EXAMINING PRIMARY SCHOOL STUDENTS' LEVELS OF MATHEMATICS MOTIVATION

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Abstract

The aim of this study was to evaluate the levels of mathematics motivation of primary school students and to identify its relationship with variables such as sex, grade level, school type, general success and mathematics success. The number of participants in this study was 709 primary school students from Aydin city center. The sampling was comprised of 345 third grade and 364 fourth grade students. Data were collected through a scale titled as *"Primary School Mathematics Motivation Scale"* (PSMMS) developed by Ersoy and Oksuz in 2015. Findings gathered from the study illustrated that primary school students have a very positive motivation towards learning mathematics. Moreover, there was no significant difference, in students' math scores of motivation with respect to gender and their grade levels. However, depending on the type of school, there was a significant difference in students' math scores of motivation in favor of private schools. In addition to this, the level of students' motivation in mathematics varied according to their level of overall academic success. The results also indicated that the level of students' motivation in mathematics varied according to their level of mathematical academic success.

Keywords: Primary school mathematics, motivation, student motivation

Introduction

One of the main goals of education is to increase the level of students' academic performances by creating an effective learning environment. Although this aim is an extrinsic aim, the realization of it is strongly connected to what extent the students embrace this goal. In this sense the role of motivation should be clearly understood. Emergence of students' learning desires and sustaining them can be accomplished through motivation. Thinking in respect of mathematics, developing students' interests in mathematics and sustaining it requires strong student motivation. Mathematical success or failure of a student might depend on several factors

such as personality, self-esteem, presence or absence of math teachers, possession of sufficient equipment, resources and materials, learning through application of student centered teaching methods, over-crowded classes and presence or absence of conceptual learning. Beside these factors, motivation is a significant factor that contributes to student's academic achievements (Aiken, 1976; Lane & Lane, 2001; Kauffman & Humsan, 2004; Ma & Xu, 2004; McCabe, 2004; Strobel, 2010). That's why enhancing a student's performance and success is closely related to increasing his/her motivation.

There are numerous theories about motivation and each theory emphasizes a different dimension of motivation. In general, motivation theories have been merged under the Behaviorist Theories, Humanistic Theories and Cognitive Theories titles. Behaviorist Theories focus on changes in behavior those were acquired as a result of individual's interaction with the environment and are based on rewards and punishment as a key feature (Pintrich & Schunk, 2002). Humanistic theories are based on the approach to realize one's potentials as an individual person and focus on holistic development and needs of a person (Pintrich & Schunk, 2002). Cognitive Theories are based on personal beliefs, expectations, predictability and understanding of the World (Deci & Ryan, 1985). Cognitive theories comprises of Expectancy value Theory, Self-Efficacy, Attribution Theory, Self-Determination Theory. Effects of each theory on learning and learner forms through the theories mentioned above.

Studies about motivation are generally described in two broad categories as intrinsic motivation and extrinsic motivation. Intrinsic motivation refers to participating in a learning activity for its own sake. Extrinsic motivation refers to participating in an activity due to the reinforces (rewards or punishment components) like getting good grades, making others happy, success in competition, failing the class (Pintrich, Roeser, & De Groot, 1994).

Studies about the effects of the motivation on learning mathematics focused on intrinsic motivation and extrinsic motivation. According to these studies it was found that female students have stronger intrinsic motivation orientation. Whereas, male students have stronger extrinsic motivation orientation (Anderman & Anderman, 1999; Gledhill & Van der Merwe, 1999; Smith, Sinclair & Chapman, 2002). In this sense, Dede and Argün (2004), within the scope of their experimental investigation on relations between intrinsic and extrinsic motivation of students in 7th grade, figured out that intrinsic motivation of students towards mathematics is higher compared to their extrinsic motivation. Similarly, in another study conducted by Akkus Ispir, Ay and Saygı (2011), in a group of high-achieving students of 10th, 11th and 12th grades in secondary education, it was shown that the factor increasing students' motivation towards

mathematics was not extrinsic but rather intrinsic. Motivated students study mathematics voluntarily. On the contrary, Aktan (2013) have determined that the most important motivational structure affecting fifth grade students' motivation levels towards mathematics subject comes from extrinsic motivation.

