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Recommended Citation
Vahap Yorgun & Serdal Mert, "Mathematical Anxiety in the Turkish Context: Mathematical Experiences of High School Students," Journal of Humanistic Mathematics, Volume 14 Issue 2 (July 2024), pages 4-26. Available at: https://scholarship.claremont.edu/jhm/vol14/iss2/3

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Mathematical Anxiety in the Turkish Context: Mathematical Experiences of High School Students

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Abstract

Although a handful of studies have investigated the prevalence of math anxiety among Turkish school children and its relationship with several variables like attitudes toward math, gender, self-efficacy, parental style, there is as of now no study focusing on development psychological interventions to cope with math anxiety. Most of the extant studies use quantitative approaches, but in order to develop intervention programs, researchers need to know how math anxiety develops, what kinds of personal variables or factors take place in this process, and what kind of emotional and cognitive reactions hold by students about math. Thus in our research, we employ qualitative methods to investigate the mathematical experiences of high school students in Turkey who have low math achievement. We discuss our findings in the context of the relevant literature. Based on these findings, psychological intervention programs may be developed to help students cope with math anxiety and remove the cognitive and emotional barrier to learning and loving mathematics.

Keywords: mathematical experience, math anxiety, Turkish context.
1. Introduction

Mathematical literacy is essential at almost every stage of schooling. When a student enters primary school, their journey in mathematics begins with numbers, symbols, and the basic skills of numeration. Things get more complicated as students progress from counting and arithmetic to geometry, complex numbers, derivatives, and integrals, each involving specific symbols and rules. This proliferation of symbols and rules may feel like a foreign language to students that do not develop a sense of meaning associated with them. Such perceived meaninglessness can create insecurity and anxiety.

In addition, there are many myths and preconceptions about learning mathematics that are common in society, along with biases, prejudices, and false assumptions. For instance, “only extremely clever and smart students can do math,” “I am not good at numeration,” “I should choose social sciences because my math grades are not good enough,” and “No matter what I do, I cannot do math because I am not a boy/girl of math.” As a result of these prejudices, math becomes psychologically distant from the student and an unfamiliar, alien subject that causes anxiety [25, 15, 30]. However, the literature on math learning or education makes it clear that all this is illogical and irrational because the ability to learn and perform math is universal; everybody can do math. Unfortunately, many students nonetheless come to have such irrational beliefs about mathematics.

Consequences of the situation described above are dire. Students may cultivate inadequate and low self-esteem due to a sense of estrangement from math. They might perceive arithmetic as an insurmountable problem that is too challenging for them to tackle. As a result, they may embrace a weak and unrealistic mathematical identity and cease trying and studying, accepting that they will never master math. Mathematics becomes a unique source of anxiety [14, 3, 24] and academic failure [10].

Data reveal important information regarding this problem. Every three years, the OECD’s PISA test, which measures the reading, math, and science abilities of fifteen-year-old children, is administered in thirty-seven OECD member countries. The 2018 PISA findings\(^1\) show that the mean of math

\(^1\) See https://www.oecd.org/pisa/publications/pisa-2018-results.htm, last accessed on July 5, 2024.
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subtest scores of the Turkish sample was lower than the overall OECD aver-
age: While just 5% of the Turkish sample scored at level 5 or higher in math, the OECD average rate for this level was 11%.

There could of course be many causes for this result. Some factors include
the mathematics curriculum used, the qualifications and attitudes of math
teachers, teaching methods and styles, as well as parental and societal atti-
tudes toward math and mathematics performance. According to studies in
learning psychology and neuropsychology [27, 23, 16, 29, 5], however, math-
ematics anxiety may be one of the most overt barriers to student learning.

