) value that is the equivalent of computed Cohen d value, the program applied for this variable has “small” effect size. It was thus concluded that the self-report inventory interest value scores of the control group differed significantly in favor of pretest scores.

Based on the findings exhibited in Table 3.3 and Table 3.4, it can be argued that in the implementation of Realistic Mathematics Education, a significant level of pretest and

posttest average scores of the experimental group was higher in comparison to the control group.

Findings on the analysis of **Practicality Value** dimension were as exhibited in Table 3.5 and Table 3.6.

Table 3.5

The comparison of the Pretest Practicality Value Scores of the Test and Control Groups

Group	N	X	S	sd	t	p
Test	23	2.06	0.45	43	-1.080	0.286
Control	22	2.23	0.57			

It was detected at the end of the conducted t-test that all groups' pretest practicality value scores had a significance value below 0.05 ($p=0.286 > 0.05$); thereby indicating that not a significant difference existed between the average practicality value scores of the groups.

Table 3.6

The comparison of the Posttest Practicality Value Scores of the Test and Control Groups

Group	N	X	S	sd	t	P
Test	23	4.06	0.45	43	13.477	0.000
Control	22	2.52	0.28			

It was seen at the end of the conducted t-test that all groups' posttest practicality value scores had a significance value below 0.05 ($p=0.000 < 0.05$); thereby indicating that not a significant difference existed between the average practicality value scores of the groups.

The arithmetic mean of ($\bar{X}=4.06$) the experimental group's posttest scores of practicality value was higher than the arithmetic mean ($\bar{X}=2.52$) of the control group. Furthermore, the computed Cohen d value shows that the difference between average scores has circa 4.11 standard deviation. According to the effect size correlation (0.90) value that is the equivalent of the computed Cohen d value, the program applied for this variable has "large" effect size. It was thus concluded that the self-report inventory practicality value scores of the groups differed significantly in favor of the experimental group having received Realistic Mathematics Education.

Upon the experimental process that manifested that with respect to self-report inventory practicality value scores of the test and control groups, the experimental group proved to be more successful; it was then aimed to unveil the relation between the pretest-posttest scores within the test and control groups themselves. To reveal whether

a significant difference existed between the test and control groups within themselves, related samples t-test analysis was conducted and the results of this analysis are as tabulated in Table 3.7 and Table 3.8.

Table 3.7

The comparison of the Pretest – Posttest Practicality Value Scores of the Experimental group

Group	N	X	S	sd	t	p
Pretest	23	2.06	0.45	22	-12.024	0.000
Posttest	23	4.06	0.45			

It was seen at the end of the conducted t-test that experimental group's pretest-posttest practicality value scores had a significance value below 0.05 ($p=0.000 < 0.05$); thereby indicating that not a significant difference existed between the average practicality value scores of the experimental group.

The arithmetic mean of ($\bar{X}=4.06$) the experimental group's posttest scores of practicality value was higher than the arithmetic mean ($\bar{X}=2.06$) of the pretest score. Besides, the computed Cohen d value shows that the difference between average scores has roughly 4.44 standard deviation. According to the effect size correlation (0.91) value that is the equivalent of computed Cohen d value, the program applied for this variable has "large" effect size. It was thus concluded that the self-report inventory practicality value scores of the experimental group differed significantly in favor of the posttest scores.

Table 3.8

The comparison of the Pretest – Posttest Practicality Value Scores of the Control Group

Group	N	X	S	sd	t	p
Control (pre)	22	2.23	0.57	21	-3.699	0.001
Control (post)	22	2.52	0.28			

It was monitored at the end of the conducted t-test that control group's pretest-posttest practicality value scores had a significance value below 0.05 ($p=0.001 < 0.05$); thereby indicating that a significant difference existed between the average practicality value scores of the experimental group. The arithmetic mean of ($\bar{X}=2.52$) the control group's posttest scores of practicality value was higher than the arithmetic mean ($\bar{X}=2.23$) of the pretest score. In addition, the computed Cohen d value manifests that the difference between average scores has around 0.64 standard deviation. According to the effect size

correlation (0.30) value that is the equivalent of the computed Cohen d value, the program applied for this variable has “small” effect size. It was thus concluded that the self-report inventory practicality value scores of the control group differed significantly in favor of the posttest scores. Based on the findings exhibited in tables 3.7 and 3.8, it can be claimed that in the implementation of Realistic Mathematics Education, a significant level of the pretest and posttest average scores of the experimental group was higher in comparison to the control group.

