MATHOPHOBIA IN HIGH SCHOOL MATHEMATICS TEACHING

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Summary

At the mere mention of the word mathematics, most students "go dark in the eyes". There are numerous reasons for this. Primarily, mathematics is an abstract science, so it becomes uninteresting and incomprehensible to children. This paper is based on mathophobia in high school students. Namely, mathophobia manifests itself as a fear of mathematics. A person who has a fear of mathematics avoids contact with mathematics in situations that have to do with mathematics. The range of symptoms extends from a mild discomfort when encountering quantitative information to a complete avoidance of anything resembling mathematics. The fear of mathematics among students in two secondary schools in Travnik and Žepće was examined with a representative sample of 288 respondents. Of these, 72 respondents are students of the fourth grade, 100 students are students of the third grade, 68 are students of the second grade and 48 are students of the first grade. The research itself showed very interesting facts, and indicators that fear is present to a certain extent among students. The topicality of the topic is evident, and the indicators themselves can be the introduction and starting point of some new research, based on the above.

Keywords: *school, mathematics, teaching, mathophobia.*

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1 INTRODUCTION

Emotions are the primary experiences that appear before all others in the development of a living being, although we know what is meant by the term emotion (experiences caused by some external or internal situation, characterized by the fact that they are mostly pleasant or unpleasant, and sometimes ambivalent), it is rare that the term in psychology so undefined (Petz, 1992).

While joy and anger are in a sense "emotions of approach", fear, on the other hand, is an "emotion of avoidance". He is characterized by running away from danger. An essential characteristic of the situation in which fear occurs is the perception of a dangerous object or threat, and the crucial thing here is the perception of the individual's lack of power or ability to fight the danger. An important component of many situations in which fear occurs is a forward-looking time perspective. Namely, the individual predicts what will happen in the future, and dwelling on those events creates states of strong anticipatory fear. The term phobia comes from the Greek word phobos, which means fear, flight. A phobia is a strong, irrational, persistent fear of certain situations, objects, activities, persons, and an exaggerated perception of impending danger associated with a specific situation or specific object.

The basic symptoms of a phobia are considered to be a strong, constant, uncontrollable conscious desire to avoid a certain unpleasant situation and a whole series of physical manifestations such as facial redness, tremors, dry mouth, sweaty palms, increased desire to urinate, defecate, palpitations (sensation of rapid or irregular heartbeat) and panic attacks. (Milivojević, 2007).

Mathophobia manifests itself as a fear of mathematics. A person who has a fear of mathematics avoids contact with mathematics in situations that have to do with mathematics.

In the last few decades, a large number of studies have been conducted with the aim of examining individual attitudes towards mathematics. Progress in this area of research has been slowed down due to the limited understanding of the concept of attitudes, and the inability to determine the numerous variables that make up that concept (Khine and Saleh, 2011).

In general, it is considered that human beings are not only cognitive but also social beings, with their own beliefs, emotions and attitudes, which influence their development. Human behavior and decision-making when faced with a task is determined more by one's own beliefs than by an individual's knowledge. Attitudes are an important part of human identity. Each individual feels, loves, hates, agrees or disagrees, accepts or does not accept a situation, object, concept, and the like. The authors conclude that attitudes represent the sum of such evaluations. Literature denotes attitudes as learned predispositions or the tendency of an individual to respond positively or negatively to an object, situation, concept, and even another person. Positive or negative feelings are sometimes permanent and especially resistant to change, although they can change under the influence of changed circumstances and new experiences (Rubinstein, 1986).

"Attitude is a mental and neural disposition, organized through experience, which has a directive and dynamic effect on the individual's responses to all objects and situations with which it is connected" (Hren, 2001: 3).

At the very beginning of the research on attitudes towards mathematics, Daniel Neale states that "attitudes play a decisive role in learning mathematics, and positive attitudes towards mathematics are the reason why students learn mathematics"

(Neale, 1969:631). Neale defines attitudes towards mathematics as "likes or dislikes, a student's tendency to persist or avoid mathematical activities, a student's belief that he is good or bad at mathematics, and the belief that mathematics is useful or unnecessary" (Neale, 1969:632).