There are some studies in literature examining motivation in terms of different variables. Yaman and Dede (2007) studied differences in motivation levels of sixth, seventh and eighth grade students towards mathematics according to the gender and grade level parameters and the results of their study revealed that motivation levels of the girls are higher than boys. They also found that as the grade level increases motivation levels of students towards mathematics decreases. Similarly, Martin (2004) investigated motivation levels of students in terms of gender and revealed that there are significant differences between the genders, where girls have higher learning focus, planning, study management capabilities, and persistence whereas boys show significantly higher self-sabotage or self-handicapping.

As a result of his research involving the student motivation levels, Aktan (2013) revealed elementary fifth grade students' motivation levels in mathematics are just above the average level. Besides, a moderate correlation has been revealed between academic achievement and motivation levels of fifth grade students in primary schools.

Several researchers explored how to increase motivation, which is essential in learning. Different methods and techniques along with their effects have been examined in these studies. In this sense, Dede (2003) has revealed that in mathematics, the approach based on ARCS Motivation Theory and Component Display Theory increases student extrinsic motivation. Tufan (2011) has revealed the significant effects of educational software developed based on Multiple Intelligence Theory on sixth grade students' motivation. Lastly, Efe has revealed that cooperative learning method if used in mathematics is more effective than traditional teaching method in increasing motivation.

Although motivation theme has been in the spotlight by many researchers, The National Council of Teachers of Mathematics (NCTM) has also suggested meeting the needs of more information about student motivation in the mathematics class. Turkey changed its educational system from behaviorism to constructivism in 2005. According to the constructive teaching and learning system, of course, activity based mathematics learning should be supported. Student-centered education and active participation of the students are some of the primary concepts for this learning approach. Motivation component has reached more meaningful senses with the transition to constructivist approach. While extrinsic motivation has been

viewed as an impact from an extrinsic origin supported by rewards and punishment, intrinsic motivation comes unconsciously and the learner is considered to be its source (Perry 1999, 54). Thus, learning takes place as much as and as long as a learner desires.

In primary mathematics curriculum, motivation plays an important role. In the curriculum it is suggested to pay attention to motivation. It is also stated that students' positive attitude towards the mathematics subject can be accomplished through meaningful learning of mathematics. Besides, it is asked to put emphasis on developing motivation towards learning mathematics by taking into consideration of individual differences of students (MEB, 2009).

It's necessary to comprehend the effects created on the students in order to succeed in reforms implemented in educational curriculum. Determining student motivation levels towards learning mathematics will give us some ideas about the effects related to the changes made in mathematical classes. In this sense, determining student motivation towards learning mathematics as a case will play a leading role in strengthening teaching methods, techniques and also will play directive role in developing motivation increasing strategies as a very important component in learning. Therefore in this study it is aimed to determine motivation of primary school students towards learning mathematics.

Aim

The main purpose of this study is to investigate the level of motivation of primary school students towards learning mathematics in accordance with variables as gender, grade level, school type, achievement level. In the scope of this main purpose, answers are sought to the following questions:

1. What is the distribution of student motivation levels towards mathematics?

2. Do the student motivation levels towards mathematics:

- Vary significantly according to the gender?
- Vary significantly according to the grade level?
- Vary significantly according to the state and private schools?
- Vary significantly according to the general academic achievement levels?
- Vary significantly according to the mathematics achievement levels?

Method

A survey research method was used in order to determine students' motivation levels towards learning mathematics in primary schools and to present the situation. A cluster random sampling method was used to select

the sample. 364 fourth grade students and 345 third grade students from five state and three private primary schools in Aydin were included to the study.

Data Collection Tool

A three-point grading scale titled as "*Primary School Mathematics Motivation Scale*" (PSMMS) developed by Ersoy and Oksuz (2015) was used to collect the data. The construct validity of 33 items was examined through exploratory factor analysis with varimax orthogonal rotation. In the result of factor analysis, the scale involves in one factor explaining 42.46% of total variance. The overall Cronbach alpha coefficient of the scale was calculated as 0.94 (Cronbach Alfa). This scale is consisted of 33 items and a three point grading system. Thus, the maximum scoring form of the scale is 99 while the minimum scoring is 33. Items of 3, 5, 9 and 11 have to be coded reversely. Higher scores indicate that the motivation of primary school students' towards learning mathematics is positive. The mean of the scale is 66, and interpretations of the acquired scores would be done according to the points corresponding to ±1, ±2, or ±3 standard deviations from the mean based on the normal distribution. This scale suggests categories such as "very low level motivation, low level motivation, middle level motivation and high level motivation and very high level motivation". According to these categories, the scores of PSMMS ranging between 33-43 implies very low level motivation towards mathematics; 44-45 implies low level motivation towards mathematics; 55-77 implies middle level motivation; 78-88 implies high level motivation; and 88-99 implies very high level motivation.