Findings on the analysis of the **Achievement Value** dimension are as exhibited in Table 3.9 and Table 3.10.

Table 3.9

The comparison of the Pretest Achievement Value Scores of the Test and Control Groups

Group	N	X	S	sd	T	p
Test	23	3.32	0.66	43	-0.28	0.774
Control	22	3.40	1.28			

It was seen at the end of the conducted t-test that all groups’ pretest achievement value scores had a significance value below 0.05 ($p=0.774 > 0.05$); thereby indicating that not a significant difference existed between the average achievement value scores of the groups.

Table 3.10

The comparison of the Posttest Achievement Value Scores of the Test and Control Groups

Group	N	X	S	sd	T	p
Test	23	4.33	0.40	43	13.477	0.034
Control	22	4.58	0.33			

It was seen at the end of the conducted t-test that all groups’ posttest achievement value scores had a significance value below 0.05 ($p=0.034 < 0.05$); thereby indicating that a significant difference existed between the average achievement value scores of the groups.

Arithmetic mean of ($\bar{X}=4.58$) the experimental group’s posttest scores of achievement value was higher than the arithmetic mean ($\bar{X}=4.33$) of the control group.

Besides, the computed Cohen d value manifests that the difference between average scores has around 0.68 standard deviation. According to the effect size correlation (0.32) value that is the equivalent of the computed Cohen d value, the program applied for this variable has “small” effect size. It was thus concluded that the self-report inventory

achievement value scores of the two groups significantly differed in favor of the experimental group having received Realistic Mathematics Education.

Upon the experimental process that manifested that with respect to self-report inventory achievement value scores of test and control groups, the experimental group proved to be more successful; it was then aimed to unveil the relation between the pretest-posttest scores within the test and control groups themselves. To reveal that whether a significant difference existed between the test and control groups within themselves, related samples t-test analysis was conducted and the results of this analysis are as tabulated in Table 3.11 and Table 3.12.

Table 3.11

The comparison of the Pretest– Posttest Achievement Value Scores of the Experimental group

Group	N	X	S	sd	t	p
Pretest	23	3.32	0.66	22	-8.349	0.000
Posttest	23	4.33	0.40			

It was seen at the end of the conducted t-test that the experimental group's pretest-posttest achievement value scores had a significance value below 0.05 ($p=0.000 < 0.05$); thereby indicating that a significant difference existed between the average achievement value scores of the experimental group. The arithmetic mean of ($\bar{X}=4.33$) experimental group's posttest scores of the achievement value was higher than the arithmetic mean ($\bar{X}=3.32$) of the pretest score. The computed Cohen d value also shows that the difference between the average scores has roughly 1.85 standard deviation. According to the effect size correlation (0.68) value that is the equivalent of the computed Cohen d value, the program applied for this variable has “medium” effect size. It was thus concluded that the self-report inventory achievement value scores of the experimental group differed significantly in favor of the posttest scores.

Table 3.12

The comparison of the Pretest–Posttest Achievement Value Scores of the Control Group

Group	N	X	S	sd	t	p
Control (pre)	22	3.40	1.28	21	-4.853	0.000
Control (post)	22	4.58	0.33			

It was monitored at the end of the conducted t-test that the control group's pretest-posttest achievement value scores had a significance value below 0.05 ($p=0.001 < 0.05$); thereby indicating that a significant difference existed between the average achievement value scores of the experimental group.

