

# The Relationship Between Math Achievement Motivation And Reflective Thinking Skills Towards Problem Solving

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## Abstract

The purpose of this study is to examine the relationship between the 8<sup>th</sup> grade students' math achievement motivation and reflective thinking skills towards problem solving. The quantitative research method was used. The research was conducted with 461 students in public and private schools in İstanbul, Turkey. The data were gathered by the "Achievement Motivation Scale" developed by Umay (2002,a) and the "Reflective Thinking Skill Towards Problem Solving Scale" developed by Kızılkaya (2009). The research results show that the mean of the achievement motive scores ( $\bar{X}=22,78$ ;  $Sd=4,13$ ) and the mean of the reflective thinking skill scale towards problem solving scale scores were ( $\bar{X}=33,84$ ;  $Sd=11,70$ ) found lower. In addition achievement motives scores were found positively and significantly correlated with the Reflective Thinking Skill Scale toward Problem Solving Scores ( $r=.63$ ,  $n=461$ ,  $p<.01$ ). The findings of this study may help to explain why students are unsuccessful in mathematics or feel themselves as a failure in this lesson.

**Keywords:** Reflective thinking, achievement motivation, problem solving, math achievement.

## Introduction

Education is an important area where the studies are conducted for the solution of many problems in the world. Educational sciences have been examined the teaching and learning process of the individual on the how, what, and in what way learned in detail. The Science of Education was revealed scientifically valid data to change individuals' behavior. In the broadest sense of teaching were providing teaching learning activities (Daubler et al, 2014).

Improving the quality of education has been one of the most important pursuits of the educational institutions. In educational programs there are items related to which behaviors to

gain to the individuals. Curriculum development is one of the factors in order to built useful classroom settings. From this perspective we take the position that curriculum must significantly based on scientific basis. Curriculum development must respect a number of basic principles: To be based on a needs assessment, to be scientific, based on the applications. “Curriculum” is a difficult concept to provide a limited description (Hitchcock et al., 2002).

Developing a curriculum involve numerous steps, needs analyzing, piloting, planning and development, implementation, evaluation. It includes very comprehensive studies such as syllabus planning, setting philosophy of education, material development testing (Zohrabi, 2014). As Young (2013) pointed today curriculum development is more difficult because of the expanding knowledge and rapid developments in technology. In order to build convenient curriculum we have to be know that students perceptions, beliefs and cognitive skills.

This study focuses on mathematic teaching and learning process within the curriculum theory. The Mathematics curriculum as part of the secondary level curricula aims at teaching students via learning experiences, values and attitudes which supported with global vision (Nicolescu&Petrescu, 2014).

Mathematics is one of the most important lessons students have to learn. At the same time, this course is seen as a difficult subject by many students. Ersoy and Erbaş (2005, p.102) report that mathematics is not merely a field designed for scientists and engineers. More over than that it integrates the kind of concepts effective in helping the individuals to maintain their daily lives. Therefore in democratic states people should be accomplished literates in mathematics and improve their mathematical skills. In the field of education more emphasis is given to cognitive dimension whereas affective dimension is ignored. Durmuş (2004a, p.509) claims that one of the reasons related to difficulties in learning mathematics is motivation. Many theories have been developed on the subject of motivation. Some of these are Behavioral, Humanistic, Social Learning and Achievement Motivation Theory. Achievement motivation is the essence of expectancy-value theory. Achievement motivation theory has drawn attention to the needs of Murray classification. Then it is classified by systematized by Atkinson. High hope of success with low fear of failure the achievement motivation will be high. The opposite low hope of success with high fear of failure the achievement motivation will be low (Açıköz, 2003, p.234). Expectancy-value theory takes over expectations as a motivational factor. According to this theory, motivation was determined expectations regarding the behavior of individuals and

their behavior to the given value. The level of motivation may affect the possibility of performing the behavior. A high probability of realization, a weak the given value for behavior can increase the individual's motivation (Brophy, 1999). This explanations focus on the expectations of individuals. However there are not only students within the scope of the objectives to be achieved in educational activities. People are forced to deal with various problems in daily life considering the fact that the development of problem-solving skills at the secondary level is inevitable (Baykul, 2009, p.50). As studies related to achievement motivation is examined it surfaces that achievement motivation is closely connected to problem-solving skill (Bedel and Hmarta, 2014; Dereli, Angin and Karakuş, 2012). Therefore in current study a deeper analysis has been conducted on problem solving skill as well.

