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DETERMINATION OF THE FACTORS THAT FORM THE STUDENTS' ATTITUDE TOWARDS MATHEMATICS

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Abstract. The education of mathematics and achievement of formal knowledge of mathematics is an important tool for its understanding and application in other sciences. On the other hand, mathematics is not very popular among the students. In this paper we present our research which was conducted among students in the final year of primary education, locally in Stip, Republic of Macedonia, in order to determine the factors that influence the formation of students' attitudes for mathematics in schools. The results of the survey are processed with statistical software SPSS 21. The ANOVA is applied in order to determine whether there is a significant difference between students' attitudes towards mathematics and the factors, which are the goals of the research. Conclusions and recommendations for improvement are given.

Keywords: *mathematics, students' achievement, attitude, grade, result, factor, teaching.*

INTRODUCTION

Education of mathematics is an important tool for understanding the other sciences and application of the knowledge for development of the technology.

Attitude towards mathematics plays a crucial role in the teaching and learning processes of mathematics. It effects students' achievement in mathematics. The teaching method, the support of the structure of the school, the family and students' attitude towards school affect the attitudes towards mathematics. Usually, the way that mathematics is represented in the classroom and perceived by students, even when teachers believe they are presenting it in authentic and context dependent way stands to alienate many students from mathematics [5]. Researchers concluded that positive attitude towards mathematics leads students towards success in mathematics [5],[6]. Attempt to improve attitude towards mathematics at lower level provides base for higher studies in mathematics. It also causes effect in achievement of mathematics at secondary school level. Research on attitudes, as a factor related to students' difficulties in Mathematics, and particularly in solving problems, dates from the 1960s. Recently, many connected concepts have been studied, such as conceptions and beliefs of Mathematics and its learning, motivation and self-regulation, self-concept, self-esteem and self-efficacy. The general tenet is that human beings are not only cognitive individuals, but also social persons with beliefs, emotions and views that influence their development as learners [8]. Actually, a person's behavior and choices, when confronted with a

task, are determined more by her/his beliefs and personal theories, rather than by her/his knowledge of the specifics of the task [8]. The complexity of factors that can influence mathematics performance is demonstrated by Singh, Granville, and Dika [3] where they show that high achievement in mathematics is a function of many interrelated variables related to students, families, and schools. Attitudes are regarded by several researchers, as an important factor to be taken into account when attempting to understand and explain variability in student performance in mathematics [2],[3],[4],[7]. Attitudes can be seen as more or less positive. A positive attitude towards mathematics reflects a positive emotional disposition in relation to the subject and, in a similar way, a negative attitude towards mathematics relates to a negative emotional disposition [6],[9]. The emotional dispositions have an impact on an individual's behavior, as one is likely to achieve better in a subject that one enjoys, has confidence in or finds useful [1]. For this reason positive attitudes towards mathematics are desirable since they may influence one's willingness to learn and also the benefits one can derive from mathematics instruction [1].

METHODOLOGY

The mathematical education is in the main focus of attention in the last few decades. On one hand, scholars, designers, and practitioners have produced exciting new developments in research, curriculum, and assessment. New standards for instruction and curriculum have been developed and an international discourse community on mathematics education has grown. On the other hand, mathematics education has been the target of intense criticism and debate among different stakeholders and communities. All these measures which have been taken in many countries, in order to emphasize the importance of mathematics, and to improve the quality of teaching mathematics do not give the expected results with the students.

In the last few years in the Republic of Macedonia, in primary and secondary schools, more reforms are implemented by the Ministry of Education, so that students can gain better knowledge. The problem of improving the capacity of staff in educational institutions has been popularized in order to improve the process of teaching mathematics. Reforms are implemented several years in order to achieve long-term results. Taking into account the current needs of the economy and industry, Ministry of Education of the Republic of Macedonia has developed a campaign to increase the number of students enrolled in a vocational school and the number of graduates who will enhance their education at technical faculties.

The international tests that were made about comparing the achievement of students in the mathematics showed that the level of achievement of the students in Macedonia is under the European countries student's achievements. Because of that, several projects are implemented in the field of mathematical education. But it seems that the intention of the government institutions does not give the satisfactory results. The number of appointed students who take mathematics as a subject of the state graduation is so small. From the other side, mathematics is required for continuing education in technical and natural sciences and mathematics, so the number of the students in this faculties and schools is also small. The same can be said for the number of students in vocational schools. This situation has encouraged us to try, at least regionally, to identify the factors that affect the formation of the students' attitudes in teaching and learning mathematics. In order to determine the impact of various factors that influence in students' attitude about mathematics, a survey is conducted. This survey is conducted on a sample of students from eighth grade-Nine year's schools in Stip, before they make a decision for their next secondary school.

