

Factors that cause students to develop math anxiety and strategies to diminish

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Abstract

This research aimed to determine the factors that cause elementary school students to feel fear and anxiety about mathematics and to identify the strategies that the teachers can use to reduce and eliminate these factors. For this purpose, a case study method based on qualitative approach was used in the study. Researchers created an online questionnaire and collected the data from randomly selected 65 classroom teachers working in various primary schools of Northern Cyprus in the 2019-2020 Academic Year. The questionnaire was finalized in line with the literature search, feedback from the field experts and the pilot study to ensure the reliability of the study. In the first part of the questionnaire, there are questions to determine the demographic features of the participants. In the second part, there are questions to determine the opinions of the teachers about the factors that may cause students to develop 'fear and anxiety towards mathematics (student, teacher, parent, and other factors). The third part of the questionnaire comprises a question to identify the strategies that the teachers use to reduce and eliminate the factors that cause anxiety development towards maths. The study is thought to contribute to the classroom teachers and the literature as it is a research aimed at identifying the factors that prevent effective mathematics teaching and the data will help teachers rethink and redesign the math courses based on data obtained.

Key words: Anxiety, Effective Teaching, Teachers, Mathematics, Primary School, Total Quality Management

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In today's world, where societies are in a rapid development process, the need for individuals who can keep up with developments and changes and add new links to the development chain increases the importance of education day by day. Every day, we encounter many problems that we need to solve. Mathematics is the most useful common thinking tool we use to explain the universe we live in. Mathematics is an indispensable key to science and technology in today's evolving world. Mathematics involves processing information, generating, making predictions, and problem-solving by using this language (MEB, 2009). It helps individuals get to know themselves and their environment in every subject. Therefore, it is necessary for individuals to understand, interpret mathematics, have a high level of understanding of mathematics, and be a good problem solver in order to cope with problems. It is thought that individuals with a high level of mathematics comprehension can think practically, determine cause-effect relationships more easily, and are more successful in finding solutions to the problems they encounter.

Mathematics, which has such an important place in human life, is one of the basic courses that is compulsory for students from preschool to university. Despite this, mathematics is one of the primary courses that students behave prejudiced and are most afraid of. It is seen as a boring and unpopular course, difficult to understand by many students (Küçük et al., 2013). The difficulty of mathematics is definitely related to its structure, but prejudices, fears, and anxieties developed against mathematics are among the factors that trigger this difficulty (Umay, 1996). According to the results of the 2012 PISA application conducted by the OECD, in which 15-year-old students from 65 countries participated, approximately half of the Turkish students had a negative attitude towards learning mathematics (OECD, 2013). Negative perception towards mathematics causes students to have very high anxiety that may hinder learning (Aliasgar et al., 2010). However, there is a low level of interest in mathematics lessons in students (Peker & Mirasyedioğlu, 2003). Math anxiety is a strong sense of anxiety and fear seen when the possibility of dealing with a math problem arises (Fennema and Sherman, 1976; Şahin, 2000), math anxiety is panic, helplessness, and mental disorganization that occurs in some people (Tobias ve Weissbrod, 1980; Alkan, 2010). Mathematics anxiety is a psychological condition that drives students to failure, undermines their self-confidence, causes students unable to use their capacity and abilities efficiently, and affects their future plans (Richardson & Suinn, 1972; Carmona, 2004; Üldaş, 2005). Students have been developing fear and anxiety towards mathematics since their first encounter with mathematics. 9-11 age range is a critical period for the formation of anxiety and fear of mathematics (Mcleod, 1993, Jackson and Leffingel, 1999). Mcleod stated that failure to make the relations between numbers as required during this period may cause students to have difficulties in establishing relationships between concepts and then prevents students to develop problem-solving skills. Therefore, while creating a mathematical foundation, it is said that negative situations such as mathematical anxiety and fear that may occur in students may cause students to have difficulties in learning mathematics in the following years and may create a ground for students to experience mathematical fear (Başar, Ünal & Yalçın, 2001).