The arithmetic mean of ($\bar{X}=4.58$) the control group's posttest scores of the achievement value was higher than the arithmetic mean ($\bar{X}=3.40$) of the pretest score.

The computed Cohen d value also manifests that the difference between average scores has around 1.26 standard deviation. According to the effect size correlation (0.53) value that is the equivalent of the computed Cohen d value, the program applied for this variable has "medium" effect size. It was thus concluded that the self-report inventory achievement value scores of the control group differed significantly in favor of the posttest scores.

Based on the findings exhibited in Table 3.11 and Table 3.12, it can be argued that in the implementation of Realistic Mathematics Education, a significant level of pretest and posttest average scores of the control group having received the education was higher in comparison to the experimental group.

Findings on the analysis of Personal Value dimension are as exhibited in Table 3.13 and Table 3.14.

Table 3.13

The comparison of the Pretest Personal Value Scores of the Test and Control Groups

Group	N	X	S	sd	t	p
Test	23	2.89	0.59	43	-0.071	0.944
Control	22	2.90	0.68			

It was seen at the end of the conducted t-test that all groups' pretest personal value scores had a significance value below 0.05 ($p=0.944 > 0.05$); thereby indicating that not a significant difference existed between the average personal value scores of the two groups.

Table 3.14

The comparison of the Posttest Personal Value Scores of the Test and Control Groups

Group	N	X	S	sd	t	p
Test	23	3.99	0.42	43	4.587	0.000
Control	22	3.31	0.55			

It was seen at the end of the conducted t-test that all groups' posttest personal value scores had a significance value below 0.05 ($p=0.000 < 0.05$); thereby indicating that a

significant difference existed between the average personal value scores of the two groups.

The arithmetic mean of ($\bar{X}=3.99$) the experimental group's posttest scores of the personal value was higher than the arithmetic mean ($\bar{X}=3.31$) of the control group.

Besides, the computed Cohen d value manifests that the difference between average scores has around 1.39 standard deviation. According to the effect size correlation (0.57) value that is the equivalent of the computed Cohen d value, the program applied for this variable has “medium” effect size. It was thus concluded that the self-report inventory personal value scores of the control group differed significantly in favor of the experimental group having received Realistic Mathematics Education.

Upon the experimental process that manifested the fact that with respect to self-report inventory personal value scores of the test and control groups, the experimental group proved to be more successful; it was then aimed to unveil the relation between the pretest-posttest scores within the test and control groups themselves. To reveal whether a significant difference existed between the test and control groups within themselves, related samples t-test analysis was conducted and the results of this analysis are as tabulated in 3.15 and Table 3.16.

Findings on the analysis are as demonstrated below.

Table 3.15

The comparison of the Pretest – Posttest Personal Value Scores of the Experimental group

Group	N	X	S	sd	t	p
Pretest	23	2.89	0.59	22	-8.509	0.000
Posttest	23	3.99	0.42			

It was seen at the end of the conducted t-test that the experimental group's pretest-posttest personal value scores had a significance value below 0.05 ($p=0.000 < 0.05$); thereby indicating that a significant difference existed between the average personal value scores of the experimental group.

The arithmetic mean of ($\bar{X}=3.99$) the experimental group's posttest scores of personal value was higher than the arithmetic mean ($\bar{X}=2.89$) of the pretest score. Moreover, the computed Cohen d value shows that the difference between average scores has roughly 2.15 standard deviation. According to the effect size correlation (0.73) value that is the equivalent of the computed Cohen d value, the program applied for this variable has “large” effect size. It was thus concluded that the self-report inventory personal value scores of the experimental group differed significantly in favor of the posttest scores.

Table 3.16

The comparison of the Pretest – Posttest Personal Value Scores of the Control Group

Group	N	X	S	sd	t	p
Control (pre)	22	2.90	0.68	21	-2.424	0.024
Control (post)	22	3.31	0.55			

It was monitored at the end of the conducted t-test that the control group's pretest-posttest personal value scores had a significance value below 0.05 ($p=0.024 < 0.05$); thereby indicating that a significant difference existed between the average personal value scores of the experimental group.