According to new elementary mathematics program, problem solving is seen as an integral part of the math courses and activities. When students feel that their solution is valued they can success in the problem solving process. According to Căprioară (2014), in mathematics, solving problems represents the most effective concept to contextualization and re-contextualization of concepts, to operational and basic mathematical knowledge transfer to ensure a sustainable and meaningful learning. According to Mone (2009) students learn to communicate with using math and to develop higher-order thinking skills is emphasized. National Council of Teachers of Mathematics, NCTM (2000) was emphasized problem-solving skills that receive priority in teaching mathematics and problem-solving approach and the teaching of mathematics subjects. Several theoretical explanations have been reviewed for dealing with problem solving. One of these theories is the John Dewey's reflective thinking theory. It has been recognized as a classical model for problem solving until the 1950s. It is thought to be practical, especially in the areas of science and math. PISA underlines that at the end of problem solving process, reflective thinking is conducted on the problem and as a component of this process reflective thinking skill towards problem solving bears importance (PISA, 2003). Based on this assumption developing, assessing and measuring reflective thinking skills take the stage as important topics of research. The ability to think is very important; this is regarded as the feature that distinguishes human beings from animals. However, it is important is because the usual vague ideas about the why and how of thinking is ambiguous, containing the values of reflective thinking is important. Dewey suggested that reflection has the five stages. These stages do not have to be in a particular order but must be compatible with each other. These five stages are suggestions, problems, hypotheses, reasoning, and testing (Dewey, 1993, cited Petek and Aşkar, 2009, p. 84).

**Suggestions:** The individual are confusing when faced with a situation that appear in the mind ideas and possibilities. Suggestions increase the need to stop and think. Suggestions are the energy source of the subsequent questioning.

**Problems,** instead of facing the small details in a confusing situation as parts of the whole, it is to see the bigger picture.

**Hypothesis,** is to what can be done with due consideration of the recommendations. working on Hypothesis involves to make more observation and thinking over the information. Thus, the problem was purified, refined, and recommendations is transformed in testable and measurable.

**Reasoning,** is to provide to test ideas, suggestions and hypotheses pieced together knowledge and previous experiences.

**Testing,** can bring clarity to existing problems.

The stages of Dewey's reflective thinking, is similar to the process of problem solving and has been a model. As the stages of problem solving was developed by the researchers.

According to Dewey (1933, quot. Petek and Aşkar, 2009) features that must be present in person are open-mindedness, willingness and full of responsibility.

**Open-mindedness,** the ability to look different and new ways to the problem. Open-mindedness requires being an active listener and readying to hear the different sides.

**Full willingness,** occurs when being involved with a subject matter. It is connected with experiencing a lot of ideas and thoughts.

**Responsibilities** are to take the results of person's activities.

Schön (1987) was defined the reflection in two ways which are reflection-on-action and reflection-in-action. Reflection-in-action focuses on problem solving when the action is being performed. It is the process of containing the rearrangement of action. Reflection-on-action evaluates every aspect of the action after the action has been performed. It allows to look back and think about the action.

### **The Purpose and Significance of the Research**

Mathematical thinking and problem solving skills not only in the areas of finance and engineering that can use in everyday life (Capriora, 2015; Dostal, 2015). Solving the problem is one of the main objectives of mathmeatics education. Therefore to enable and develop problem solving skills are very important in mathematics education. One other characteristic that is required for student success is motivation. Research offers some evidence that motivation have important effects on student achievement (Erdoğan, Kesici and Şahin, 2011). Students must want to learn and give attention to learn something. They must be driven for it.

The overall purpose of this study presented as to investigate MAM (Math Achievement Motivation) and RTSTPS (Reflective Thinking Skills Towards Problem Solving) scores levels of the 8<sup>th</sup> grade students towards mathematic.

### **Research Questions**

The problem being addressed in this study is “What are the relationships between math achievement motivations and reflective thinking skills towards problem solving of the 8<sup>th</sup> grade students?” and the sub problems presented as below.

