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PERSPECTIVES OF TEACHERS ON THE SIGNS AND CAUSES OF MATHEMATICS ANXIETY

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Abstract: Math anxiety is a common challenge that affects students in different age groups, hinders their achievements in math, and leads to avoidance of math related activities. This article aims to contribute to a better understanding of the signs of math anxiety in students and the factors which contribute to math anxiety. The research instrument was an online questionnaire specially designed for this study. The questions related to the main aspects presented in this paper were closed questions, most of them measured on a 4-level Likert scale. The participants were 160 mathematics teachers, most of them active teachers with special qualifications and more than 5 years of experience in teaching mathematics. The participants were teaching on different grade levels, covering grades from 1 to 12. Participants self-reported a high familiarity with math anxiety, teachers with special qualification for teaching mathematics, those with more than 5 years of experience, and teachers teaching in grades 7-12 perceived a higher level of familiarity, but the differences were not statistically significant. Teachers reported that there are students with math anxiety in their classes, teachers with qualification reported more students with anxiety, teachers with more experience observed less students with anxiety, these differences being not significant. Teachers teaching grades 7-12 observed a significantly higher number of students with math anxiety than those teaching in grades 1-6. Also, teachers observed physical symptoms of math anxiety, those teaching grades 7-12 in a significantly higher number of students than those teaching in grades 1-6. As regarding other symptoms, increased stress or frustration while doing math and negative self-talk about math ability are the most frequently observed. Teachers consider that the main causes of students' math anxiety are related to the parents, their math anxiety and their attitude to their child's math ability could increase anxiety.

Key words: mathematics education, mathematics anxiety, mathematics teachers, causes of math anxiety, symptoms of math anxiety.

1. Introduction

Mathematics plays a significant role not only in academic success but also in practical decision-making. Ayuso et al. (2021) and Falco & Summers (2021) emphasize its value beyond academic achievement, enabling logical thinking applicable in everyday scenarios. In addition, mathematical calculations foster necessary problem-solving skills (Cresswell & Speelman, 2020). Despite global efforts to improve math achievement, OECD tests conducted in 70+ countries every three years reveal a persistent stagnation in performance in the case of Israel (OECD, 2012, 2019). Various initiatives aimed to find the reasons for these results and to improve math education. One reason for mediocre achievement could be mathematics anxiety, as it is in strong negative correlation with mathematical results (Hembree, 1990; Wu et al., 2012). Math anxiety can hinder mathematical performance, affecting both speed and accuracy in mathematical tasks (Ashcraft, 2002).

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Math anxiety, initially characterized by Richardson and Sint (1972) as a cognitive disorder in dealing with numbers and calculations, causes tension and anxiety in various mathematical scenarios. The math anxiety questionnaires they created systematically assessed people's fears and discomforts about math. Building on this foundation, subsequent researchers have expanded the definition, describing math anxiety as an impediment to mathematical thinking and problem-solving abilities. This obstacle often results in increased apprehension and discomfort when faced with mathematical challenges, affecting both academic and everyday situations (Barroso, 2021; Pellizzoni et al., 2022). Reports indicate that about 20% of people, beyond just students, face high math anxiety (Ashcraft, 2002; Gilar Jatisunda et al., 2021). Even if math anxiety is more frequent in high-school students or adults, some students start experiencing math anxiety already in elementary school (Commodari & La Rosa, 2021; Živković et al., 2022).

Symptoms often associated with math anxiety include tension, frustration, apprehension, and irrational fear (Dowker et al., 2016; Luttenberger et al., 2018; Caviola et al., 2019, 2022; Ma et al., 2021). The literature agrees that students dealing with math anxiety experience a vicious cycle of failure, avoidance, and increased anxiety (Hembree, 1990; Barroso et al., 2021; Cohen et al., 2021; Ma et al., 2021; Mikołajewska, 2021). But math anxiety goes beyond emotional aspects, affecting the fundamental cognitive processes involved in mathematical tasks (Ashcraft & Ridley, 2005). Math anxiety can influence attention, working memory, and information processing (Ashcraft & Ridley, 2005; Suárez-Pellicioni, 2016), thus it affects concentration and performance. Students with high levels of math anxiety could experience mental block (Lu, 2015). This effect can be seen even on MRI scans where the area of the brain responsible with mathematical reasoning shows hyperactivity (Young et al., 2012). Math anxiety can create a negative perception of one's own abilities, potentially affecting self-esteem and interpersonal relationships (Foley et al., 2017). Math anxiety is associated with lower levels of confidence and self-efficacy in mathematical tasks, thus students with math anxiety may doubt their abilities to successfully tackle math-related challenges (Wigfield & Meece, 1988) and thus avoid math-related activities in school and everyday life (Ma, 1999; Commodari & La Rosa, 2021; Živković et al., 2023). Math anxiety can be recognized also from face expressions and voice tones (Foley et al., 2017) and it can have physical symptoms such as sweating, increased heart rate, nausea, and stomach discomfort (Chernoff & Stone, 2014).