According to a simpler definition, there are two main categories of attitudes about mathematics, namely positive or negative emotional dispositions towards mathematics (McLeod, 1994). A more complex definition defines attitudes as a three-component model: a positive or negative emotional response to mathematics, and the concept of mathematics, which implies how much an individual knows mathematics and the tendency to behave towards mathematics (Hart, 1989).

A group of measures of liking or disliking mathematics, the tendency to persist or avoid mathematical activities, the belief that someone is good or bad at mathematics, and the belief that mathematics is useful or useless" (Ma and Kishor, 1997:27). Research shows that most children start school with positive attitudes towards mathematics, but as they grow up, these attitudes become negative. When starting school, students' attitudes towards mathematics depend solely on their family environment. However, success or failure experienced in the classroom changes the initial state and shapes early school experiences that ultimately influence later situations (Lumsden, 1994). In accordance with the recognized increased negative attitudes towards mathematics, negative attitudes are the result of frequent failures in work, and repeated emotional reactions become permanent patterns of behavior towards mathematics. It seems that the pressure that students feel when dealing with high goals is often beyond their capabilities, together with uninteresting teaching and insufficiently positive attitudes of teachers, have a destructive effect on their attitudes towards mathematics (Philippou and Christou, 1998).

The beginning of schooling has been identified as the most significant period in the development of students' attitudes towards mathematics; in that period, teachers have both the opportunity and the responsibility to encourage positive attitudes and high student achievement (Ma and Kishor, 1997).

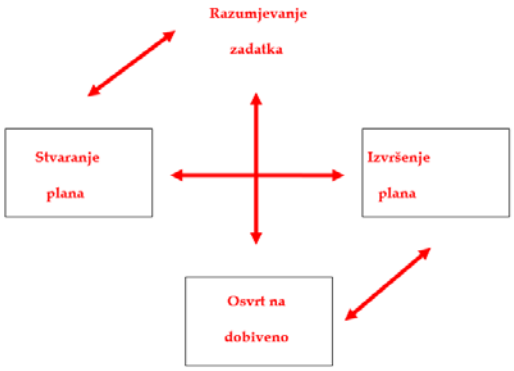
Despite the mixed results of research on the relationship between attitudes towards mathematics and academic achievement, teachers believe that students learn better and are more effective if they are interested in the content they are learning, and achieve better results if they like the content they are learning. Thus, students who enjoy mathematics increase their own intrinsic motivation for learning and vice versa. Therefore, there is a very obvious need to focus attention on the creation and development of positive attitudes in any subject.

In previous research, e.g. in Croatia, on a sample of 306 students from the 5th to the 8th grade of elementary school, it was shown that the respondents have a slightly positive attitude towards mathematics, with a significant statistical difference according to the age of the respondents. Younger students have a more positive attitude. Students generally do not believe that mathematical abilities are innate. A significant difference in understanding mathematics as a male domain was also obtained. Girls are less convinced of this, and boys' assessments are neutral.

However, it should be emphasized that the attitudes of students are influenced by many factors: growing up - initially puberty, class environment, relationship with the teacher, previous achievements, the interestingness of the class, the novelties that the teacher brings into his work, and the like.

Persistence in work and continuing to work after an experienced failure is associated with student self-confidence, so it is desirable to encourage students and constantly monitor their progress.

The prevailing opinion is that for successful mathematics, it is often more useful to solve the same problem in several different ways than to solve several different problems in the same way. By solving one task in several different ways, we can establish by comparison which of the ways is shorter and more rational, more elegant and more effective (Kadum, 2005). In this way, the student's abilities to solve problem tasks come to the fore.



Scheme 1: Solving mathematical problems

We schematically presented the relationship between the ability to solve mathematical problems. The same are expressed in:

- understanding the task,
- creating a plan to solve the problem,
- the realization, that is, the execution of that plan i
- analysis of problem solutions, i.e. review of what was obtained (Kadum, 2005).

"Dyscalculia is a partial disorder of the process of acquiring mathematics, which can appear in all or only certain areas of mathematics. At the same time, the child progresses in learning mathematics, but much slower than his peers and inadequate for his mental age. Acalculia is a term that denotes the complete inability to acquire material from mathematics, that is, the complete absence of mathematical thinking." (Sharma, 2001:15).