There are many factors that cause math anxiety and are not dependent on a single cause (Fennema and Sherman, 1976; Butterworth, 1999; Fiore, 1999). Bloom (1979) stated that, when examining the learning differences in individuals, approximately 25% of this is because of affective factors. (Dursun & Bindak, 2011). It has been observed that anxiety and fear, which are among these affective features, negatively affect mathematics performance. Math anxiety may be caused by students' fear of failure and feeling inadequate in class (Perry, 2004). Devine et al. (2012) suggested that negative experiences in class, degree of thought, self-esteem, learning style, attitude, and confidence may influence to generate math anxiety and prevent students to develop their full capacity. In a study, students at secondary school showed anxiety toward mathematics, and students having a high sense of achievement and low self-esteem had higher levels of anxiety (Kesici & Erdogan, 2010).

Situations that cause students to feel anxiety in the classroom are classified as the authority created by the teacher in the classroom, the time limitation of the teacher in the course and exams, the expectations of parents and teachers from the student, and the student's feeling of pressure accordingly (Curtain, 1999 cited in Yenilmez & Özabaci, 2003). Continuous pressure is also likely to cause anxiety in students. Not establishing a relationship with the actual world in lessons, problems during learning, negative classroom environment and teacher's attitude (Bekdemir et al, 2004; Tretter, 2012; Clark, 2013), teachers' narrative style, teacher's character (Swanon, 2006), teaching method (Baloğlu, 2001) may lead to math anxiety in students. It is thought that teachers' math anxiety and math teaching anxiety may be important factors on the basis of students' math anxiety (Peker, 2006). Teacher attitude and strategy can affect students' attitudes toward mathematics negatively. For this reason, primary school teachers should be very careful while teaching mathematics and treat each student as a unique individual (Keklikçi & Yilmazer, 2013; Gresham, 2010). Oberlin (1982) stated that situations such as evaluation of each student with the same criteria, insisting of teacher that there is only one correct answer in the solution of a problem, and want misbehaving students to solve math problems in order to punish them increase the students' math anxiety and fear. It causes a negative attitude and consequently failure (Alkan, 2009). Mathematics anxiety experienced by students not only reduces the quality of education but also causes it to fall far below the targeted point in education. Parents' frustration and despair are depressing factors for children and parents who give less value to mathematics and oppress children are also factors that cause math anxiety and fear (Dossel, 1993; Fraser & Honeyford, 2000). There are studies showing that students' positive mathematics attitude and academic success in mathematics are parallel to the increase in economic resources (Chiu and Xihau, 2008; Dinçer and Uysal, 2010; OECD, 2013).

In the studies conducted by Ethington and Wolfle (1986) and Ma (1997), it was understood that students with high mathematics attitudes were more successful in mathematics. Revealing the relationship of mathematics with actual life plays an important role in understanding mathematical concepts in individuals, increasing their interest and motivation in the course, and learning mathematics (Temel, 2012). The first and foremost thing to reduce math anxiety and fear is a safe environment where students can take risks and where student thinking is respected. The classroom environment should be created in such a way that questions can be asked, ideas can be explained, rational thinking and reflections can be made (Haylock, 2007). The reason for anxiety and fear may be inadequate understanding (Butterworth, 1999). There is also evidence that male students suffer less anxiety than female students towards mathematics and female students have less confidence in their mathematical abilities (Pérez et al., 2009; Devine et al., 2012; Seng, 2015). But in a study, Hernández (2008) found no significant level between female and male students in terms of their anxiety levels when they apply the Stroop test in high school and no differences were detected in the test scores of both genders. Math anxiety is one issue that educators should focus on with importance and seriousness. Therefore, it is important to determine anxiety levels to determine the factors that cause student failure.

Aim of the research

This research aimed to determine the factors that cause elementary school students to feel fear and anxiety about mathematics and to identify the strategies that the teachers can use to reduce and eliminate these factors. For this purpose, answers of the following questions were sought:

1. What are the student-related factors that cause students to develop fear and anxiety towards mathematics?
2. What are the factors related with teachers that cause students to develop fear and anxiety towards mathematics?
3. What are the factors related with parents that cause students to develop fear and anxiety towards mathematics?

4. What are the other factors which may cause students to develop fear and anxiety towards mathematics?

5. Which strategies do the teachers use to reduce and eliminate the factors that cause students to develop fear and anxiety towards mathematics?