The literature points to many potential causes of math anxiety, including poor math knowledge (Hembree, 1990; Ma, 1999), performance pressure from school or parents (Supekar, 2015), negative past experiences (Ashcraft & Ridley, 2005), personal attitudes toward math (Ashcraft & Moore, 2009), low self-efficacy (Hembree, 1990; Ma, 1999), low motivation (Ma, 1999; Harari, 2013). Teachers have a decisive role in pupils' math anxiety. For example, teaching in a too fast rhythm, explaining poorly and always in the same way, and having a negative attitude towards mistakes can generate anxiety in students (Ng, 2012). Teachers also can influence students' attitudes toward mathematics, which in turn may have implications for the development of math anxiety (Gresham, 2007). It's worth noting that the dynamics between teachers' attitudes and students' math anxiety are complex and can be influenced by various factors, including teaching methods, classroom environment, and the overall culture surrounding mathematics education. Besides teachers, parents also have an important role in the level of their children's math anxiety. The attitudes and behaviors that parents exhibit regarding mathematics have the potential to impact a child's experience of math anxiety. Children of parents who express math anxiety are more likely to develop similar anxieties (Ramirez et al., 2013), as parents can transmit their negative view and attitude regarding mathematics (Soni & Kumari, 2017).

Most of the papers study students' or teachers' math anxiety, there are very few publications regarding teachers' perception about their students' math anxiety (for example, Lu, 2015). The objective of the investigation presented in this paper is to discern the extent of teachers' comprehension regarding mathematical anxiety, the signs they encounter during their teaching or know from their studies and the identified causes.

2. Methodology

The research was carried out in Israel during July 2023.

2.1. Research aim

The aim of the research is to investigate teachers' perceptions about math anxiety, their knowledge and experiences regarding symptoms and causes.

2.2. Research questions

This research tried to answer the following questions:

- Have teachers met students with math anxiety?
- Which symptoms of math anxiety do participants recognize?
- What do participants believe are the likely causes of math anxiety?
- Is there a significant difference between experienced teachers and new teachers in their perceptions of math anxiety regarding recognition, symptoms, and causes?
- Is there a significant difference between 1-6 grade teachers and 7-12 grade teachers in their perceptions of math anxiety regarding recognition, symptoms, and causes?
- Is there a significant difference between teachers without and with special training for teaching mathematics in their perceptions of math anxiety regarding recognition, symptoms, and causes?

2.3. Instrument

For the purpose of this research a questionnaire for mathematics teachers was developed, using mixed methods of research paradigms, quantitative and qualitative. This questionnaire comprised 40 items. The first part of this questionnaire contained 5 introductory questions to get to know the research participants, such as years of experience, qualifications for teaching mathematics, and the ages of their students. The second part of the questionnaire contained 35 items related to the research topic: knowledge and experiences related to math anxiety, focusing on recognition, symptoms and causes, as well as possible tools and methods for dealing with students' math anxiety.

The reliability of the questionnaire was tested including all measurable questions. The obtained Cronbach's alpha was 0.795, which indicates a strong reliability.

2.4. Data collection

The questionnaire was developed online and subsequent to obtaining authorization from the group administrators, the corresponding link was disseminated to mathematics educators within a closed group via the WhatsApp platform. This group encompassed a total of 983 mathematics teachers, spanning diverse demographic characteristics such as age and religious affiliation, and representing a nationwide distribution. 160 math teachers filled in the questionnaire.

2.5. Participants

160 mathematics teachers participated in the study. The participants are active or retired teachers who teach/taught mathematics from grades 1st to 12$^{th.}$ 96.9% of the respondents are active teachers, 82.5% of them obtained teaching qualifications, 83.1% of the participants gained more than 5 years of teaching experience. 59.4% of the participants teach middle or high school students, while 37.5% elementary students (Table 1).