Turkish education literature on math anxiety is limited. Although some re-
search has been conducted to determine the prevalence of the problem, in
order to investigate the relationship between math anxiety and variables like
attitudes toward math [4, 38] as well as gender [7, 40] and self efficacy [1, 28],
we have not found any study focusing on the development and application of
psychological interventions to help participants cope with their math anxiety.
Furthermore, the majority of research studies on math anxiety in the edu-
cation literature in the Turkish context employ quantitative approaches [2].
In particular, Toptaş and Gözel [39] reviewed forty-three master theses on
math anxiety and found that thirty-six of them employed quantitative meth-
ods investigating the prevalence of math anxiety, the relationship with other
variables, development of math anxiety scales and degree of math anxiety.
The remaining seven focused on different teaching styles. Unfortunately, we
have not been able to find any scientific effort or qualitative research directed
towards the goal of reducing or eliminating math anxiety. Moreover a study
conducted on math teachers [8] found that they could not detect math anx-
iety competently and had limited knowledge and skills to intervene or help
students cope with this type of anxiety.

Therefore, there is a need for qualitative studies in the Turkish context that
may provide findings that will be useful in developing an intervention pro-
gram. In order to develop such a program, educators should know how math
anxiety develops, what kind of variables or factors are relevant to this pro-
cess, and what kinds of attitudes students have towards math. We hope that
our research will contribute in this regard. We also hope that scholars from
other regional and national educational contexts will find resonances in our
work.
2. Method

The aim of this research was to investigate and understand the mathematical experiences of high school students who have low math grades. We wanted to know their feelings and thoughts in depth, so we decided to use a qualitative method. In order to collect data about the participants’ mathematical experiences, we developed a fourteen-item questionnaire. While six items are about personal information like the names of the students’ schools, gender, age, grade level, and the educational level of the parents, the rest are concerned with mathematical experiences and are listed below:

1. How old were you when you had your first adverse or bad memory related to math?

2. Can you describe in detail the memory that led to the development of the thought “I can’t do maths”?

3. What do you think when you are faced with a math problem that sounds like a difficult or hard problem?

4. How do you feel when you are faced with a math problem that sounds like a difficult or hard problem?

5. What do you do when you are trying to solve a math problem that seems difficult or hard to you? How do you stop trying?

6. In relation to math, how do you think of yourself as being clever or smart?

7. Do you have any positive memories of mathematics? If so, please give some details

8. Please write three words that immediately spring to mind when you think of mathematics.

School counselors of six high schools located in the Bayraklı district of İzmir, Türkiye, were informed about the research and data collection instrument through a meeting held online in June 2021 due to pandemic restrictions. The survey was then sent to them to be distributed to ninth graders with low mathematics achievement. 390 students completed the online questionnaire. (Some participants sent their responses twice or submitted inappropriate answers, so these were excluded from the data.)
We then used content analysis to analyze the qualitative data. First, participants’ responses to each question were read and coded. Then previously generated codes were categorized to develop certain themes for each question. Below we present the data about socio-demographic variables including gender, school type, grade, and educational level of the parents.

Of the participants that took place in the research 116 were male, while 274 were female (Figure 1).

Of the participants 263 were general high school students. These high schools provide academic education in Turkey. On the other hand, 27 of the participants were vocational high school students, and these high schools predominantly focus on teaching vocational skills. See Figure 2.

Our target population was ninth and tenth grade students, and most participants were in those grades. More specifically, 165 participants were in ninth grade, 183 were in tenth grade, and 42 were in eleventh grade. See Figure 3.

In content analysis, the researcher first codes the data. The code can be a single word or a phrase. Secondly, the researcher uses these codes to develop several themes. In other words, at this stage, the previously developed codes are clustered into different categories based on semantic similarity or proximity. Finally, the themes are interpreted and discussed; see [37, 42] for more on content analysis.
Data revealed that 24 of the mothers and 3 fathers have no schooling completion; 156 mothers and 137 fathers had primary school completion; 81 mothers and 84 mothers had secondary school completion; 94 mothers and 124 fathers had high school completion, and 35 mothers and 41 fathers had university degree. See Figure 4.
3. Results

We present our results question by question. We highlight the codes derived from the responses and, based on these codes, introduce the semantic themes.

Question 1: How old were you when you had your first adverse or bad memory related to math?