2 The empirical part of the research

The instrument used in the empirical part of the research is a survey questionnaire. Before the process of approaching the analysis and interpretation of the results, the reliability of the measuring instrument was tested using Cronbach's Alpha, and it is 0.762, which shows very good reliability and internal agreement of the scale for this sample.

After the mentioned test, the factor analysis was started. In order to check whether the data set is suitable for factor analysis, we checked whether the value of the KMO indicator (Kaiser-Meyer-Olkin Measure of Sampling Adequacy) is equal to or greater than 0.6 and whether the value of the Bartlett's Test of Sphericity indicator is significant (ie that the Sig. value is 0.05 or less).

In our case, the KMO value is 0.706, which is the first indicator of the justification of the factor analysis, and the same is confirmed by the value of Bartlett's Test of Sphericity, i.e. significance (Sig.=0.000).
Based on all of the above, we see that the factor analysis is justified. According to Kaiser's criterion, we were only interested in components whose characteristic value is one or more. In our case, only the first four components have a value above 1 (4.696, 2.396, 1.623, 1.309).

Four factors were identified, with their names: *Fear and difficulties in mastering mathematics, Positive attitude and happiness when encountering mathematics, Prejudices and failure to master basic and fundamental mathematical concepts, Potential lack of fear of mathematics in certain circumstances.* Each factor is

assigned claims according to its membership in the *Total Variance Explained table.* The aforementioned four factors or components explain 66.83 percent of the variance. In accordance with the factors and the objectives of the work, sub-hypotheses or hypotheses were defined and tested using parametric methods.

Sub-hypothesis 1.: It is assumed that there is fear and difficulty in mastering mathematics, and that there is a statistically significant difference in relation to gender and the class from which the respondents come.

Varijabla	N	M	SD	95% Interval pouzda		t-test	P
				Donja granica	Gornja granica		
Postoji strah i teškoće u savladavanju matematike	288	2,82	0,989	-,2929	-,0636	-3,059	0,002

Table 1. Arithmetic mean values, standard deviations of the it - test - There is fear and difficulty in mastering mathematics

Observing and analyzing table 1, we can see that the t-test is (-3.059) and the value Sig.=0.002, while the arithmetic mean (M=2.82) thus we can generally see that there is fear and difficulty in mastering mathematics.

First of all, we will present a sample T-test on the variable there is fear and difficulty in mastering mathematics. The results are shown in Table 2.

Nezavisne varijable		N	M	SD	*t- vrijed./ ANOVA*	*p*
Spol	M	142	2,95	0,964		
	Ž	146	2,69	0,999	2,217	0,027
Razred	I	48	2,78	0,981	0,455	0,714
	II	68	2,78	0,890		
	III	100	2,78	1,071		
	IV	72	2,94	0,974		

Table 2. t-test and ANOVA - There is fear and difficulty in mastering mathematics

Looking at table 2, we see that the value t=2,217 as well as its significance Sig.= 0.027 which is below the threshold value of 0.05, analyzing this issue we see that there is a statistically significant difference of arithmetic means between male and female gender where the value (M=2 .95) in male subjects and (M=2.69) in female subjects. And with a higher standard deviation in female subjects (SD=.999) in contrast to male subjects (SD=.964). This indicates that there is a statistically significant difference between the sexes.

The findings of the research between respondents with regard to class (Table 2.), show that there is no statistically significant difference between respondents with regard to class (t=0.455; p=.714). By analyzing the arithmetic means, it can be seen that it is slightly higher in the respondents in the fourth grade category, and it is the same amount (M=2.94), while the lowest arithmetic mean was shown in the category of respondents in the first, second, and third grades (M= 2.78). . Taking into account the results of the standard deviation, we observe that the highest standard deviation (SD=1.071) was shown in the III grade, and the smallest (SD=.890) in the II grade category.

Sub-hypothesis 2.: It is assumed that there is no positive attitude and happiness when encountering mathematics, and that there is no statistically significant difference in relation to gender and the class from which the respondents come.