Table 1: *School level participants teach*

School level	Frequency	Percent
grades 1-6	60	37.5
grades 7-12	95	59.4
both	5	3.1
Total	160	100

2.6. Data analysis

In this paper the questions related to recognition, symptoms and causes of math anxiety were quantitatively analyzed using frequencies and percentages, means and standard deviation. Comparisons with Mann-Withney test, ANOVA, and repeated-measure ANOVA were performed.

3. Results and discussion

3.1. Teachers' self-perceived familiarity with math anxiety

Firstly, teachers had to rate on a 4-level scale how familiar with math anxiety they are. 86.88% of the respondents have chosen variants 3 or 4, which shows a high level of familiarity. The mean of the answers is 3.93 with standard deviation 0.78 which also indicates that participants are familiar with mathematics anxiety.

Comparing the means for teachers with and without specific qualification for teaching mathematics Mann-Withney test was used, as Shapiro-Wilk test showed deviation from normality ($W = 787$ and $p < .001$ for teachers without specific qualifications and $W = 718$ and $p < .001$ for teachers without specific qualifications). The mean is slightly higher in the case of the teachers with specific qualifications for teaching mathematics, but this difference is not statistically significant (Table 2).

Table 2. *Comparing means on the familiarity with math anxiety in case of teachers with and without specific qualification for teaching mathematics*

Group	N	Descriptives		Mann-Withney test	
		Mean	Standard deviation	W	p
Teachers without qualification	27	3.21	0.787	1540.00	.123
Teachers with qualification	128	3.43	0.774		

Analyzing if seniority influences the familiarity level with math anxiety, the mean in the case of teachers with up to 5 years of seniority is compared with the mean in the case of teachers with more than 5 years of seniority. The Shapiro-Wilk test showed deviation from normality ($W = 813$ and $p < .001$ for teachers with up to 5 years of seniority and $W = 733$ and $p < .001$ for teachers with more than 5 years of seniority) thus the Mann-Whitney test was used for comparison of means. The mean is slightly higher in the case of the teachers with more teaching experience, but this difference is not statistically significant (Table 3).

Table 3. *Comparing means on the familiarity with math anxiety in the case of teachers with up to 5 years of seniority and teachers with more than 5 years of seniority*

Group	N	Descriptives		Mann-Withney test	
		Mean	Standard deviation	W	p
Teachers with up to 5 years of seniority	22	3.14	0.941	1228.50	.181
Teachers with more than 5 years of seniority	133	3.42	0.791		

A question arises regarding the varying degrees of familiarity with math anxiety among educators instructing at different academic levels. To answer this question teachers were grouped in two clusters: those teaching grades 1-3 or 4-6 or 1-6 into the cluster *grades 1-6* and those teaching grades 7-9 or 10-12 or 7–12 into the cluster *grades 7-12*. Teachers who were teaching in both grades 1-6 and grades 7-12 were left out from this analysis, thus 120 participants were included. As the Shapiro-Wilk test showed deviation from normality ($W = 793$ and $p < .001$ for elementary teachers and $W = 712$ and $p < .001$ for secondary teachers) thus the Mann-Whitney test was used for comparison of means. The mean is slightly

higher in the case of the teachers teaching grades 7-12, but this difference is not statistically significant (Table 4).

Table 4. *Comparing means on the familiarity with math anxiety in the case of elementary teachers (grades 1-6) and secondary teachers (grades 7-12)*

Group	N	Descriptives		Mann-Withney test	
		Mean	Standard deviation	W	p
Teachers teaching grades 1-6	60	3.25	0.836	1538.50	.129
Teachers teaching grades 7-12	60	3.47	0.747		

3.2. Teachers' observations on their students' math anxiety

Teachers were asked to answer questions related to their classroom observations regarding students' math anxiety. They have to give on a 4-level scale how many students satisfy the described situation from 1 - none of them to 4 - almost everyone. The percentage of choosing levels 1 to 4, respectively mean and standard deviation in case of each possible factor is given in Table 5. The results show that teachers have observed students with math anxiety, have noticed physical symptoms indicating math anxiety, students avoiding math tasks or giving up before tackling the math task. Physical symptoms are the easiest characteristics of math anxiety for teachers to recognize (Calhoun, 2021).

