

LEVEL OF MATH ANXIETY AMONG THE STUDENTS OF THE 5TH – 9TH YEAR OF STUDY IN SLOVAKIA

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Abstract

Mathematics accompanies us throughout our lives. Difficulties in acquiring mathematical ideas can appear even without the presence of a math learning disability – developmental dyscalculia. Our lack of success can result from various external or endogenous causes. People who have a higher level of math anxiety often have difficulties in everyday life, wherever mathematics occurs in some way. Therefore, it is important to pay attention to this issue and look for possible solutions and qualitatively discuss questions related to math anxiety. Why and what level of anxiety do individual mathematical tasks cause in some people? Is it not only the fear and anxiety of failure in mathematics but also of failure in everyday life in solving everyday problems, such as counting up purchases, planning financial transactions, interest, discounts, etc.? These difficulties cause fear, stress and anxiety in individuals, and the impairment of mathematical skills is transferred into adulthood. Chinn (2020) reports that up to 22% of adults in the UK have difficulties with the mathematics that limit them in everyday life.

The paper is aimed at finding out the level of math anxiety in a selected population of students and analyzing the questionnaire "How I feel about math" Chinn (2020) translated into Slovak. The research group consisted of 11-16-year-old Slovak students. The aim of the paper is to point out the importance of investigating mathematics anxiety in the diagnosis of a mathematical learning disability. At the same time, to draw attention to the fact that students with special educational needs experience a higher level of math anxiety than their peers. The authors point out that there are no significant gender differences in the experience of math anxiety in the Slovak sample of students and confirm, as stated by Chinn, that 4-6% of neuro-typical (normal) children experience a high level of math anxiety.

Key words

dyscalculia, math anxiety, Developing Learning Disability (DLD), neuro-typical students, Special Educational Needs (SEN)

Theoretical backgrounds

We often come across various comments and excuses in case someone is not good at math, such as: "I don't have a facility for math." or "I was never good at math." Chinn (2020) states that in Western culture, such behavior is more acceptable, and people often use this strategy to lower math anxiety. In this way, they try to make apologies or avoid activities where it is necessary to display mathematical performance and mathematical skills. However, this strategy is not always successful and can lead to lower self-esteem and feelings of personal failure.

During compulsory school attendance, the student acquires a large number of mathematical competencies (Janicek Pavelova, Erhardtova, et al. 2022). Telekova (2020) points out that the requirements and demands of a student in school education have an impact on all components of his personality. In order to find out where the student is failing, it is necessary to

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properly diagnose the math learning disability and at what level the student is. If needed, it is necessary to return to a lower developmental stage and start with special pedagogical intervention there. It is important to introduce support measures (Semradova, 2022) to individualize learning. At other times, it is enough to encourage the students, raise their self-confidence and gradually remove their math anxiety.

In the international comparative assessment of 15-year-old students in the PISA program (2012), in which 65 countries participated (Chinn, 2020), up to 33% of students felt anxious when solving mathematical tasks.

In Anglophone literature, we encounter two terms related to fear "state anxiety" and "trait anxiety" (see Wittchen, Hoyer, 2006). "State anxiety" is defined as a condition or property and is understood as a transient emotion arising as a consequence of real danger. "Trait anxiety" is a more stable personality feature, defined as a constant individual difference related to a tendency to respond with concerns, troubles and worries to various situations. Trait anxiety is thought to belong to a list of characteristic traits of an individual's personality" (Saviola, Pappaiani, Monti, et al., 2020).

The English term *anxiety* is defined by the author Heretik (2007) as an unpleasant mental state bound to the unconscious, which is accompanied by a premonition of a threat and is at the same time oriented towards the future, which distinguishes it from fear as a subjective negative emotion bound to consciousness, a specific object and the current situation.

Chinn distinguishes between two types of math anxiety:

1. anxiety caused by mental blocks in the process of learning mathematics
 2. anxiety as a result of sociocultural factors (Chinn, 2020).
- Hembree (1990) describes math anxiety as a negative emotional reaction to mathematics.

Such a response to mathematics can block the ability to perform mathematical tasks. Mathematical anxiety can manifest itself in different ways on different levels:

- emotional – feelings of worry and fear, tension, concerns, frustration
- physical – contracted stomach, so-called butterflies in the stomach, gasping for breath, palpitations, or inappropriate behavior, avoiding math tasks, or studying math only to the minimum necessary level (Hembree, 1990).

There is a smooth transition between fear and anxiety without sharp boundaries. Trachtova (2018) defines anxiety as an indefinite stifling feeling that is caused by a threat to the value system or security of an individual, arising on the basis of innate dispositions and overloading of the nervous system, by the contribution of stronger psychological traumas and by the influence of conflict situations.