Figure 5: Participant responses to Q1.
In the Turkish educational system, students enter primary school at the age of six. After completing primary school, they have to attend secondary and then high school. Each level lasts four years. In terms of age, years 6, 7, 8 and 9 belong to the primary level; years 10, 11, 12 and 13 belong to the secondary level and years 14, 15, 16 and 17 belong to the high school level. As shown in Figure 5, most participants experienced a negative mathematical memory in the early years of education. 95 experienced a negative memory during primary level; 190 experienced such a memory in secondary school, and 67 experienced a negative memory during high school years.

**Question 2: Can you describe in detail the memory that led to the development of the thought “I can’t do maths”?**

Based on the content analysis of memories, we derived eight codes as seen on Table 1: “Overall math failure”, “Failure on a specific math topic”, “Meaningless”, “Teachers’ attitudes”, “Feeling humiliated”, “Parents’ attitudes”, “Sense of difficultness” and “Not seeing the point of a topic”. The codes with the highest frequency were “Teachers’ attitudes” (N=66); “Overall math failure” (N=62); “Failure on a specific math topic” (N=29) and “Sense of difficultness” (N= 24). In other words, teachers’ ineffective, humiliating, discouraging, and sarcastic behaviors, students’ perceptions of math as being difficult, and students’ specific experiences with failure were the most commonly observed contents of the first negative mathematical memories of participants who perceive math as being very hard to learn.

**Question 3: What do you think when you are faced with a math problem that sounds like a difficult or hard problem?**

The data for Q3 show that when students try to solve a math problem that sounds difficult, they produce psychologically negative reactions. These reactions may become emotional, cognitive, behavioral and physiological as well. The codes with the highest frequency include negative expectations (29 times), which involves evaluating oneself as being unable to solve math problems. Desperation occurs 17 times, reflecting a feeling of helplessness in the face of math problems. Anxiety, experienced 15 times, pertains to feeling worried about math problems, while chaos with math knowledge (11 times) signifies feeling confused about math concepts. Freezing (9 times) denotes feeling stuck, and avoiding (8 times) represents the attempt to evade confronting math. See Table 2.
<table>
<thead>
<tr>
<th>No.</th>
<th>Codes</th>
<th>Frequency</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Overall math failure</td>
<td>62*</td>
<td><em>I was in 4th grade and took low grade from exam and I thought that I would never success the math.</em></td>
</tr>
<tr>
<td>2</td>
<td>Failure on a specific math topic</td>
<td>29*</td>
<td><em>I studied the topic of clusters repeatedly but nothing so I thought that I could not do math.</em></td>
</tr>
<tr>
<td>3</td>
<td>Meaningless</td>
<td>4</td>
<td><em>Math sounds like meaningless to me. There is not any relation to real life.</em></td>
</tr>
<tr>
<td>4</td>
<td>Teachers’ attitudes</td>
<td>66*</td>
<td><em>When I was at secondary school our math teacher perpetually got angry with me when I couldn’t solve the problems in front of the class.</em></td>
</tr>
<tr>
<td>5</td>
<td>Feeling humiliated</td>
<td>17</td>
<td><em>When I was at secondary school math teacher forced me to solve the problem and when I couldn’t do it he humiliated me saying “You are idiot! Do you have any brain?”</em></td>
</tr>
<tr>
<td>6</td>
<td>Parents’ attitudes</td>
<td>2</td>
<td><em>When my father heard that my math grade was low, he said this would never do well.</em></td>
</tr>
<tr>
<td>7</td>
<td>Sense of difficultness</td>
<td>24*</td>
<td><em>Math is very difficult to me to have a sense.</em></td>
</tr>
<tr>
<td>8</td>
<td>Not seeing the point of a topic</td>
<td>18</td>
<td><em>I cannot see the points when studying math whether by myself or learning from teacher.</em></td>
</tr>
</tbody>
</table>

Table 1: Codes used for Q2.

Looking at the total frequencies in Table 2, two categories of codes emerge. The first category includes accepted inefficacy (false premises about his/her own math competency), negative self-talk, negative expectation, low self-esteem, inefficacy and irrational self-evaluation. We can conclude that stu-
Table 2: Codes used for Q3.