The objective of the research is getting information about students' attitudes in teaching mathematics. For achieving the goal we had determined several tasks:

1) Is the gender of the student, factor in the formation of positive / negative attitude?

2) Does the grade of mathematics / computer science from half year affect the formation of positive / negative attitude? (In the context of this task we did not decide to conduct a test of knowledge, but we based on the grade given by the teacher.)
3) Does the structure of the students in the classes / class affect with positive / negative attitude?
4) Does the method of implementation of mathematics by the teacher influences the formation of positive / negative attitude?
5) Does the teacher's personality affect to the formation of positive / negative attitude?
6) Does the attitude towards mathematics influences the choice of students' future education?

Questionnaire for measuring attitude toward mathematics of students in primary school was constructed for the purposes of this research. The survey had several sets of questions. Questions relating to the assessments that students have in mathematics, questions about their choice of future education, issues related to the way of teaching by their mathematics teacher, questions that express their own attitude about mathematics, questions related to the way that solve the problems faced during the study of curricula in mathematics and issues related to their engagement in mathematics out of the school.

The results of the survey were processed with statistical software SPSS 21. For determining the influence factors, factor analysis was applied. Also, the strength of the connections between various factors was calculated.

In the survey 101 students from the primary schools in Stip were examined. There are 47 male and 54 female students. They were from a wide range of social and economic backgrounds. Data used in this study were collected at school. Letters describing the study were sent to the parents who gave their written consent to the head teacher. Questionnaires were administered in the classroom under the supervision of a member of our research team.

RESULTS AND DISCUSSION

In the research the descriptive statistics of participants' attitudes, motivation and perceived social support towards mathematics, and also their differences considering gender, grade are presented. By using the parametric statistics, more research hypotheses have been checked. One factor analysis ANOVA is applied, also.

Table 1

Group Statistics

	Sex	N	Mean	Std. Deviation	Std. Error Mean
attitude	male	47	87,9565	13,20094	1,94637
	female	54	87,9623	15,74919	2,16332

53,5% of respondents are female and 46,5% are male, which shows that in terms of gender we have almost equal representation (Table 1). The subjects were students in three elementary schools in Stip, 34.8% are from Goce Delchev, 20.1% from the school Tosho Arsov and 45.1% are students in the school Slavejko Arsov. In the survey 42.6% reported that they will continue their education in high school and 57.4% in the vocational school.

Regarding to the reliability of the instrument, the coefficient of internal homogeneity Cronbach's alpha was 0.83 and it can be concluded that the internal consistency of the whole instrument is solid (Cronbach's alpha in the range 0.80 to 0.90).

Horner (1972) suggested that being successful in competitive situations in mathematics is more of a male than a female trait because the attainment of success is said to produce anxiety in girls and that this is associated with subsequent negative performance. Also, previous studies have

found that boys perform better in mathematics than girls. In order to determine, if there is any correlations between the students' attitude and the students' gender, we apply Student's t-test. By using t-test we can compare the means of these two samples even if they have different numbers of replicates.

We applied the t-Test for independent groups, the male students (M = 87.96, SD = 13.20) and female students (M = 87.96, SD = 15.75) in terms of attitude for mathematics. From the table 2, the value of the t-Test $t(97) = -0.002 < 1.433 = F$, $p > 0.05$, so it can be concluded that there are no differences between students' gender and attitude for teaching mathematics.

		Levene's Test for Equality of Variances		t-test for Equality of Means					
								95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	Lower	Upper
attitude	Equal variances assumed	1,433	,234	-,002	97	,998	-,00574	2,947	-5,853	5,842
	Equal variances not assumed			-,002	96,893	,998	-,00574	2,910	-5,781	5,770

Table 2

One factor analysis ANOVA showed that there are not differences between students from different schools which were included in the survey in terms of the average attitude for mathematics ($F(2,97) = 0.82$, $p > 0.05$) (Table 3). It follows that a positive attitude towards mathematics does not depend on the school.

ATTITUDE

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	345,303	3	172,651	,822	,443
Within Groups	20372,537	98	210,026		
Total	20717,840	101			

Table 3

The research has shown that there are no differences between students who said that they will continue their education at various schools (high school and vocational school), in terms of the average attitude towards mathematics.

		Levene's Test for Equality of Variances		t-test for Equality of Means					
								95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Attitude	Equal variances assumed	3,527	,063	1,255	99	,212	3,63713	2,89814	-2,11341)	9,38766
	Equal variances not assumed			1,225	81,818	,224	3,63713	2,96862	-2,26860)	9,54286

Table 4

According to results from the application of t- test for independent groups, there are no differences between students who said that they prefer to choose high school (gymnasium) (M = 89.93, SD = 15.70) and students who said that they want to choose training college (M = 86.29, SD = 13.36) for continuing their education, in terms of the average attitude towards mathematics.