For comparing the answers given for the last four questions, the percentages for levels 3 and 4 were added. The only question with a percentage higher than 50% is that about how common math anxiety is, in case of all the other questions the percentages are lower than 50%.

It is interesting that the percentage for 'How much common is math anxiety' is higher than for the item 'How many students from your class deal with math anxiety?', which shows that even if they consider math anxiety a general phenomenon in schools, it is not so generalized in the classes they teach. The percentage for 'How many students from your class deal with math anxiety?' is similar to the percentage for the question 'How many students do you think avoid math classes or math activities because they are anxious about the subject?', which is in accordance with the literature that work avoidance is often a consequence of math anxiety (Calhoun, 2021). But the percentage for the question 'How many students do you think give up before tackling the math task?' is higher, which shows that giving up working on a math task is not only the characteristics of math anxious students.

Table 5. *Mean and standard deviation for items related to students' math anxiety*

Item	1 (%)	2 (%)	3 (%)	4 (%)	3 + 4 (%)	Mean	Standard deviation
Have you noticed physical symptoms such as sweating, shaking, or an increased heart rate in any of your students while doing math?	18.75	34.38	31.88	15.00	46.88	2.43	0.96
How many students from your class deal with math anxiety?	8.75	50.63	30.63	10.00	40.63	2.42	0.79
How much, in your opinion, common is math anxiety?	1.88	37.50	43.13	17.50	60.63	2.76	0.76
How many students do you think avoid math classes or math activities because they are anxious about the subject?	7.50	53.13	35.00	4.38	39.38	2.36	0.69
How many students do you think give up before tackling the math task?	2.50	51.88	38.75	6.88	45.63	2.50	0.66

The analysis investigated whether there were significant differences in the responses provided by teachers with specialized training in mathematics education compared to those without such training. As the Shapiro-Wilk test indicated deviation from normality, the Mann-Withney test was used for this comparison (Table 6). Even if the means are slightly higher for teachers with special training for teaching mathematics, the difference is not significant.

Table 6. *Comparing answers given by teachers with and without special training*

Item	Group	N	Shapiro-Wilk test		Descriptives		Mann-Withney test	
			W	p	Mean	Standard deviation	W	p
Have you noticed physical symptoms such as sweating, shaking, or an increased heart rate in any of your students while doing math?	without training	27	0.875	.004	2.26	0.86	1808.50	.280
	with training	128	0.880	< .001	2.48	0.97		
How many students from your class deal with math anxiety?	without training	27	0.853	.001	2.33	0.78	1616.50	.568
	with training	128	0.846	< .001	2.44	0.80		
How much, in your opinion, common is math anxiety?	without training	27	0.833	< .001	2.56	0.75	1434.00	.136
	with training	128	0.833	< .001	2.80	0.76		
How many students do you think avoid math classes or math activities because they are anxious about the subject?	without training	27	0.785	< .001	2.41	0.69	1753.50	.896
	with training	128	0.819	< .001	2.35	0.68		
How many students do you think give up before tackling the math task?	without training	27	0.686	< .001	2.48	0.70	1623.00	.582
	with training	128	0.798	< .001	2.51	0.65		

A further comparison was conducted between the responses provided by teachers with less than 5 years of experience and those with more than 5 years of experience. As the Shapiro-Wilk test indicated deviation from normality, the Mann-Withney test was used (Table 7). Even if the means are slightly lower for teachers with more than 5 years of seniority, the difference is not significant.

Table 7. *Comparing answers given by teachers with up to 5 years and more than 5 years of seniority*

Item	Group	N	Shapiro-Wilk test		Descriptives		Mann-Withney test	
			W	p	Mean	Standard deviation	W	p
Have you noticed physical symptoms such as sweating, shaking, or an increased heart rate in any of your students while doing math?	Up to 5 years	22	0.879	.012	2.46	0.86	1490.00	.887
	More than 5 years	133	0.879	< .001	2.44	0.97		

How many students from your class deal with math anxiety?	Up to 5 years	22	0.846	.003	2.55	0.74	1628.50	.357
	More than 5 years	133	0.845	< .001	2.40	0.81		
How much, in your opinion, common is math anxiety?	Up to 5 years	22	0.775	< .001	3.00	0.62	1784.00	.077
	More than 5 years	133	0.832	< .001	2.71	0.77		
How many students do you think avoid math classes or math activities because they are anxious about the subject?	Up to 5 years	22	0.823	.001	2.50	0.67	1651.00	.285
	More than 5 years	133	0.818	< .001	2.34	0.68		
How many students do you think give up before tackling the math task?	Up to 5 years	22	0.613	< .001	2.64	0.49	1702.00	.172
	More than 5 years	133	0.793	< .001	2.48	0.68		