<table>
<thead>
<tr>
<th>No.</th>
<th>Codes</th>
<th>Other Codes with Semantic Similarity</th>
<th>Total Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Chaos with math knowledge</td>
<td></td>
<td>11</td>
</tr>
<tr>
<td>2</td>
<td>Cognitive chaos</td>
<td>Complexity and uncertainty, Mental confusion, Foreign language</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>Freezing</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>4</td>
<td>Emotional-cognitive chaos</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>Frustration</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Accepted inefficacy</td>
<td>Negative self-talk, Negative expectation, Low self-esteem, Inefficacy, Irrational self-evaluation</td>
<td>95</td>
</tr>
<tr>
<td>7</td>
<td>Avoiding</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>8</td>
<td>Anger</td>
<td>Anger-self blaming, Hopelessness, Meaninglessness, Anxiety, Stress, Desperation</td>
<td>44</td>
</tr>
<tr>
<td>9</td>
<td>Self feedback</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>10</td>
<td>Total negativity</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>Traumatic memory</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>12</td>
<td>Hard sledding</td>
<td>Hard sledding-overwhelming, Hard sledding-reluctance</td>
<td>16</td>
</tr>
</tbody>
</table>

Table 2: Codes used for Q3.

Students with low mathematical achievement develop a negative self-identity in relation to math. The second category of codes includes anger, self-blaming, hopelessness, meaningfulness, anxiety, stress and desperation. In other words, a negative mathematical identity can lead to negative thoughts and self-evaluation.

**Question 4: How do you feel when you are faced with a math problem that sounds like a difficult or hard problem?**

The data for Q4 show that when students try to solve a math problem that sounds difficult, they produce negative and strong feelings. The codes with the highest frequency were negativity (35 times); fear (27 times); inefficacy (25 times); stress (24 times); anxiety (24 times); frustration (18 times); anger (14 times); helplessness (13 times); hopelessness (12 times); and bored (12 times). Analyzing total frequencies, six categories of codes emerge; see Table 3. The first includes “anxiety,” “fear,” “worry,” and “panic.” The second includes “unsuccessful,” “laziness,” and “inefficacy.” The parts of the third category are “negativity” and “negative thoughts” about math. “Pessimism,” “hopelessness,” “helplessness,” and “unhappiness,” constitute the fourth category. The fifth includes “stress” while the codes in the last one are “disgust,” “exhausted,” “depressed,” and “bored.” In short, math failure may result in feelings of anxiety, fear, panic, low self-esteem and self-efficacy.
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Table 3: Codes used for Q4.

Question 5: What do you do when you are trying to solve a math problem that seems difficult or hard to you? How do you stop trying?

The codes for Q5 can be seen below in Table 4.

Table 4: Codes used for Q5.
The data for Q5 show that when students try to solve math problems that sound difficult, they easily get confused and give up trying to solve it. Many participants said that they leave the problem unresolved, while others stated that they feel frozen when they face a difficult math problem.

**Question 6: In relation to math, how do you think of yourself as being clever or smart?**

The codes for Q6 can be seen below in Table 5.

<table>
<thead>
<tr>
<th>No.</th>
<th>Codes</th>
<th>Other Codes with Semantic Similarity</th>
<th>Total Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Stupid</td>
<td>Foolish, Idiot</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>Unsuccessful</td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>Unskillful</td>
<td>Untalented, Inefficient</td>
<td>54</td>
</tr>
<tr>
<td>4</td>
<td>Helpless</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Math requires being intelligent</td>
<td>If you have mathematical abilities, you can do it,</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>One who can do math is intelligent,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Being able to do math is a sign of intelligence</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>I have no mathematical ability</td>
<td>I am not a man of numbers, I am bad at math,</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Math is not for me</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Poor</td>
<td>One step behind</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 5: Codes used for Q6.

We can see that participants think negatively about their mathematical abilities. The most frequent codes include “unskillful,” “untalented,” “inefficient,” “unsuccessful,” and “stupid.” These self-identifications are related to myths about math such as “math requires being intelligent,” “those who can do math are clever” and “math is a sign of intelligence.”