There are three causes of math anxiety (Hadfield, McNeil, 1994):

- environmental anxiety – problems in the classroom, excessive pressure from parents, perception of mathematics as a rigid set of rules
- intellectual anxiety – inconsistency of learning and teaching styles, self-doubt

- personality factors – reluctance to ask questions in class and low self-esteem.

Anxiety does not only block the motivation to learn (Chinn, 2020), but can also fundamentally reduce working memory or attention (see Janicek Pavelova, Zovinec, 2022).

The aim of research and establishing hypotheses

The aim of this study is to determine the prevalence of different levels of anxiety using the questionnaire "How I feel about math" in the second grade of primary schools in the Nitra region. Furthermore, we focus on the comparison of gender differences and the comparison of math anxiety between neuro-typical students and students with special educational needs (hereinafter referred to as SEN).

Hypotheses:

H1 – We assume that there will be no statistically significant differences in the level of math anxiety between gender groups among 11-16-year-old Slovak students.

H2 – We assume a statistically significant higher level of math anxiety in students with SEN compared to neuro-typical students.

H3 – We assume that the prevalence rate of the highest level of math anxiety in the Slovak population of 11-16-year-old primary school students will be higher than 4% (score above 59 points).

Research sample

The research sample consisted of students in their 5th-9th year of study at six primary schools in the Nitra district (western Slovakia). The research group was formed by deliberate group selection. We addressed six primary schools which agreed to the research. The criterion for the selection of the research sample was the inclusion in one of the classes of the 5th-9th year of study. The research sample consisted of N = 264 all students, of which were 94 neuro-typical boys and 24 boys with a diagnosed developmental learning disability and 137 neuro-typical girls and 9 girls with a diagnosed developmental learning disability.

Research method

Slovak adaptation of the questionnaire "How I feel about math."

The English pioneer and authority Chinn (2020) compiled several math anxiety questionnaires for primary and secondary school students as well as adults as part of the diagnosis of dyscalculia. This math anxiety test is part of his protocol, which includes a set of different tests to diagnose dyscalculia. It is important that this questionnaire is evaluated not only quantitatively but especially after its administration, it is additionally evaluated qualitatively using an interview and supplementary questions. The questionnaires use a scale from 1-4, where a rating of 1 represents no anxiety and 4 the highest level of anxiety. The questionnaire for students consists of 20 questions. The questions in the questionnaire "How I feel about math" for 11- to 16-year-old students focus mainly on the teaching process, it is a mixture of different

items focused on different activities that can cause anxiety. Some questions refer to specific tasks in mathematics, such as long division, and others relate to classroom activities or other social and emotional aspects related to mathematics (e.g., reporting the results of a mathematics test to a parent). We implemented the experimental translation according to the recommended methodological standards.

The questionnaire has 20 questions related to the teaching of mathematics. The questions are designed to reflect the students' level of anxiety as well as possible. For this research, the questionnaires were administered in groups, but in some cases (detection of the level of anxiety in students with SEN), the questionnaires were administered individually within the diagnosis of developmental learning disabilities by centers of pedagogical-psychological counseling and prevention.

The individual administration of a questionnaire is a suitable tool for the diagnosis of developmental dyscalculia, together with a diagnostic interview about the perception and experience of mathematics in everyday life. Group administration is suitable for determining the level of anxiety of the entire class collective, whether due to the teaching methods or learning methods of the students (Pavelova, et al. 2022).

The evaluations of the individual questions are designed to express the experience and feeling of anxiety that **causes fear or concern scale: 1 = never, 2 = sometimes, 3 = often, 4 = always**. In the text for students, the term fear and concerns are used, as students at this age may not understand the term anxiety in the same way.

Analysis of the findings

The research compares the results of the test, which was administered to neuro-typical students of the 5th-9th year of study of primary schools N= 264 students. The set consisted of neuro-typical students (N= 231) and at the same time for 33 dyslexic students who are students with SEN in a regular primary school in the form of school integration.

Descriptive statistics, calculations of average values, percentage representation, and standard deviation were used for data analysis. Subsequently, T-test and Mann-Whitney U test were used to test differences.

Analysis of research findings

In the first step, we presented the questionnaires to students in the 5th to 9th year of study from six selected primary schools in the Nitra region.