The answers given by teachers teaching in 1-6 grades are compared with the answers given by teachers teaching in 7-12 grades. As the Shapiro-Wilk test indicated deviation from normality, the Mann-Withney test was used for comparing means (Table 8). Teachers from grades 7-12 observed physical symptoms of math anxiety on significantly more students than teachers from grades 1-6. Also, teachers teaching grades 7-12 observed math anxiety in a significantly higher number of students than teachers teaching grades 1-6. This result is in line with the findings of Erdem (2017), based on students from grades 3-6 having lower math anxiety than students from grades 7-12. But it is important to note that the increase from lower grades to upper grades is not necessarily linear (Erdem, 2017). One reason for increasing math anxiety could be the transition from elementary to secondary school which is often associated with an increase in the complexity of mathematical concepts and a higher abstraction level. Studying more complex mathematics, students' perceptions on mathematics change. The perception of mathematics as a difficult subject can contribute to anxiety.

Table 8. *Comparing answers given by 1-6 and 7-12 grade teachers regarding observed math anxiety*

Item	Group	N	Shapiro-Wilk test		Descriptives		Mann-Withney test	
			W	p	Mean	Standard deviation	W	p
Have you noticed physical symptoms such as sweating, shaking, or an increased heart rate in any of your students while doing math?	Teachers teaching grades 1-6	60	0.854	< .001	2.12	0.94	1288.50	.005
	Teachers teaching grades 7-12	60	0.880	< .001	2.60	0.94		
How many students from your class deal with math anxiety?	Teachers teaching grades 1-6	60	0.820	< .001	2.25	0.73	1386.00	.018
	Teachers teaching grades 7-12	60	0.846	< .001	2.60	0.81		
How much, in your opinion, common is math anxiety?	Teachers teaching grades 1-6	60	0.815	< .001	2.65	0.71	1601.00	.261
	Teachers teaching grades 7-12	60	0.854	< .001	2.80	0.80		

How many students do you think avoid math classes or math activities because they are anxious about the subject?	Teachers teaching grades 1-6	60	0.788	< .001	2.30	0.65	1631.00	.327
	Teachers teaching grades 7-12	60	0.853	< .001	2.42	0.77		
How many students do you think give up before tackling the math task?	Teachers teaching grades 1-6	60	0.746	< .001	2.45	0.68	1591.00	.232
	Teachers teaching grades 7-12	60	0.838	< .001	2.57	0.72		

To find out if teachers self-perceived familiarity with math anxiety influenced the accuracy in their observations, Pearson correlation coefficients were calculated (Table 9). The results show that there is a strong correlation between teachers' self-perceived familiarity with math anxiety and the number of students on which teachers observe math anxiety, physical symptoms, or behavior signs.

Table 9. *Pearson correlation coefficient*

Item	Familiarity with math anxiety	
	r	p
Have you noticed physical symptoms such as sweating, shaking, or an increased heart rate in any of your students while doing math?	0.343	< .001
How many students from your class deal with math anxiety?	0.252	.001
How much, in your opinion, common is math anxiety?	0.363	< .001
How many students do you think avoid math classes or math activities because they are anxious about the subject?	0.167	.035
How many students do you think give up before tackling the math task?	0.018	.819

95.09% of the respondents have seen students who feel embarrassed after giving an incorrect answer and 93.87% have met students who feel ashamed in front of their classmates because of their math ability.

3.3. Teachers' knowledge about the signs of math anxiety

As seen in section 3.2, teachers observed some physical symptoms of math anxiety in their students. The responses of teachers teaching grades 7-12 had a significantly higher mean than in the case of teachers of grades 1-6 (Table 8), which shows that older students develop higher levels of anxiety and have more symptoms. Teachers were also asked if they noticed the listed behavioral or cognitive symptoms. They had to rate each symptom on a 4-level scale from 1 - not at all to 4 - to a great extent each symptom. The percentage of choosing levels 1 to 4, respectively mean and standard deviation in case of each possible factor is given in Table 10. Adding response variants 3 and 4, the highest percentage was obtained for observing students' increased stress or frustration, followed by negative self-talk about their math ability. The least observed symptom is related to concentration and listening difficulties during math lessons. It is known that math anxiety can lead to disruptions in working memory (Maloney & Beilock, 2012) and difficulties in sustaining attention on math-related tasks (Suárez-Pellicioni, 2016), thus can contribute to concentration difficulties. Seems that teachers are not aware about this sign of math anxiety, they likely associated concentration difficulties with behavioral issues.