**Question 7: Do you have any positive memories of mathematics? If so, please give some details.**

The codes for Q7 can be seen below in Table 6. The data make it clear that almost half of the participants had no positive experiences or memories of mathematics. When positive experiences are considered, most of them involve being successful in mathematics. One example of a positive experience is getting a high score on a mathematics exam. Teachers’ positive attitudes also help students to develop positive relationships with mathematics. In other words, in order to like mathematics, students need to experience the feeling of being successful and must be exposed to positive teacher behavior.
Question 8: Please write three words that immediately spring to mind when you think of mathematics.

The participants’ responses to Q8 can be seen in Figure 6. Based on the data, we can build four categories of word clusters:

1. Positive words (green),
2. Negative words (red),
3. Neutral words (blue),
4. Either positive or negative words (brown / orange).

Positive words include “fun,” “funny,” “joyful” and “wonder.” Their frequency is calculated as 23. On the other hand, “failure,” “confusing,” “fear,” “anxiety,” “difficulty,” “tension,” “boring,” “crying,” “anger,” and “pain” are examples of negative words. The frequency for this category is 357. The third category is made up of neutral words, words that have no obvious emotional connotations, such as “geometry,” “math problems,” “operations,” and “numbers.” Their frequency is 285. The last category contains words that can be coded either positive or negative based on the specific experience.

<table>
<thead>
<tr>
<th>No.</th>
<th>Codes</th>
<th>Examples</th>
<th>Total Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I have no positive memories</td>
<td>One day I got the highest grade on a math exam</td>
<td>160</td>
</tr>
<tr>
<td>2</td>
<td>Being successful</td>
<td>One day I had solved the problem that the teacher wrote at the blackboard, and my peers applauded me</td>
<td>99</td>
</tr>
<tr>
<td>3</td>
<td>Solving a problem at a blackboard</td>
<td>One day I had solved the problem that the teacher wrote at the blackboard, and my peers applauded me</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>Liking a topic of math</td>
<td>When I was in the 10th grade, the first topic was probability, and I liked it very much.</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Teacher attitudes</td>
<td>I thought that I couldn’t do math. But when I was a freshman in high school, our math teacher made me love math, and then math became my favorite course.</td>
<td>50</td>
</tr>
</tbody>
</table>

Table 6: Codes used for Q7.
“Teachers,” “intelligence,” “brain,” and “logic” are such words. In case of a conflict with a math teacher, these words may have negative associations. If a student believes myths like “math requires being intelligent,” then the word “intelligent” may also code negative. The frequency is 48 for this category.

![Figure 6: Participant responses to Q8.](image)

4. Discussion

Our findings show that the participants mostly experienced their first negative mathematical memories during primary and secondary grades, that is, between ages 6 and 13. One explanation for this may be that when students start primary school, they are confronted with classroom rules and authority figures (teachers) that restrict their ability to play. This shift or change in life may lead to anxiety. While the principal mathematical skills expected from students at the primary school level are basic arithmetic skills, the skills that students need to master get more and more complicated at the secondary school level. This may be an additional source of anxiety, and may lead students to acquire negative memories about math.
Our content analysis of participants’ negative memories about math revealed that these memories are mainly about failure, teachers’ attitudes, and finding math difficult. This resonates with the findings of Alkan [2]; in her review of the literature on math anxiety, she points out that math anxiety is a consequence of a lack of feelings of self-efficacy, as well as a lack of support from parents and teachers. However, it is unclear whether one of these causes is more important than the other. Teachers’ attitudes may trigger a sense of difficulty; a sense of difficulty may prevent students from trying to be successful in math, and failure may force students to develop negative attitudes towards math and math teachers.

Students’ thoughts when faced with a difficult math problem are categorized as accepted inefficacy (false premises about their own mathematical competence), anger, hopelessness, self-blame, chaos with math knowledge (not knowing how to use math knowledge to solve a problem). Similar findings have been reported in different studies [13, 20]. These thoughts or cognitive patterns seem to be generally negative.