Data Analysis

During the data collection process, PSMMS was delivered to 709 third and fourth grade students at primary schools. Data from 130 scales have been excluded from the analysis due to the wrong and missing information of filling or the existing of contradictions in the responses to Scale Control Items of 1 and 9. Therefore, in this study the data gathered from 579 students was analyzed.

The responses given to the scale from the choice of 'I agree' to 'I disagree' have been recorded to the computer by scoring the choices. The data was analyzed by using version of SPSS 15 program. To meet the assumption of normality of the data, outliers were excluded and data from 555 students were used for the final analysis. As the value of Kolmogorov-Smirnov, which was calculated to determine whether the distribution is normal or not, was 1.34 and corresponding p value was significant for the level of 0.05, it was decided to use nonparametric test methods to compare scores from scale. In data analysis, mean, median and standard deviations

were used for descriptive statistics and nonparametric tests like Mann Whitney *U*-test and Kruskal Wallis Test were used in comparisons. All assumptions of the study were tested by considering 0.05 probability level.

Findings

In this chapter, there are findings related to students' motivation towards learning mathematics in primary schools. The values regarding student PSMMS scores are presented in Table 1.

Table 1. *Values respecting the Student's PSMMS Scores*

Measurement	***n***	$\overline{\times}$	**S.d.**	**Median**	**Mode**	**Skewness**	**Kurtosis**
PSMMS	555	91.07	7.03	93	99	-0.76	-0.38

When table 1 is analyzed, it can be stated that the mean score of students' responses towards PSMMS is 91.07, standard deviation is 7.03, median is 93 and mode is 99. To determine whether the scores from the scale normally distributed or not, extreme values in the data set have been examined. For that purpose, the total PSMMS scores of students were converted into Z scores and outliers were removed according to Z scores between-3 and +3. When examining values of skewness and kurtosis, it was seen that those values are within the boundaries of normal distribution (skewness is -0.76, and kurtosis is -0.38). The values of skewness and kurtosis indicated that the curve was negatively skewed and flattened in shape. In histogram graphics negatively skewed distribution was also seen. As the value of Kolmogorov-Smirnov, 1.34 and corresponding p value was significant for the level of 0.05, non-normal distribution was determined and nonparametric test methods to compare scores from scale were decided to use.

Results of descriptive analysis carried out aiming to find an answer to the first research question of this study is given in Table 1. When examining the mean scores of students' responses towards PSMMS ($\overline{\times}$ = 91.06), it can be stated that students' motivation levels towards learning mathematics in primary schools is 'very high'.

Mann Whitney *U*-Test results of students' PSMMS scores by means of gender are given in Table 2.

Table 2. *Mann Whitney U-Test results of students' PSMMS scores by means of gender*

Sex	***n***	**Mean Rank**	**Rank Sum**	***U***	***p***
Female	284	280.76	79737.0	**37697.0**	**0.677**
Male	271	275.10	74553.0		

As it can be seen in Table 2, there is no statistically significant difference in PSMMS scores of males and females (*U*= 37697.0; p<.05). While mean rank of female students' PSMMS score is 280.76, mean rank of male student's PSMMS score is 275.20. On the basis of this finding, it can be stated that there is not a statistically significant difference by means of gender in participants' motivation levels towards learning mathematics.

Mann Whitney *U*-Test results of students' PSMMS scores by means of the grade level are given in Table 3.