Table 10. *Teachers' responses regarding the signs of math anxiety*

	1 (%)	2 (%)	3 (%)	4 (%)	3 + 4 (%)	Mean	Standard deviation
Avoiding math-related activities or tasks	4.91	15.95	31.90	45.40	77.30	3.20	0.89
Concentration and listening difficulties during math lessons	14.11	34.36	31.29	18.41	49.70	2.55	0.96
Increased stress or frustration while doing math	2.45	7.98	38.04	49.69	87.73	3.38	0.74
Negative self-talk about math ability	1.84	11.66	29.45	55.22	84.67	3.41	0.77

The lowest mean was obtained for the sign ‘concentration and listening difficulties during math lessons’, the highest for ‘negative self-talk about math ability’ (Table 10). Repeated-measures ANOVA was performed to compare the perceived level of presence of different math anxiety symptoms in students. Mauchly's test indicated that the assumption of sphericity had been violated ($\chi2(5) = 40.346$, $p < .001$), therefore degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon = .848$). The differences between the observed levels of different math anxiety signs are statistically significant ($F(2.545) = 48.344$, $p < .001$). The Holm post-hoc test shows that the mean obtained for the sign ‘concentration and listening difficulties during math lessons’ is significantly lower than the mean obtained for the other three symptoms ($p < .001$ in all comparisons). The mean obtained for the sign ‘avoiding math-related activities or tasks’ is significantly lower than for the sign ‘negative self-talk about math ability’ ($p = .034$).

The subsequent analysis examines whether the level of seniority or the grade level at which teachers instruct influences their perceptions of the various symptoms associated with math anxiety. Compared by seniority, the Shapiro-Wilk test indicated deviation from normality, thus Mann-Withney test was used (Table 11). Even if the means are slightly lower in the case of most symptoms for teachers with more than 5 years of seniority, the difference is not significant.

Table 11. *Teachers' responses regarding the signs of math anxiety compared by their seniority.*

Symptom	Group	N	Shapiro-Wilk test		Descriptives		Mann-Withney test	
			W	p	Mean	Standard deviation	W	p
Avoiding math-related activities or tasks	Up to 5 years of seniority	22	0.738	< .001	3.41	0.59	1617.00	.397
	More than 5 years of seniority	133	0.801	< .001	3.16	0.93		
Concentration and listening difficulties during math lessons	Up to 5 years of seniority	22	0.888	.017	2.59	0.96	1491.50	.881
	More than 5 years of seniority	133	0.879	< .001	2.56	0.95		
Increased stress or frustration while doing math	Up to 5 years of seniority	22	0.760	< .001	3.27	0.77	1315.50	.402
	More than 5 years of seniority	133	0.744	< .001	3.40	0.74		

Negative self-talk about math ability	Up to 5 years of seniority	22	0.684	< .001	3.55	0.67	1618.00	.387
	More than 5 years of seniority	133	0.746	< .001	3.38	0.79		

Now the comparison is made by the grade level teachers teach. The Shapiro-Wilk test indicated deviation from normality, thus Mann-Withney test was used (Table 12). Even if the means are slightly higher in the case of most symptoms for 1-6 grade teachers, the difference is not significant. Math anxiety is higher in higher grades (Erdem, 2017), thus it is interesting that teachers from grades 1-6 perceive the signs of math anxiety on a higher level on a 4-level scale. This could be because in the first classes one teacher teaches all the subjects and that person knows better each student, thus observe easier the signs of their anxiety.