For this research, we had chosen the method of analyzing and comparing the results of students between the gender comparison of boys and girls according to individual years of study, as well as the comparison between dyslexic boys and girls and the comparison of boys and girls as a whole and finding a statistically significant difference between gender groups. We also compared the findings between neuro-typical students and students with developmental learning disabilities. We were also interested in the analysis of the total score, which percentage of all students achieved a high level of anxiety above the observed score of more than 59 points. The basis for us is

the scientific findings of Chinn (2016, 2020), who investigated the issue of math anxiety in England and conducted research on students aged 11 to 16. The minimum score in the questionnaire is 20 points, and the maximum score is 80 points. In accordance with the findings of Chinn (2020), we adapted the original questionnaire to three intervals of experiencing math anxiety as follows:

- **no/low level of math anxiety** 20 to 39 points,
- **higher level of math anxiety** 40 to 59 points
- **high level of math anxiety** 60 to 80 points.

The following table processes the data according to the selected criteria (year of study, gender, specific learning disabilities).

We cannot consider the total score obtained from the questionnaire as definitive. It is important to take into account factors resulting from the context of several factors when interpreting the results, as well as taking into account the current state of the student.

Table 1 Score, standard deviation and number of students with SEN and neuro-typical students according individual years of study.

	K-5 girls	K-5 boys	K-6 girls	K-6 boys	K-7 girls	K-7 boys	K-8 girls	K-8 boys	K-9 girls	K-9 boys	Σ
Average											
SEN	50,50	42,33	40,00	43,50	54,00	40,75	42,00	32,00	30,00	45,73	42,97
NON-SEN	32,52	36,40	38,26	36,76	41,79	38,25	31,63	32,24	42,44	32,00	36,57
TOTAL	34,84	37,17	38,31	37,35	42,28	38,61	32,34	32,19	41,96	38,57	37,37
SD											
DL	14,34	14,57		30,41		12,82	14,14	1,41		13,89	13,35
NEUR OTYP student	8,83	11,41	9,35	11,67	13,09	13,29	6,95	8,59	10,95	8,42	10,95
TOTAL	11,21	11,66	9,22	13,02	13,04	13,02	7,69	7,70	11,01	13,12	11,45
Number of students											
SEN	4	3	1	2	1	4	2	4	1	11	33
NEUR OTYP student	27	20	34	21	24	24	27	17	25	12	231
TOTAL	31	23	35	23	25	28	29	21	26	23	264

H1 – We assume that there will be no statistically significant differences in the level of math anxiety between gender groups among 11-16-year-old Slovak students.

H_0 : Anxiety between boys and girls is the same.

H_A : There are statistically significant differences between boys and girls.

We compared the total score in the group (N = 264) of boys and girls (Table No. 1), which we also calculated as a percentage due to the uneven number of the selected sample (118 boys and 146 girls). The boys obtained an average score of 28.3 points, which is 37.24%. The girls scored an average of 34 points, which is 44.69%. The average score was 7.45% higher for girls than for boys. The standard deviation is statistically significant for both groups, and differences from normality can be seen. It is 9.3 for boys and 9.7 for girls. At the significance level of 0.05, we confirm the null hypothesis ($p=0.326$, $W=8008.500$). In this case, there are no statistically significant differences between girls and boys. The difference between the sexes is not significant. Chinn (2020) also noted relatively few gender differences in his research, which is also confirmed by our research. However, Carey et al. (2019) in their research found not only a higher level of math anxiety in girls compared to boys but also a generally higher level of anxiety, regardless of the current level of education. Both groups received a minimum score of 20 points. We can observe a difference of 5.7 points in the maximum score, while the highest measured score for boys was 66 points, and for girls, it was 72 points.

Table 2 Average point score in math anxiety of boys/girls.

	AM	%	SD	MIN	MAX
Boys (N = 118)	28,3	37,24	9,3	20	66
Girls (N = 146)	34	44,69	9,7	20	72

Table 3 Independent Samples T-Test.

	W	df	p
SUM TOTAL	8008.500		0.326
<i>Note.</i> Mann-Whitney U test.			
Assumption Checks - Test of Normality (Shapiro-Wilk)			
	W		p
SUM TOTAL	Boys	0.921	< .001
SUM TOTAL	Girls	0.956	< .001
<i>Note.</i> Significant results suggest a deviation from normality.			

H2 – We assume a statistically significant higher level of math anxiety in students with SEN compared to neuro-typical students.

H_0 : Anxiety between SEN and neuro-typical students is the same.

H_A : There are statistically significant differences between SEN and neuro-typical students.

We can also observe math anxiety in students who achieve average performance in mathematics (Carey et al., 2017).