Cognitive psychology focuses on the effects of irrational or negative thinking styles on feelings and behaviors of individuals. Such irrational ways of thinking lead to negative feelings such as anxiety, anger, blame, etc. In order to cope with these feelings, individuals may generate dysfunctional behaviors such as depression, avoidance, or blaming others and themselves. An empirical intervention based on Cognitive Behavioral Therapy (CBT) has been evaluated as one of the promising interventions to reduce math anxiety [14, 18, 22, 24, 44].

Some strong emotions students experience when faced with a hard math problem are anxiety, fear, panic, hopelessness, and helplessness. From a cognitive psychological lens, this is expected because these feelings are natural consequences of the negative cognitions about math that we discussed above. The resultant anxiety is what is referred to as math anxiety in the literature: “mathematics anxiety can be defined as the emotional reaction of fear, tension, helplessness, and mental disorganization when dealing with a mathematics problem.” See [3, 12, 44] as cited in [6].

When describing themselves and their feelings, our participants used negative adjectives like “unskillful,” “untalented,” “inefficient,” “unsuccessful,” and “unintelligent.” These adjectives may be viewed as the summaries of these
students’ mathematical identities. The concept of mathematical identity is about how students see their relationship with math and it seems to be central to students’ feelings of self efficacy at one end of the spectrum and math anxiety at the other. See [19, 32, 45].

Many of our participants had no positive memories of math. Psychologically, not having any positive memories can lead to chronic stress in students, or a sense of hopelessness, and it may trigger depression and anxiety. Those who had some positive memories revealed that, in these instances, they experienced moments of success in math and positive attitudes from teachers, including admiration, praise, and glorification. The positive behaviors of teachers, therefore, play an essential role in helping students love and learn mathematics. This resonates with Erden and Akgul [11], who point out that math anxiety and teacher support are significant predictors of math success.

Finally, employing a metaphorical approach, the words or adjectives that surface in students’ minds can offer crucial clues to unlock the doors of their inner mathematical world. Unfortunately, most of these words are associated with negative experiences, feelings, and thoughts. “Difficult,” “difficulty,” “hard sledding at math,” “fear,” “anxiety,” “stress,” and “boring” are the most frequently mentioned words that come up when students reflect on mathematics. However, the essential nature of mathematics does not seem to be the leading cause of math anxiety; there is evidence showing that math anxiety develops in students as a consequence of ineffective teaching methods or approaches, rather than the inherent difficulty of the content or topic [41].

In conclusion, students who struggle with math harbor negative thoughts, feelings, and behaviors associated with learning and studying mathematics. Believing in myths or holding irrational beliefs about math, experiencing negative emotions such as anxiety, fear, hopelessness, helplessness, anger, and self-blame, and avoiding attempts to learn math appear to be the main components of participants’ actual mathematical identity. Particular attention should be paid to students’ negative early memories of mathematics.

3 A student’s thoughts, feelings, behaviors, efforts to be successful at math, interactions with teachers, peers, and parents about math build a pattern all together which has been conceptualized as that student’s mathematical identity. Readers interested in this construct may check out [9, 21, 26, 33].
5. Suggestions

As we said before, although there are some studies in the Turkish education literature on math anxiety, most of them are correlational or descriptive. They investigate the prevalence of math anxiety and its relationship with certain variables without the practical step of developing an intervention program to help students cope with their math anxiety. The development of such psycho-educational programs is urgently needed. Such programs may include group or individual counseling sessions focused on recalling early negative memories related to math, erasing the emotional and cognitive consequences of these memories by analyzing them in a more realistic way, identifying biased assumptions or myths about mathematics, processing feelings of anxiety, fear, and pain related to math failure, and developing a positive mathematical identity.4

Math teachers have a significant influence on students’ attitudes towards mathematics broadly, or towards a particular topic such as equations or algebra. Our findings suggest that teachers should adopt a positive teaching and relationship style when teaching mathematics. This is particularly important at the moment of failure when solving a math problem in front of peers. The feeling of being humiliated by teachers or peers may lead to low self-esteem related to math and consequently, math anxiety or even math phobia. It may be more effective for teachers not to focus strictly on the correct answer but to praise whatever is correct in the reasoning while solving a math problem. In order to support teachers in this endeavor, school counselors can organize sessions to inform them about studies on math anxiety.