Table 12. *Teachers' responses regarding the signs of math anxiety compared by the grade they teach*

Causes of math anxiety	Group	N	Shapiro-Wilk test		Descriptives		Mann-Withney test	
			W	p	Mean	Standard deviation	W	p
Avoiding math-related activities or tasks	Teachers teaching grades 1-6	60	0.728	< .001	3.40	0.81	2130.00	.060
	Teachers teaching grades 7-12	60	0.816	< .001	3.03	0.96		
Concentration and listening difficulties during math lessons	Teachers teaching grades 1-6	60	0.877	< .001	2.65	0.95	1984.00	.316
	Teachers teaching grades 7-12	60	0.874	< .001	2.47	1.03		
Increased stress or frustration while doing math	Teachers teaching grades 1-6	60	0.702	< .001	3.50	0.70	2059.00	.129
	Teachers teaching grades 7-12	60	0.771	< .001	3.33	0.71		
Negative self-talk about math ability	Teachers teaching grades 1-6	60	0.653	< .001	3.57	0.67	2049.00	.135
	Teachers teaching grades 7-12	60	0.757	< .001	3.37	0.78		

3.4. Teachers' opinion about the causes of math anxiety

The teachers were asked to rate different possible factors that contributed to students' math anxiety on a 4-level scale from 1 - a small contribution to 4 - an important contribution. The percentage of choosing levels 1 to 4, respectively mean and standard deviation in case of each possible factor is given in Table 13. Adding the percentages choosing variants 3 and 4, the results show that each of the factors mentioned in the questionnaire is perceived as contributing to math anxiety by at least half of the respondents. The most agreed factors are related to parents. Teachers consider parents' attitude to their child's mathematical ability and their math anxiety to have a major contribution to the development of the students' math anxiety. The smallest contribution is given to the level of difficulty of the mathematical curriculum and the teachers' math anxiety. Teachers consider that their contribution to the math anxiety of the students is significantly lower than parents' contribution. This is in contradiction with the

literature, where the most frequently mentioned factor is the teacher who can create tension in the classroom (Foong, 1987). Teachers' anxiety can generate anxiety in the students (Hembree, 1990).

Table 13. *Teachers' responses to the causes of anxiety.*

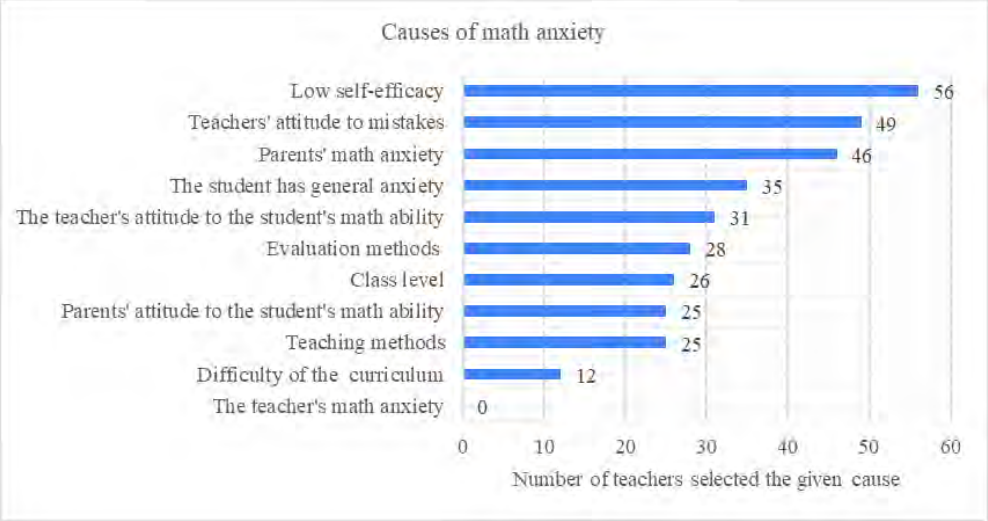
Possible causes of math anxiety	1 (%)	2 (%)	3 (%)	4 (%)	3 + 4 (%)	Mean	Standard deviation
Teachers' attitude to mistakes/failures	12.27	16.56	32.52	36.81	69.33	2.95	1.03
Teaching methods used by the teachers	11.04	27.61	26.38	33.13	59.51	2.84	1.02
Evaluation methods used by the teacher	7.36	19.02	31.29	40.49	71.78	3.08	0.95
The level of difficulty of the mathematics curriculum	16.56	30.06	29.45	22.09	51.54	2.58	1.02
The teacher's math anxiety	33.13	14.72	20.86	29.45	50.31	2.48	1.24
Parents' math anxiety	1.84	14.11	31.29	50.92	82.21	3.35	0.79
The teacher's attitude to the student's math ability	7.36	23.31	31.29	36.20	67.49	2.99	0.96
Parents' attitude to the student's math ability	2.45	9.82	38.65	47.24	85.89	3.33	0.76
The successful students in the class increase the anxiety of the students who are not successful	7.36	25.77	32.52	32.52	60.12	2.92	0.95
The student has general anxiety for non-academic reasons	9.82	28.22	33.13	26.99	65.04	2.78	0.96