Sub-problem1: What are the Achievement Motivation Scale scores levels of the 8<sup>th</sup> grade students?

Sub-problem2: What are the Reflective Thinking Skills towards Problem Solving Scale scores levels of the 8<sup>th</sup> grade students?

Sub-problem3: Is there any relationship between students’ Achievement Motivation Scale scores and Reflective Thinking Skill towards Problem Solving Scale scores?

### **Method**

#### **Design of the Study**

In this study has been used the descriptive quantitative research method. To look up main and joint effect of variables, data were examined through general statistics. In addition, the correlational research design was chosen in order to investigate the strength of the relationships among MAM and RTSTPS.

#### **Study Group**

Participants of this study were selected from students from three regions of İstanbul Anatolian side. Since the target population was too large the accessible population defined for study. The study was conducted with eighth grade students (N=461) at 2 public and 2 private elementary schools in different district of the Anatolian side of İstanbul.

#### **Instruments**

In order to better understand the properties of the group, personal information form has been prepared. Socio-demographic characteristics included information about students such as gender, type of schools, mothers’ education level, fathers’ education level, teachers’ gender,

having pre-school education, having support from extra courses information about the educational level and income of parents.

Achievement motivation is an expectation, a need and a request for success (Umay, 2002c). AMS, used to measure eighth grade students' achievement motivations towards mathematics in this study was developed by Umay (2002,a). This scale consists of two parts. First part consists of seven items. The second part consists of 14 items that are rated triple. Scoring has been designed according to the responses of the student considering the frequency of the performing of the action in that question. Action frequencies have been organized in the levels of "Always", "Sometimes", and "Never". These levels have been scored as Always = 3, Sometimes = 2 and Never = 1. Accordingly, Scores were added across items to form a possible total score ranging from 14 (low achievement motivation) to 52 (high achievement motivation) for each participants. Umay (2002a) measured reliability coefficient of scale as Cronbach alpha value 0,75 on the basis of second part. For present study, the result of the Cronbach Alpha analysis indicated a coefficient of 0.67.

RTSTPS scale was developed by Kızılkaya (2009). Scale items were intended for a math lesson. The scale consists of 14 items. Scale items were graded 5-point Likert type. The options are like "always", "often", "Sometimes", "Rarely", and "never". These levels were highest with followed by always=5, often=4, sometimes=3, rarely=2, never=1. Of this scale prepared by Kızılkaya (2009) KMO value was found as "0.872" and Bartlett's Test of Sphericity value as 1084.329 ( $p < 0.01$ ). In this research 461 students from 8<sup>th</sup> grade were analyzed and it was found out that Cronbach alphas reliability coefficient of RTSTPS was 0,89.

### **Data Analysis**

This study employed descriptive and correlational statistical calculations in measuring Math Achievement Motivation (MAM) and Reflective Thinking Skills Towards Problem Solving (RTSTPS) of the 8<sup>th</sup> grade students.

### **Results**

The problem sentence of this research determined as "What are relationships between math achievement motivations (MAM) and reflective thinking skills towards problem solving (RTSTPS) of the 8<sup>th</sup> grade students? To answer this problem AMS and RTSTPS scale responses of the students are investigated separately.

### The results related to the First Section of the AMS

Achievement Motivation Scale consists of two parts. In the first section have questions about the achievement motivation. Means, standard deviations, frequency and percentages of the students' answers to the first section were presented in Table 5.

Table 1.

Descriptive Statistics Related To The Achievement Motivation Scale of First Section

Item1	1		2		3		4		Mean ( $\bar{X}$ )	Sd
	F	%	f	%	f	%	f	%		
Do you find yourself successful in mathematics? 1.Yes 2.No	258	56	200	43,4					1,43	,49

According to the data obtained from table 5, 258 (56%) of the students has found himself/herself successful in math courses. 200 (43,4%) of the students has found himself/herself unsuccessful in math courses.

Table 2.