Interventions to cope with math anxiety should focus on students, teachers, and peers using a systemic perspective. In order to reduce or prevent the feeling of being humiliated by teachers or peers, a peaceful and supportive learning environment should be encouraged, so all will respond in a healthier way to a student who has come up with an incorrect solution to a math problem. To illustrate, the teacher can explain to all students that any attempt to solve a problem on the blackboard using logical reasoning will be considered and marked, and the focus will no longer be only on the correct solution.

4 For a handful of examples of how some of this work can be done, at least to an extent, within the mathematics classroom, check out [36], as well as [34] and the references therein.
Another effective procedure to cope with math anxiety involves the Mathematical Resilience (MR) approach. Mathematical resilience is defined as “maintaining self-efficacy in the face of personal or social threat to mathematical well-being” [17], and it is based on four attributes: personal value of mathematics, growth mindset, community, and struggle. Using the tools provided by MR may empower students in learning situations that may otherwise cause exorbitant anxiety.

More research is needed to develop interventions based on different theoretical foundations to address math fear or anxiety. For example, Eye Movement Desensitization and Reprocessing (EMDR) is a promising tool for erasing the emotional and cognitive consequences of negative memories and instilling strength to heal traumatic events that may provoke anxiety and panic [35]. Gestalt Therapy is another effective approach to process unfinished psychological business and unexplained feelings [31]. To adapt these therapeutic techniques to learning environments or mathematics education, counselors and counselor educators can collaborate with mathematicians or math teachers in an interdisciplinary way.\[5\]

References


\[5\]Indeed a recent presentation points to the results of one such study that showed that a ten-session psycho-educational program developed for maths anxiety was effective to reduce the math anxiety level of secondary students in the Turkish context; see [43].
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[20] Ş. Konca, “Yedinci sınıf öğrencilerinin matematik kaygısı nedenlerinin bazı değişkenler açısından incelenmesi [Examining the Relationship Be-
24 Mathematical Anxiety in the Turkish Context

tween Math Anxiety of 7th Grade Students and Some Variables|” (in
Turkish), Masters’ Thesis, Yüzüncü Yıl Üniversitesi, Van, Turkey, 2008.

[21] C.M. Latterell and J. L. Wilson, “Metaphors and mathematical identity:
Math is like a tornado in Kansas,” Journal of Humanistic Mathematics,
Volume 7 Issue 1 (2017), pages 46–61. doi:10.5642/jhummath.201701.05

[22] I.M. Lyons and S.L. Beilock, “Mathematics Anxiety: Separating the
Math from the Anxiety,” Cerebral Cortex, Volume 22 Issue 9 (2012),
pages 2102-2110. doi:10.1093/cercor/bhr289

[23] X. Ma and N. Kishor, “Attitudes toward self, social factors, and achieve-
ment in mathematics: Meta-analytic review,” Educational Psychology
Review, Volume 9 Number 2 (1997), pages 89-120.

develops, and how to guard against it,” Trends in Cognitive Sciences,

[25] Lucia Mason, “High school students’ beliefs about math, mathemati-
cal problem solving, and their achievement in math: A cross-sectional
study,” Educational Psychology, Volume 23 Issue 1 (2003), pages 73-85.

and Identity Development in Mathematics,” Journal of Hu-

[27] D. B. Mcleod, “Research on Affect in Mathematics Education: A Recon-
ceptualization,” pages 575-596 in Handbook of Research on Mathematics
Teaching And Learning edited by Douglas A. Grouws (Macmillan, New

students’ mathematics self-efficacy sources and mathematics anxiety le-

[29] H. Miller, and J. Bichsel, “Anxiety, working memory, gender, and math
performance,” Personality and Individual Differences, Volume 37 Issue


[39] V. Toptaş and E. Gözel, “The content analysis of the post-graduate theses concerning maths anxiety” (in Turkish), *Journal of Education,*
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