Varijabla	N	M	SD	95% Interval pouzda		t-test	p
				Donja granica	Gornja granica		
Ne postoji pozitivan stav i sreća pri susretu s matematikom	288	2,89	1,0702	-,2318	,0165	-1,707	0,089

Table 3. Arithmetic mean values, standard deviations of the it - test - There is no positive attitude and happiness when encountering mathematics

Observing and analyzing table 3, we can see that the t-test is (-1.707) and the value Sig.=0.089, while the arithmetic mean (M=2.89) thus we can generally see that there is no positive attitude and happiness when dealing with mathematics.

First of all, we will present a sample T-test on the variable there is no positive attitude and happiness when encountering mathematics. The results are shown in Table 4.

Nezavisne varijable		N	M	SD	*t- vrijed./ ANOVA*	*p*
Spol	M	142	2,93	1,081		
	Ž	146	2,86	1,061	0,581	0,561
Razred	I	48	2,84	1,097	0,344	0,793
	II	68	2,99	1,011		
	III	100	2,91	1,072		
	IV	72	2,81	1,118		

Table 4. t-test and ANOVA - There is no positive attitude and happiness when encountering mathematics

Looking at table 4, we see that the value t=0.581 as well as its significance Sig.= 0.561 which is above the threshold value of 0.05, analyzing this issue we see that there is no statistically significant difference in arithmetic means between male and female gender where the value (M =2.93) in male subjects and (M=2.86) in female subjects. And with a higher standard deviation in male subjects (SD=1.081) in contrast to female subjects (SD=1.061). This indicates that there is no statistically significant difference between the sexes.

The findings of the research between respondents with regard to class (Table 4.), show that there is no statistically significant difference between respondents with regard to class (t=0.344; p=.793). By analyzing the arithmetic means, it can be seen that it is slightly higher for respondents in the category of second grades, and the same amount (M=2.99), while the lowest arithmetic mean was shown in the category of respondents of the fourth grade (M= 2.81). Taking into account the results of the standard deviation, we observe that the highest standard deviation (SD=1.118) was shown in the first grade, and the smallest (SD=1.011) in the second grade category.

Sub-hypothesis 3.: It is assumed that there are prejudices and lack of mastery of basic and fundamental mathematical concepts, and that there is a statistically significant difference in relation to gender and the class from which the respondents come.

Varijabla	N	M	SD	95% Interval pouzda		t-test	p
				Donja granica	Gornja granica		
Postoje predrasude i nesavladavanje osnovnih i temeljnih matematičkih pojmova	288	2,70	0,8028	-,3882	-.2020	-6,239	0,000

Table 5. Arithmetic mean values, standard deviations of the it - test - There are prejudices and failure to master basic and fundamental mathematical concepts

Observing and analyzing table 5, we can see that the t-test is (-6.239) and the value Sig.=0.000, while the arithmetic mean (M=2.70) thus we can generally see that there are prejudices and lack of mastery of basic and fundamental mathematical concepts.

Nezavisne varijable		N	M	SD	*t- vrijed./ ANOVA*	*p*
Spol	M	142	2,81	,7777		
	Ž	146	2,60	,8153	2,264	0,024
Razred	I	48	2,55	,6848	2,973	0,032
	II	68	2,53	,8726		
	III	100	2,79	,7862		
	IV	72	2,85	,7968		

Table 6. t-test and ANOVA - There are prejudices and failure to master basic and fundamental mathematical concepts

Looking at table 6, we see that the value of t=2.264 as well as its significance Sig.= 0.024 which is below the threshold value of 0.05, analyzing this problem we see that there is a statistically significant difference of arithmetic means between male and female gender where the value (M=2 .81) in male subjects and (M=2.60) in female subjects. And with a higher standard deviation in male subjects (SD=.8153) in contrast to female subjects (SD=0.7777). This indicates that there is a statistically significant difference between the sexes.