Method

Research design

The events and thoughts can be examined in a natural environment in a realistic and holistic way during qualitative data collection methods such as interview, observation, and document review (Yildirim & Şimşek, 2008). Case study, which is a qualitative research model, is based on the questions of "how" and "why" which allows the in-depth examination of the events or facts that the researcher cannot control (Çepni, 2010). To determine the factors that cause math anxiety and different strategies that may be used by the teachers to diminish these factors in detail, the case study based on qualitative approach was used in the study.

Participants

The participants of the research are the classroom teachers working in various primary schools in North Cyprus in the 2019-2020 Academic Year. Teachers were selected by random sampling method. 65 teachers participated in this study. 62% of the teachers were female and 38% were male teachers and they are all working in state primary schools with teaching experience more than 5 years.

Data collection

Researchers created an online questionnaire to collect data. The semi-structured questionnaire tries to reveal the opinions of the participants, and is between a formally structured and unstructured questionnaire containing open and closed-ended questions (Sarantakos, 2005). Based on the data obtained by analyzing the literature, the questionnaire was prepared. For the reliability and validity of the survey, 2 different field experts examined the questions about suitability for the purpose, sufficiency and understandability. In addition, two Turkish teachers examined the questionnaire in terms of grammar rules etc. The questionnaire, prepared in line with the opinions of experts, was administered to 2 classroom teachers as a pilot study. The survey was finalized in line with feedback from the experts and the pilot study to ensure the reliability of the questionnaire (Silverman, 2005). In the first part of the questionnaire, there are questions to determine the demographic features of the participants. In the second part, there are questions to determine the opinions of the teachers about the factors that cause students to create 'fear and anxiety towards mathematics. The third part of the questionnaire comprises a question to identify the strategies that the teachers use to reduce and eliminate the factors that cause anxiety development towards mathematics.

Data analysis

The data obtained with the semi-structured questionnaire were transferred to the computer environment. The data in the computer environment were analyzed using the content analysis method. The content analysis method is expressed as a systematic, innovative analysis technique in which some words are described with smaller content categories by using the data obtained from the participants with the codings determined in line with certain rules (Büyüköztürk et al., 2008). The data obtained from the participants were categorized by coding done by 2 researchers. Direct quotations were used to reveal to which category the obtained data was included and according to which opinion the coding was made. Each participant' explanation was written in quotation marks and symbolized at the end of each explanation like (T(21) where T stands for teacher and number of teacher is given in bracket. The frequencies of the codes were also specified in the analysis of the answers given for the specified categories. For the analysis reliability of the data, the reliability formula (Reliability: [(Consensus) / (Consensus + Disagreement) x100] developed by Miles and Huberman (1994) was used. Sub-themes were created as a result of the coding. The researchers

determined the sub-themes that they agreed on and disagreed and found the percentage of agreement between their views as 89% (Yildirim & Şimşek, 2008).

Results

Results of the research are given as answers of the research questions:

Research Question 1: What are the student-related factors that cause students to create fear and anxiety towards mathematics.

Table 1 Student-related factors that cause students to create fear and anxiety towards math course

Student-related factors
Lack of knowledge of students from a lower class
Dyscalculia
Not understanding the logic of the problem
Failure to grasp the importance of mathematics in daily life
Afraid to answer a question wrong
Being bored or afraid of reading long problem sentences
Inability to read fluently
Lack of concentration
Not being in intelligence-enhancing environments

One teacher claimed that *“Most of the students are only playing with toys and they are not taking part in intelligence-enhancing environments such as chess and puzzles. Some students have attention and concentration problems. Some students have a lack of knowledge from previous grades. For this reason, the same teacher can teach mathematics to the same students during the primary school period. If this is not possible, teachers who teach students at one grade for one year should report the academic progress of their students to teachers who will teach the same students next year...”* (T (4)).

Another teacher expressed that *“Some students have concentration and attention problems and have lack of knowledge from previous grades or some have inability to read fluently. These problems can be tested at the beginning of each term and deficiencies can be completed with activities such as weekend courses. Based on my experience, I suggest teachers motivate their students in math courses such as giving stickers or applauding or even saying well done to the students who can solve math questions correctly...”* (T (22)).

Research Question 2: What are the factors related with teachers that cause students to create fear and anxiety towards mathematics?