Table 3. *Mann Whitney U-Test results of students' PSMMS scores by means of the grade level*

Grade	*n*	Mean Rank	Rank Sum	*U*	*p*
3rd Grade	261	286.82	74859.50	**36065.50**	**2.21**
4th Grade	294	270.17	79430.50		

* *p*< 0.01

As can be seen in Table 3, there is no statistically significant difference in PSMMS scores with students' grade levels (*U*= 36065.0; *p*> .05). While mean rank of fourth grade students' PSMMS score is 286.82, mean rank of third grade student' PSMMS score is 270.17. On the basis of this finding, it can be stated that there is no statistically significant difference in third and fourth grade participants' motivation levels towards learning mathematics. Mann Whitney U-Test results of students' PSMMS scores by means of the school types are given in Table 4.

Table 4. *Mann Whitney U-Test results of students' PSMMS scores by means of the school types.*

School	*n*	Mean Rank	Rank Sum	*U*	*p*
State	391	266.14	104059.50	**27423.50***	**0.007**
Private	164	306.28	50230.50		

* *p*< 0.01

As can be seen in Table 4, there is a statistically significant difference in PSMMS scores according to the types of the schools (*U*= 27423.50; *p*< .000). While the mean rank of students' PSMMS scores in state schools is 266.14, the mean rank of students' PSMMS scores in private school is 306.28. On the basis of this finding it can be stated that motivation levels of students attending private primary schools is higher than motivation levels of students attending state primary schools towards learning mathematics. Kruskal Wallis Test results of students' PSMMS scores by means of their achievement in a year are given in Table 5.

Table 5. *Kruskal Wallis Test results of students' PSMMS scores by means of the general achievement level*

Final Grade	*n*	Mean Rank	df	χ^2	*p*	Significant Difference
1	-	-	3	37,125	0.000	2-4*, 2-5***
2	13	140,31				
3	40	214,75				
4	100	222,96				
5	402	302,44				

* $p< 0.05$, ** $p< 0.01$, *** $p< 0.001$

As can be seen in Table 6 there isn't any student who gets final grade 1 in the year-end report cards in sample group. Overall year-end grades of students' vary among 2 to 5. As a result of the analysis there is a statistically significant difference in PSMMS scores by means of students' overall year-end scores, $\chi^2= 37.125$ (df=3, n=555), $p< 0.05$. This finding indicates that motivation levels of students' towards learning mathematics are different according to their overall success. When mean rank of groups is considered, the students whose overall year-end grade is 5 have very high motivation level and the succession is followed by the students whose overall performance grade is 4, 3 and 2. Mann Whitney U-Test carried out on binary combinations of groups to investigate the source of significancy between different groups. In this sense, meaningful difference was encountered between the students whose year-end grades were 2 and 4 and the students whose year-end grades were 2 and 5, but meaningful difference wasn't encountered between students whose year-end grades 2 and 3 and whose year-end grades 3 and 4. Kruskal Wallis Test results of students' PSMMS scores by means of the year–end mathematics achievements are given in Table 6.

Table 6. *Kruskal Wallis Test results of students' PSMMS scores by means of the Achievement Level in Mathematics*

Final Grade		Rank	df	χ^2	*p*	Significant Difference
1	3	62,33	4	68.825	0.000	1-3*, 1-5**, 2-3**, 2-4*, 2-5***, 3-5***, 4-5***
2	16	124,38				
3	52	232,44				
4	131	212,01				
5	353	18,00				

* $p< 0.05$, ** $p< 0.01$, *** $p< 0.001$

As can be seen in Table 7, year-end mathematics grades of students vary among 1 to 5. As a result of the analysis there is a statistically significant difference in PSMMS scores by means of students' different year-end mathematics achievements, $X^2= 68.825$ (df= 4, n= 555), $p< 0.05$. This

finding indicates that motivation levels of students towards learning mathematics are different according to their mathematical success. When mean rank of groups is considered, the students whose mathematics performance grade is 5 have very high motivation level and this succession is followed by the students whose overall performance grade is 3, then 4, then 2 and 1. Mann Whitney *U*-Test carried out on binary combinations of groups to investigate the source of significancy between different groups. In this sense significant difference was encountered between the year-end mathematics grade 1 and 3, 1 and 5, 2 and 3, 2 and 4, 2 and 5, 3 and 5, 4 and 5. However, significant difference wasn't encountered between the year-end mathematics grade 2 and 3 and 3 and 4.