Descriptive Statistics Related To The Achievement Motivation Scale of First Section

Item 2	1		2		3		4		Mean ( $\bar{X}$ )	Sd
	F	%	f	%	f	%	f	%		
What is success? 1. Hanging himself 2. Others go through	323	70,1	133	28,9					1,29	,45

323 (70,1%) of the students was defined the success hanging one's self. 133 (28,9%) of the students was defined the success going through others.

Table 3.

Descriptive Statistics Related To The Achievement Motivation Scale of First Section

Item 3	1		2		3		4		Mean ( $\bar{X}$ )	Sd
	F	%	f	%	f	%	f	%		

You will need several things to be successful in this course. 103 (22,3%) of the students participated that talent skill, intelligence, and luck is required to be successful. 355 (77%) of the students participated that effort and work is required to be successful.

What is the decisive aspects in this course?

- 1.Talent, skill, intelligence, luck
- 2.Effort, diligence, work

103 (22,3%) of the students was participated that talent skill, intelligence, and luck is required to be successful. 355 (77%) of the students was participated that effort and work is required to be successful.

Table 4.

Descriptive Statistics Related To The Achievement Motivation Scale of First Section

Item 4	1		2		3		4		Mean ( $\bar{X}$ )	Sd
	F	%	f	%	f	%	f	%		
Do you work for what in this course?	186	40,3	206	44,7	38	8,2	29	6,3	1,80	,83
1. Learn something new										
2. Take good notes										
3. Pass the class										
4. Improve my skills										

186 (40,3%) of the students wanted to learn something new in mathematics. 206 (44,7%) of the students wanted to get good notes in mathematics. 38 (8,2%) of the students wanted to pass the class. 29 (6,3%) of the students wanted to improve himself/herself abilities.

Table 5.

Descriptive Statistics Related To The Achievement Motivation Scale of First Section

Item 5	1		2		3		4		Mean ( $\bar{X}$ )	Sd
	F	%	f	%	f	%	f	%		
For whom you have been studying?	116	25,2	343	74,4					1,74	,435
1.For my Families and teachers										
2.For me										

116 (25,2%) of the students was preferred for his/her parents and his/her teachers to be successful. 343 (74,4%) of the students was preferred for himself/herself to be successful.

Table 6.

### Descriptive Statistics Related To The Achievement Motivation Scale of First Section

Item 6	1		2		3		4		Mean ( $\bar{X}$ )	Sd
	F	%	f	%	f	%	f	%		
What kind of goals you put yourself?	100	21,7	263	57	94	20,4			1,98	,652
1. Goals that I can reach in a short time										
2. Goals that I can reach in a long time										
3.I do not put the targets. I study to learn										

100 (21,7%) of the students was set short-term goals himself/herself such as successful in exam. 263 (57%) of the students was set the goals himself/herself such as pass the class. 94 (20,4%) of the students was not set the goals. They study to learn.

Table 7.

### Descriptive Statistics Related To The Achievement Motivation Scale of First Section

Item 7	1		2		3		4		Mean ( $\bar{X}$ )	Sd
	F	%	F	%	f	%	f	%		
In this course, which is similar to most of the goals that you set?	54	11,7	195	42,3	208	45,1			2,33	,678
1. Get a passing grade Is enough										
2. Best note I've hoped that I could get										
3. Too best note										

54 (11,7%) of the students was thought that get a passing grade. 195 (42,3%) of the students was set the goals to hope the best note. 208 (45,1%) of the students was set the goals for the best one.

### The results related to the First Sub Problem

AMS levels of 8<sup>th</sup> grade students were investigated. The descriptive statistics of 8<sup>th</sup> grade students' AMS scores were presented below.

Table 8.

### Descriptive Statistics of 8<sup>th</sup> grade students' total AMS scores

	f	Minimum	Maximum	Midpoint	Mean	Std. Deviation	Range
Achievement Motivation Scale Scores	460	14,00	42,00	28,00	22,78	4,13	14-42

Table 12 shows that the standard deviation and the arithmetic average of the total students' achievement motivation scale score. The mean of the AMS score is ( $\bar{X}=22,78$ ;  $Sd=4,13$ ) in this research and the midpoint of it is (28,00 min. 14, max. 42). It was seen that students' AMS scores mean is under the midpoint of the AMS.