Repeated-measures ANOVA was performed to compare the contribution of different factors to students' math anxiety. Mauchly's test indicated that the assumption of sphericity had been violated ($\chi 2(44) = 206.153$, $p < .001$), therefore degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon = .777$). The differences between the contributions of different factors are statistically significant ($F(6.996) = 17.033$, $p < .001$). The Holm post-hoc test shows that the contribution of the parents' anxiety is significantly higher, than the contribution of the teacher's attitude to the math ability of the students ($p = .006$) or teacher's math anxiety ($p < .001$). Similarly, the contribution of the parents' attitude to the math ability of the student is significantly higher, than the contribution of the teacher's attitude to the math ability of the students ($p = .007$) or teacher's math anxiety ($p < .001$). The third highest mean is in the case of the evaluation method, but this mean is significantly higher only than the level of difficulty of the mathematics curriculum ($p < .001$) and teachers' math anxiety ($p < .001$).

The question arises as to whether teachers instructing grades 1-6 and those teaching grades 7-12 perceive the causes of math anxiety differently. As the Shapiro-Wilk test indicated deviation from normality, thus Mann-Withney test was used for comparison of means in case of each math anxiety factor. The only factor where significant difference occurred is 'teachers' math anxiety': in the case of the teachers instructing grades 1-6 the mean (2.88, standard deviation 1.14) is significantly higher than the mean (2.10, standard deviation 1.22) in the case of teachers from grades 7-12 ($W = 2427.50$ and $p < .001$). This result can be explained by the fact that elementary school teachers have a higher math anxiety than teachers teaching in higher grades (Chen, 2022).

Teachers were asked to select from a given list the two most important factors that contribute to the development of math anxiety in the students. The results are presented in Figure 1. It was found that the most common cause is the student's low self-efficacy, this factor being selected by 56 teachers (35%). The second most important factor is the teachers' attitude towards the student's mistakes or failures, which was selected by 49 teachers (31%). It is interesting that in the previous question they didn't give so much importance to this factor. Parents' anxiety was only the third most important factor in the responses of this question, selected by 46 teachers (28.75%). The less important factor was the teacher's anxiety, which wasn't selected by any teacher between the two most important causes of math anxiety.

Figure 1: *Teachers' responses to the causes of anxiety.*



4. Conclusions

Participants self-reported a high familiarity with math anxiety, teachers with special qualification for teaching mathematics, those with more than 5 years of experience, and teachers teaching in grades 7-12 perceived a higher level of familiarity, but the differences were not statistically significant.

Teachers reported that there are students with math anxiety in their classes. Teachers with special qualifications for teaching mathematics reported more students with anxiety, teachers with more experience observed less students with anxiety, these differences being not significant. Teachers teaching grades 7-12 observed a significantly higher number of students with math anxiety than those teaching in grades 1-6.

Regarding symptoms of math anxiety, teachers observed physical symptoms of math anxiety, those teaching grades 7-12 in a significantly higher number of students than those teaching in grades 1-6. Concerning other symptoms, increased stress or frustration while doing math and negative self-talk about math ability are the most frequently observed.

Teachers consider that the main causes of students' math anxiety are related to the parents, their math anxiety and their attitude to their child's math ability could increase anxiety. This indicates a lack of awareness regarding their role in the emergence of students' math anxiety, underscoring the significance of raising their consciousness on this matter.

The results show that dealing with math anxiety in teacher training and professional development is essential. The study highlights the need for comprehensive training to equip teachers with strategies to identify, understand, and effectively treat math anxiety in all ages of students. Failure to address this issue not only harms students' progress but also perpetuates the existing gaps and worsens anxiety about mathematics. It is the collective responsibility of all educational institutions in Israel and the world to prioritize the integration of education for math anxiety in the training of new and veteran teachers.

As a subsequent step, we suggest examining methods for addressing math anxiety in further detail. Following the identification of symptoms and causes, which is the focus of this paper, a crucial endeavor involves the development of mathematical programs aimed at alleviating students' math anxiety. This initiative aims to cultivate a generation of students who are more self-assured and successful in their journey of learning mathematics.

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