The findings of the research between respondents with respect to class (Table 6.), show that there are statistically significant differences between respondents with

respect to class (t=2.973; p=0.032). By analyzing the arithmetic means, it can be seen that it is slightly higher for respondents in the category of fourth grades, and it amounts to the same (M=2.85), while the lowest arithmetic mean was shown in the category of respondents of second grades (M= 2.53). Taking into account the results of the standard deviation, we observe that the highest standard deviation (SD=0.8726) was shown in the second grade, and the smallest (SD=0.6848) in the first grade category.

Sub-hypothesis 4.: It is assumed that there is a potential lack of fear of mathematics in certain circumstances, and that there is a statistically significant difference in relation to gender and the class from which the respondents come.

Varijabla	N	M	SD	95% Interval pouzda		t-test	p
				Donja granica	Gornja granica		
Postoji potencijalni nedostatak straha od matematike u određenim okolnostima	288	3,20	1,173	0,0671	0,332	2,939	0,004

Table 7. Arithmetic mean values, standard deviations of the it - test - There is a potential lack of fear of mathematics in certain circumstances

Observing and analyzing table 7, we see that the t-test is (2.939) and the value Sig.=0.004, while the arithmetic mean (M=3.20) thus we can generally see that there is a potential lack of fear of mathematics in certain circumstances.

Nezavisne varijable		N	M	SD	*t- vrijed./ ANOVA*	*p*
Spol	M	142	3,18	1,191		
	Ž	146	3,23	1,158	-0,335	0,738
Razred	I	48	3,13	1,274	2,075	0,104
	II	68	2,99	1,082		
	III	100	3,20	1,073		
	IV	72	3,47	1,173		

Table 8. t-test and ANOVA - There is a potential lack of fear of mathematics in certain circumstances

Looking at table 8, we see that the value t=-0.335 as well as its significance Sig.= 0.738 which is above the threshold value of 0.05, analyzing this issue we see that there is no statistically significant difference in arithmetic means between male and female gender where the value (M =3.18) in male subjects and (M=3.23) in female subjects. And with a higher standard deviation in male subjects (SD=1.191) in contrast to female subjects (SD=1.158). This indicates that there is no statistically significant difference between the sexes.

The findings of the research between respondents with respect to class (Table 8.), show that there is no statistically significant difference between respondents with respect to class (t=2.075; p=0.104). By analyzing the arithmetic means, it can be seen that it is slightly higher in the respondents in the fourth grade category, and it amounts to the same (M=3.47), while the lowest arithmetic mean was shown in the category of respondents in the second grades (M= 2.99). Taking into account the results of the standard deviation, we observe that the highest standard deviation (SD=1.274) was shown in the first grade, and the smallest (SD=1.073) in the third grade category. It is important to note that in all classes the SD is greater than 1, and differs by several decimal places.

CONCLUSION

Fear of mathematics mathophobia, and it is an increasingly common phenomenon, which can take on serious clinical forms. Fear can appear after a specific unpleasant experience or when the student gradually stops following the professor's explanations and feels lost. Thus, he gradually loses motivation and "runs away" from everything related to mathematics. The concept of fear of mathematics has been of interest to researchers for years, and the earliest research was conducted in the middle of the 20th century, because it was noticed that many students feel emotionally bad when they do mathematics. The phenomenon itself is very current, and even in 1995 a "strict" definition of mathophobia

was reached, which reads *"Fear of mathematics can be defined as a feeling of tension and anxiety that interferes with manipulating numbers and solving mathematical problems in a wide range of everyday life and academic situations."* (Gierl and Bisanz, 1995:140). By examining the assumptions that we defined through the work, we came to the indicators that there is a fear of mathematics in high school mathematics classes, and that there are also difficulties in mastering mathematics. Furthermore, there was an indication that there is a statistically significant difference in the attitude based on the approach to mathematics in relation to gender, while in relation to class, the same does not exist. What can also be noticed is that in some situations the fear does not dominate, it is not expressed, which can be concluded that the fear of mathematics, i.e. mathophobia are not always "of the same amount". With this indicator, we arrive at new knowledge and new questions, which should be the subject and goal of some new research. We therefore conclude that the fear of mathematics and difficulties in mastering mathematical content in primary schools are evident, but that they are not always expressed in the same way. Also, it is concluded that there is no positive attitude of the respondents towards mathematics, which is one of the additional worrying facts.

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