### 3.1.3. Results related to the Second Sub Problem

Second sub-problem statement of the research is "What are the Reflective Thinking Skills towards Problem Solving scores levels of the 8<sup>th</sup> grade students?". For this purpose the levels of RTSTPS of 8<sup>th</sup> grade students were investigated. The descriptive statistics of 8<sup>th</sup> grade students' RTSTPS scores were presented in table 13.

Table 9.

Descriptive statistics of students' RTSTPS Scale

	f	Minimum	Maximum	Midpoint	Mean	Std. Deviation	Range
RTSTPS	457	14,00	70,00	47,00	33,84	11,70	14-70

According to the table 13 the mean of the RTSTPS Scale score is found ( $\bar{X}=33,84$ ;  $Sd=11,70$ ) and the midpoint of the scale is 47,00 (min. 14, max. 70). It was seen that students' RTSTPS scores mean is under the midpoint of the scale.

### 3.1.4. Results related to the Third sub problem

Third subproblem sentence of the research was defined as "Is there any relationship between students' math achievement motivation scale scores and Reflective Thinking Skills towards Problem Solving Scale scores? As a statistical technique correlation was used to answer this question.

Correlation is a statistical technique that shows at what degree two variables are related to each other. In another sense, it explains the degree of association between two variables. To investigate the relationship between students' AMS scores and RTSTPS scale scores, correlation analysis was utilized. There are different correlation coefficients that are used for particular situations. This problem was analyzed through Pearson product-moment correlation

to see the strength and direction of the relationship between the two variables in determined cases.

Table 15 shows the relationship levels between AMS and RTSTPS scores obtained from participant.

Table 10.

The relationship between AMS scores and RTSTPS Scale scores

		Total AMS	Total RTSTPS
Total AMS	Pearson Correlation	1	,628**
	Sig. (2-tailed)		,000
	N	460	457
Total RTSTPS	Pearson Correlation	,628**	1
	Sig. (2-tailed)	,000	
	N	457	457

\*\* . Correlation is significant at the 0.01 level (2-tailed).

As shown in table 15 there is a positive and significant relationship between AMS and RTSTPS Scale. The total quality of AMS scores positively and significantly correlated with the RTSTPS Scale Scores,  $r=.63$ ,  $n=460$ ,  $p<.01$ .

Pearson correlation coefficient (r) calculated for two variables can be defined as high (0.70-1.00), medium (0.30-0.70) and low (0.00-0.30) (Büyüköztürk, 2004). Accordingly, since there is a moderate relation between scores obtained from the scale AMS and RTSTPS can be mentioned.

## Discussion

Accordingly among 458 students 258 students (56%) considered themselves successful in mathematics course while 200 students (43,4%) considered themselves not successful in mathematic courses. This result relates to a negative situation as regards students' achievement motivation towards mathematics course. Although mathematics course of which functions are present in almost all situations in life, most students dislike the lesson (Dursun and Dede, 2004; İflazoğlu, 2000). There are a number of reasons explaining why students are unsuccessful in

mathematics or feel themselves as a failure in this lesson. Prejudices towards mathematics course, teacher attitudes, teaching methods, lack of diligence are some of the reasons why students cannot adopt mathematics lesson (Peker and Mirasyedioğlu, 2003; Özsoy, 2005; Perker, 2005).

Another question in this scale is related to defining achievement. Among 456 participant students 323 students (70,1%) defined achievement as “outrunning oneself” while 133 students defined the term as (28,9%) “Outrunning others”. Üredi and Üredi(2005) claims that achievement is an indicator showing the level an individual benefits from a particular lesson in the curriculum or an academic program. In our society a deep-rooted bias exists as “mathematics is a difficult lesson”; thus students work hard in mathematics lesson to receive good grades and gain prestige in society. Nonetheless this also means that students’ motivation origin moves further away from intrinsic motives. Intrinsic motivation comes to surface with inner factors like curiosity and interest which relate to inner needs of individuals whereas extrinsic motivation comes to surface with external factors such as reward and punishment which turn into incentives for individuals (Akbaba, 2006). Hence 133 students (28,9%) among the total participants of present research associated achievement with external factors because of the pressure they had faced and it is likely that they failed to form an intrinsic motivation consequently. Another question in this research is directed to determining the motives for studying lesson. Among 459 students 186 (40,3%) students claimed to study lesson to learn new things; 206 students (44,7%) claimed to study to get good grades and 38 students (8,2%) claimed to study lesson to pass their class and 29 students (6,3%) claimed to study to polish their skills. Once students taste achievement they feel more motivated. In an opposite situation they feel disappointed. Students who feel failed tend to avoid learning (Fidan, 1996, cited Dursun and Dede, 2004). The fact that scores received from national TEOG exams are affected by school grades students are filled with score anxiety. It should also be noted that there is a strong social pressure to get high scores (Yıldırım, 2000). Alkan (2011) in a study revealed that parents exert great pressure on students to get higher grades from exams.