The arithmetic mean of ($\bar{X}=3.31$) the control group's posttest scores of personal value was higher than the arithmetic mean ($\bar{X}=2.90$) of the pretest score.

The computed Cohen d value also manifests that the difference between average scores has around 0.66 standard deviation. According to the effect size correlation (0.31) value that is the equivalent of the computed Cohen d value, the program applied for this variable has "small" effect size. It was thus concluded that the self-report inventory personal value scores of the control group differed significantly in favor of the posttest scores.

Based on the findings exhibited in 3.15 and Table 3.16, it can be argued that in the implementation of Realistic Mathematics Education, a significant level of the pretest and posttest average scores of the experimental group having received the education was higher in comparison to the control group.

4. Discussions

According to the results derived from the research findings, the teaching of the 5th grade "numbers and operation" unit in accordance with the activities prepared using realistic mathematics education is further effective in mathematics self-reports of the students when compared to the current curriculum followed at schools.

In order to measure the effectiveness of RME on students' self-reports, the test and control groups were administered pretests and posttests for the dimensions of "interest value", "practicality value", "achievement value" and "personal value". Although the pretest scores of both groups unveiled an insignificant difference, their posttest scores manifested that a significant difference existed in favor of the experimental group. The fact that a significant difference in favor of the experimental group emerged in the posttest administered to both groups signals that RME is an effective teaching method. It was also attempted to unveil the relation between the pretest-posttest scores of the test

and control groups within themselves. As the inner comparison between each individual group was analyzed, a list of significant differences in favor of the posttest was observed. It was detected that within the experimental group having received RME, a significance level between pretest-posttest average scores in dimensions of “interest value”, “practicality value” and “personal value” was higher when compared to the control group. Within the control group having received the current program, a significant level of difference between the pretest-posttest average scores was higher, compared to the experimental group as regards “achievement value” dimension.

Students’ motivation towards learning and achievement has been a long-time neglected factor in professional curriculums although students’ motivation is recognized as the utmost critical component of curriculums (Gökcül, 2007). Educational theorists claim that self-perception on expectation and value is the determinant of one's motivation level (Atkinson, 1964; Eccles et al., 1983). As reported by expectation-value theory grounded on achievement motivation, students’ conceptions regarding the expectations and values of various tasks play a pivotal role in academic motivation and these are the conceptions affecting students’ behaviors and their learning levels alike (Eccles et al., 1983; Xiang, McBride, Guan, Solmon, 2003).

Likewise, in this study, the base point has been expectation-value theory driven from one of the motivation theories, achievement motivation in particular, and it has been unveiled that mathematics self-reports of the students exhibited a positive increase in RME-applied experimental group when compared to the control group.

Expectation-value theory suggests that interest value relates to the pleasure a student derives while performing an activity or sympathy that a student cultivates to the topic involving a particular task or activity (Eccles and Wigfield, 2002). It has been observed that students with high level of interest towards mathematics can, compared to the ones with lower levels of interest, spend longer times to accomplish mathematics tasks and can receive higher mathematics scores (Hidi, 1990; Schiefele, 1991). Within the context of this study, the students’ academic achievement scores increased in favor of the experimental group having received RME. During the implementation process of the research, their curiosity toward a relatively different approach, RME, enhanced the students’ interest toward the lesson and by their shortening adaptation time to the novel approach, it allowed to conduct an effective teaching time. Further to that, the students’ maximized level of interest and concentration on the course that was taught in a new approach assisted them in better learning the relevant concepts. Therefore, it can be concluded that RME approach eradicated the students’ misconceptions and worries towards mathematics course; augmented their interest towards the course; aided them to be released from rote and literal information thereby paving the ways of connecting mathematics with daily life and boosting the permanency of learning. The same finding

was echoed in the studies of (Fauzan, 2002; Zulkardi, 2002; Üzel and Uyangör, 2006; Akyüz, 2010; Arseven, 2010; Çakır, 2013; Bildircin, 2012; Cansız, 2015) as well.