Conclusion and Discussion

The study aimed to put forth a scale to determine students' motivations for learning mathematics in primary school. The study firstly examined primary school learners' level of motivation for mathematics. . The results of the study indicated that students' motivation levels towards learning mathematics in primary schools were 'very high'. In this respect, this result differs from the result of Aktan's study (2013) in which the researcher determined that fifth grade students' motivation levels towards learning mathematics is slightly higher than moderate level. A number of studies have concluded that as grade level increases student participation and student motivation in learning declines especially when they enter secondary school after elementary school (Meece, Anderman, & Anderman, 2006). Similarly, Yaman and Dede (2007) have found out in their study in which they examined 6^{th}, 7^{th} and 8^{th} grade students' mathematics motivations that when students pass to the higher grade levels, their motivation for mathematics gets lower. However, similar studies should be evaluated using different sample groups.

Secondly it was found that there is no element creating meaningful difference in students' mathematics motivation scores. A similar finding was put forth in the study done by Pokay and Blumenfield (1990) indicating that gender does not have a significant role on the effect of motivation on success. In Yaman and Dede's (2007) study dealing with the motivation of 6^{th}, 7^{th} and 8^{th} grade elementary school students' motivations for the mathematics course, they stated that the motivations of female students for mathematics course was higher than the motivations of male students. Comparing the results of this study with Yaman and Dede's (2007) study it can be interpreted that the differences of the scales might have an affect on findings. Since the scale used in this study was for specifically measuring students' motivations for mathematics under 1 factor. On the other hand, the scale designed by Yaman and Dede (2007) was not specifically related with

mathematics. Rather, they modified the 5 factor 'Motivation Scale for Learning Science' in an appropriate format and applied it to mathematics course. Such studies should be conducted with different sample groups and the role of gender should be tested as an affecting factor of motivation for learning mathematics. When attitudes towards learning mathematics are examined, it in a number of studies that there are no differences between the attitudes of female and male students towards learning mathematics (Koğce et al., 2009; Nicolaidou & Philippou, 2003).

Thirdly, the results indicated that there is no meaningful difference between the student motivation points in mathematics of 4th grade students and the student motivation points in mathematics of 3rd grade students. As mentioned above some researchers mentioned that the higher students' grade is, the lower motivation levels towards mathematics they have. (Meece, Anderman, & Anderman, 2006; Yaman & Dede, 2007). Similarly it was reported that the higher the students' grade is, the less attitude towards mathematics they have (Kogce et. al, 2009). According to the findings, the decrease in the achievement depending on the increase of grade level can be monitored with the enrolling of students in secondary schools and it was concluded that this difference may not be seen in primary schools.

Fourthly, it was stated that meaningful differences existed in student motivation points towards mathematics in primary classes that is student motivation point towards learning mathematics in the state schools is lower than the student motivation point towards learning mathematics in private schools. Interpretations for the comparison of these results with other studies are impossible due to lack of studies in literature on this issue.

Fifthly, the results showed that student motivation differentiates as to the overall performance and this differentiation occurs parallel with overall performance, in other words motivation towards mathematics increases with the increasing of overall performance. This finding has parallels with numerous research results indicating meaningful positive relationships between student achievement and motivation level (Pokay & Blumefeld, 1990; Broussard, 2002; Lane & Lane, 2001; Kauffan & Humsan, 2004; Ma and Xu, 2004; McCabe, 2004; Strobel, 2010).

The other results of the study indicates meaningful difference between student motivations towards learning mathematics and their final grades. According to the results of this research, student motivation differentiates with their achievement level in mathematics. This differentiation occurs parallel with achievement level. In other words student motivation towards mathematics increases with the increasing of student achievement level in mathematics. This result of the study cannot be evaluated with other studies due to the absence of studies in literature comparing student motivation levels towards mathematics and achievement

level in mathematics. By the help of this study it can be stated that there are meaningful positive relationships between student achievement level and motivation level which is identical with overall performance. Carrying out similar researches on different grade levels and different groups to increase the generalizability status of the findings searched out at the end of this study can be beneficial. Besides, integrating the quantitative study findings with qualitative study results would contribute to the acquisition of deep and comprehensive knowledge about the subject. In fact student behaviors and attitudes in real environment differentiate from what they had meant. Therefore it is suggested to take into consideration how positive student motivation levels towards learning mathematics reflects on real learning environments and to find out relationships between the behaviors and perceptions towards motivation.

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