Within the scope of present research three dimensions of reflective thinking have been analyzed. Francisco & Maher (2005) in their study posited that one of these dimensions, causation dimension, is related to problem solving.

Some of the sub items listed below scale items are;

- “When I fail to solve a problem I ask myself questions to understand better why I cannot solve it”

- “After solving the problem I think on my own if I could find a better solution method.”
- “I try to find a better solution method by contemplating on my friends’ solution methods.”

These steps are parallel to the stages in reflective thinking. Reflecting on the solution of a problem is, as stipulated in OECD’s PISA 2003 report, one of the steps to follow. Reflecting on solution consists of offering a list of options on problem solution and by structuring in each step holding a mirror in each subsequent stage. Dewey (1933, cited Kızılkaya, 2009) claims that reflection is by nature problem centered. Kızılkaya (2009) pointed that problem solving and reflective thinking are interrelated concepts.

Problem solution is a vital skill that should be inherent in each individual. Kızılkaya (2009) concluded that reflective thinking skill has positive effects on problem solving process. Soylu and Soylu (2006) refer to the importance of problem solving in mathematics teaching and claim that to reach success in this course students should be accomplished problem solvers. While learning it is of great importance to reflect during problem-solving process, assess the knowledge gained and holding a mirror towards this process (Dewey, 1933). It is seen that when a problem arises reflective thinking skill emerges. Still a number of researches indicate that reflective thinking skill best emerges in problem solving cases (Kıvılcım and Baş 2012, Kızılkaya, 2009). In problem-solving process, next to creative and critical thinking which are among the thinking strategies, reflective thinking strategies are also utilized (Çakmak, 2000). Reflective thinking entails actions such as questioning, generalizing, making judgments, analyzing, discussing and reasoning. On that account students should plan learning processes effectively, practice the activities knowingly, move further by questioning each step, make reasoning before moving to further step and constantly hold a mirror to this process (Kıvılcım and Baş, 2012). During problem solving process particularly it is of vital importance to complete reflective thinking stage successfully. During problem solving process creating alternative solutions and evaluating the results and relevant actions should be valued as the vital characteristics of reflective thinking process (Kızılkaya and Aşkar, 2009).

It can reasonably be claimed that there is a parallel rise between students’ AMS and reflective RTSTPS. This parallelism might be related to the fact that students with high achievement motives are more interested and participative in mathematics course. In line with this deduction it is likely that a student who is motivated to participate in class activities can develop much faster and practical methods in problem solving process. Those who put their best efforts to

reach success are the ones with higher motives for success. Teachers are expected to try hard to increase their motivation and students' as well. It would be unreasonable to expect teachers' with low motives for success to appropriately motivate their students (Umay, 2002). Umay (2003) in one of his studies found out that freshman students in Elementary Education Mathematics Teaching department have achievement motives above the average. Bulut (2006) examined achievement motivations of elementary education second level students towards mathematics course. It was reported that students whose achievement level was five had higher states of achievement compared to students with level two, three and four achievement motives. As seen once motivated students taste achievement they become even more motivated and students' state of achievement in mathematics course has positive effect in their achievement motivation. So long as students study hard for their lesson, their faith towards success correspondingly rises. A large number of studies identified a strong relation between learning and motivation (Şahin, Erdoğan and Kesici, 2010; Waage, 2010). Endly, the study shown that students' motivations positively and significantly correlated with the reflective thinking skills. This findings could bring avaluable contribution to the classroom settings in terms of teacher and student relationships.

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