Practicality value relates to the extent that an individual's performed task can meet his/her present and future objectives such as career objectives etc. (Eccles and Wigfield, 2002) and this concept aims to measure the significance and necessity of one task for the individual.

Real-life problems are designed in a way to support re-exploration process allowing the students to access formal mathematics knowledge in RME approach, too. Real-life problems, by virtue of enabling the students to witness the practical use of their acquisitions and its motivating effect, play a key role in RME (Gravemeijer & Doorman, 1999). Within the scope of this study as well, the students' interest values increased in favor of the experimental group having received RME. It has been underpinned in relevant studies that RME approach offers to students certain strategies to apply mathematics in real-life problems, and by discouraging remote learning, the approach allows students to identify and apply their own methods in problem solving (Zulkardi, 2002; Üzel & Uyangör, 2006; Akkaya, 2010; Uça, 2014; Cansız, 2015). Thus, it can be argued that this approach encourage students to develop an alternative perspective to real-life problems, to harness creative thinking, to explore and connect and gain an ability of abstract thinking for the aim of incrementing the level of practicing mathematics in daily life. Mathematics studies established upon expectation-value theory based on achievement motivation stated that personal value relates to the negative attitudes towards mathematics literacy. Students' discomfort in accomplishing mathematics tasks brings mathematics anxiety (Zhu, 2009). It can thus be deduced that RME-based activities not only augmented achievement and positive attitudes of students but also alleviated mathematics anxiety levels. This finding is in parallel with the research results claiming that RME approach, by engaging students in real-life problems, tremendously assisted them in better grasping mathematical concepts and generalizations, which eventually lowered students' anxiety level (Eccles and Wigfield, 2002; Zhu, 2009; Akkaya, 2010; Memnun, 2011; Uça, 2014; Cansız, 2015).

Achievement value relates to the perceived significance of aptly performing any commissioned task by the individual (Eccles, 1983). By the same token, a number of researchers claimed that individuals who seek to prove their success in any commissioned task hold higher achievement values (Greene, DeBacker, Ravindran and Krows, 1999, p. 424). In radical constructivism approach, teachers fail to apply research method in problem solving, or any given problem solving method, learnings from past experiences or seeking practical ways to reach a solution. In essence, RME is a teacher-guided process of re-exploration (Eccles and Wigfield, 2002). Based on the findings of the conducted study, it is thus safe to argue that it was an expected result that the

achievement value differed significantly in favor of the control group students having received the current curriculum and in need of self-actualization.

Mathematics anxiety scales developed for elementary school students have been shown to only measure feelings of anxiety, fear and anxiety about mathematics lessons. For this reason, the lack of studies that measure the expectations and values of students about mathematics and examine their interrelationships is a major drawback. This study aimed to contribute to the literature by linking the changes in expectations and values of primary school students with research and academic achievement.

5. Suggestions

One noteworthy finding of this study is that RME-based activities not only increased the students' achievement levels in numbers and operation unit but also positively affected late-changing affective learning outcomes such as self-report. It should be noted that the students' mathematics course self-reports shifted towards a negative direction with the inclusion of abstract and challenging topics into the context and in the emergence of this negation, the students' failure to set links between abstract topics and real-life played a major role. Hence, teaching of abstract mathematical concepts through RME-based activities holds value also in terms of its potential to transform the negative bias into a positive experience. Mathematics self-report inventory devised on the basis of achievement- motivation grounded expectation-value theory is worthy of appreciation on accounts of being a pioneering Turkey-based measurement tool developed for students in the second stage of Elementary Education. This study aims to apply this inventory onto a wide-scope research for the first time and to determine the effects of RME approach on mathematics self-reports of the students. Nevertheless, due to its inapplicability for 5th grade level, one dimension of the inventory was excluded from the scope of this research. In future studies it is thus suggested to implement the inventory with all its dimensions.

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