The established hypothesis H2 was verified by comparing the obtained statistical data of the raw score and calculating the percentage values in relation to the number of students within the individual groups and compared

with descriptive statistics as we have two unequally represented groups – students with SEN (N = 33) and neuro-typical students (N = 231), which is declared in Table 1. The Mean average score for students with SEN (N = 33) corresponds to the value of 42.970, where the median SD value is 13.355. Neuro-typical students (N = 231) achieved a mean score of 36.567, where the median value is 10.947. At the significance level of 0.05, we reject the hypothesis ($p=0.009$, $W=4877.000$). In this case, there are statistically significant differences between SEN and neuro-typical students, and we confirm H_A . From the given data, we can state a significant difference in the average point and percentage values within the compared research samples. Our findings correspond with the research of Carey et al. (2017), who found that the criteria for math anxiety were met to a higher extent in students with SEN than in neuro-typical students.

Table 4: Average score of students with SEN/without SEN. Significant results suggest a deviation from normality.

Test of Normality (Shapiro-Wilk)					
		W	p		
SUM TOTAL	DLD students	0.961	0.279		
SUM TOTAL	Neurotypical students	0.941	< .001		
Group Descriptives					
	Group	N	Mean	SD	SE
SUM TOTAL	DLD students	33	42.970	13.355	2.325
SUM TOTAL	Neurotypical students	231	36.567	10.947	0.720

H3 – We assume that the prevalence rate of the highest level of math anxiety in the Slovak population of 11-16-year-old primary school students will be higher than 4% (score above 59 points).

Chinn (2020) states that 2-6% of neuro-typical students score high in math anxiety. Students with high levels of math anxiety can often be anxious, which negatively affects their performance. Based on the above mentioned, we determined the average percentage value of students (4%) achieving a score above 59 points (the score corresponds to a high level of anxiety). Table No. 3 indicates the interval score according to the established criteria. We divided the students into two categories with developmental learning disabilities and neurotypical students. In Table No. 5, results that 12% of students with SEN and 3.9% of neuro-typical students experience a high level of anxiety, and if we take all the students who participated in the research, it is 4.9%. In the hypothesis, we focused on neuro-typical students, and therefore **Hypothesis H3 was not confirmed** as we assumed that more than 4% of neuro-typical students will reach a high level of anxiety.

Table 5 Percentage of students experiencing math anxiety

<i>Anxiety</i>	<i>Anxiety score in intervals</i>	<i>SUM DLD (N = 33)</i>	<i>DLD %</i>	<i>SUM NEURO TYP (N = 231)</i>	<i>SUM NEURO TYP %</i>	<i>TOTAL (N = 264)</i>	<i>TOTAL %</i>
None/Low	20-39	14	42,4%	154	66,7%	168	63,6%
Higher	40-59	15	45,5%	68	29,4%	83	31,4%
High	59<	4	12,1%	9	3,9%	13	4,9%

Discussion

In Slovakia, the issue of mathematical anxiety has not been studied much from a professional point of view. However, Rubinstein et al. (2018) states that math anxiety is considered a widespread problem affecting a large number of people worldwide.

The research focused on the areas of the level of experiencing math anxiety among students in their 5th to 9th year of study (11-16-year-old students) from primary schools in the Nitra region. By comparing the research group with a sample (N = 264) of which were 118 boys and 146 girls, it was found that the differences in gender groups in experiencing math anxiety are not statistically significant. Furthermore, the research compared the results of experiencing math anxiety between regular students (N = 231) and students with developmental learning disabilities (N = 33). These differences between groups of students with special educational needs and neuro-typical students are statistically significant differences. The research looked at what percentage of neuro-typical students experience high levels of math anxiety. In this case, it is 3.9% of (N= 264) intact students who feel a high level of math anxiety. A very high level of anxiety was experienced by students with specific developmental learning disabilities, although these data were not primarily the goal of this research, up to 12.1% of (N=33).

Chinn (2020) pointed out in his research that they are not significant among students of the above-mentioned age and also that 2-6% of neuro-typical students feel a high level of math anxiety. It results from the above mentioned that it is very important to address the issue of math anxiety when diagnosing developmental dyscalculia, but also in general when detecting special educational needs. Thanks to this questionnaire, we can set up intervention programs more correctly, while it is also possible to use common psychological intervention methods. Awareness of the heterogeneity of the causes and symptoms of math anxiety can help educators and psychologists to identify students who have developed math anxiety or who are at risk of developing it as soon as possible and as accurately as possible. Individual interventions should be based on the educational and behavioral needs of students, which must be continuously monitored and reassessed. The extent of interventions should correspond to the therapeutic history of the students and be based on the information obtained as part of monitoring the severity of their difficulties (Janicek Pavelova et al., 2022). The support of healthy self-confidence, self-esteem and mutual respect should be a natural part of school activities and school culture (Valisova, 2022).

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