For determination of the relationship between attitude toward mathematics and grade in mathematics from the previous year among students of primary school, non-parametric test was applied (Spearman's rho coefficient), because the variable-grade in mathematics from the previous year is measured on ordinal level. According to the data of a statistical correlation analysis it can be concluded that there is distinct difference between attitude toward mathematics and mathematics assessment of the previous year ($r = 0.34$; $p < 0.01$). Students who had higher grade in mathematics in previous year, have a more positive attitude towards mathematics, i.e. with increasing success in mathematics, attitude of positivity in mathematics is increased. (Table 5)

Correlations

			Mathematics' grade from previous year	Attitude for mathematics
Spearman's rho	Mathematics' grade from previous year	Correlation Coefficient	1,000	,344**
		Sig. (2-tailed)		,000
		N	101	101
	Attitude for mathematics	Correlation Coefficient	,344**	1,000
		Sig. (2-tailed)	,000	.
		N	101	101

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

Table 5

According to the results of the statistical correlation analysis there is significant relationship between attitude towards mathematics and grade in mathematics on a half year ($r = 0.37$; $p<0.01$). The students who had better grade in mathematics at half year, have positive attitude towards mathematics, i.e. with increasing success in mathematics, positivity of attitude in mathematics is increased (Table 6).

			attitude	Assessment in mathematics from half year
Spearman's rho	attitude	Correlation Coefficient	1,000	,373**
		Sig. (2-tailed)		,000
		N	101	101
	Assessment in mathematics from half year	Correlation Coefficient	,373**	1,000
		Sig. (2-tailed)	,000 .	
		N	101	101

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

Table 6

There are many studies which have explored the role of the environment on learning. Students get maximum learning and develop positive attitude toward a subject in a climate where student get higher involvement, teacher-student relationship, and creative teaching methodology. There is positive correlation among upshots and perceptions about attitude (Fraser and Fisher, 1982). In order to provide maximum learning, there should be an environment, where student feel comfort, motivation, and experimentation in the classroom. Attitude has positive impact on student motivation, it eventually generates fruitful results.

From the surveyed students, even 27% said that sometimes they have performance anxiety in mathematics and 23% are afraid to answer the question that is posed by the teacher. This shows that almost a third of the students sometimes have performance anxiety and fear of mathematics. This is why teachers should make changes in their approach to the students, in order to eliminate fear among the students and to provide a pleasant climate for working.

34% of the students said that sometimes they have difficulties with the curriculum content in mathematics, and even 26% said that they often face up with this problem. When they face up with a problem related to mathematics, even 41% of the surveyed students ask their parents to hire a private teacher, 34% always retreat hoping to get lucky, and only 5% always seek help from a mathematics teacher at the school. On the other side, only 3% of the students said that the mathematics teacher never says what is important on the class and even 51% said that the teacher always emphasizes the important thing during the class. 34% of the surveyed students said that the teacher does not encourage discussion and 55% said that teacher never leaves them to solve the problems alone while he does something else. Even 34% said that teacher compares what they learn on the class with the real problems in their lives. Also the results from the survey show that the mathematics teachers always use the books-70%, but only 19% always use computer software.
These data indicate that mathematics teachers should seriously think about introducing changes in the process of teaching mathematics.

The approach should be made in a different way and problems in mathematics should be associated with real situations, in order to change the students' attitude towards mathematics. The students should recognize that they study something necessary, useful and applicable. It is necessary to increase the application of computers in teaching process. In this way, students could easily understand that mathematics could be integrated in computers which are an integral part of their everyday life.

CONCLUSION

Gender-related attitudes towards mathematics seem to be identical. This finding corroborates the results of other research that claims that boys and girls present very similar attitudes towards mathematics.

Our findings concerning the relationship between mathematics achievement and attitudes towards mathematics are consistent with research showing that good achievers develop more positive attitudes than lower achievers. The teachers should focus to increase the level of achievements in order to foster optimistic attitude.

A good deal of research has been conducted on attitudes towards mathematics, but most of the analyses used have focused on how specific variables influence or are related to attitudes, considering these variables in an isolated way.

Considering that information technology and computers are in everyday students' lives, we would give recommendation for greater use of the computers in teaching mathematics, in order to allow visualization for the students, and connecting mathematics with real situations.

Lack of student motivation and engagement in academic work is an issue of concern amongst teachers. Our findings confirm that attitudes are deeply related to motivation and social support.

The developing strategies in educational contexts to improve teacher support and student engagement could be of vital importance in improving not only attitudes but also mathematical performance among students throughout their schooling.

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