Table 2 Teacher-related factors that cause students to create fear and anxiety towards mathematics

Teacher-related factors
Insufficient knowledge of effective teaching strategies
Not using different methods to endear math lesson
Not explaining the need for using math in daily life
Not doing reinforcement activities about each topic
Not sparing sufficient time for each student

One teacher expressed that *“Most of the teachers in the classroom use question-and-answer method. Activities such as games and dramas motivate students. They don't use the induction and simplification technique enough. The training is based on rote learning. Problem situations related to real life are not given. The child has not fully learned to read and write in the 2nd grade and is asked*

to solve problems. Teachers do not arouse curiosity in students. The student is not given the feeling that I can do it” (T (31)).

Another teacher pointed out that “Some teachers have inability to teach lessons appropriate to the level of the students. I think this is because of insufficient knowledge of teachers about effective teaching strategies in math that suit to the grade of the students” (T (47)).

One teacher claimed that “Teachers try to complete all the topics in the curriculum at each grade each year but they don’t care whether the students understood the topics very well or not. Some students can learn a new concept in one lesson but some can learn in one week. The learning speed of children is different. Teachers have to take sufficient time for each student but unfortunately, this may be impossible because of crowded classes” (T (51)).

Research Question 3: What are the factors related with parents that cause students to develop fear and anxiety towards math course?

Table 3 Factors related with parents that cause students to develop fear and anxiety towards math course

Factors
Parents' pressure on students always to get high marks
Negative statements of parents
Comparison with successful students
Not being able to help their children with math at home
Not allow the student to use his/her math knowledge in daily life
Crowded families

One teacher reported that “Parents want their children always to get high marks on math exams. They can't tolerate a low grade. There are parents who say humiliating words to the child when he/she gets a poor mark. In particular, they compare their children to other children who are consistently successful. Therefore, they exert pressure on their children to work constantly” (T (3)).

Another teacher emphasized that “Some parents say that their children are not good at mathematics, he/she cannot perceive it and always tell negative words to their children and others. Children are affected by these negative statements and this situation creates prejudice in the child and the child thinks that he/she is unsuccessful” (T (17)).

One teacher stressed that “Some students have many siblings and their homes are very crowded and they don't have their own study rooms where students can study quietly. Some parents do not allow their children to shop on their own. Therefore, children cannot use their mathematical knowledge in daily life. When the student gets a low grade, the parent sees only the child guilty” (T (62)).

Research Question 4: What are the other factors which may cause students to create fear and anxiety towards mathematics?

Table 4 Other factors which may cause students to develop fear and anxiety towards math course

Factors
Huge size curriculum
Crowded classrooms
Insufficient course materials
Inappropriate evaluation system

One of the experienced teachers emphasized the problem with math curriculum “We have huge size math curriculum and we have to complete all the topics in a limited time and this situation does not allow us to do more practice on topics” (T (29)).

Another teacher explained the effect of crowded classes “In public schools, classes are very crowded, we cannot take every student to the blackboard in every lesson and we cannot deal with students individually. Problem solving opportunities cannot be provided in the form of group work. A competitive environment is created. Active learning methods are not applied” (T (36)).

Another teacher mentioned the need for additional course materials as follows: “We need more visual course resources. School books are insufficient. Some teachers only use the textbook and do not use any other course resources. The books are for rote education and exam oriented. Topics start with natural numbers and units of measure at the end. For example, the subject of measurement units is in the last section of the curriculum in the 3rd grade, and the subject of measurement units is in the last section of the curriculum in the 4th grade again” (T (23)).

One teacher stressed the importance of the evaluation system which may cause math anxiety “Teachers giving their students too much math homework comprising difficult questions. This causes anxiety and distress for children. Classical exams are held collectively, there is no individual evaluation. Exams are prepared solely for the teacher's initiative. No exam is prepared according to the course outcomes. Exams are always information oriented. There is no evaluation for analysis and synthesis in math. Still, teachers want children to memorize the multiplication table. Those who have strong memorization are successful, if their memorization is not strong, they will take a low mark in math. Maybe the child be able to solve the problem with rhythmic counting?” (T (12)).

Research Question 5: Which strategies do the teachers use to reduce and eliminate the factors that cause students to develop fear and anxiety towards mathematics?

Table 5 Strategies used by the teachers use to reduce and eliminate the factors that cause students to develop fear and anxiety towards math course

Strategies
One to one interaction between student and teacher
Motivating students
Relating math with daily life
Using effective teaching strategies
Testing students for dyscalculia
In-service training to teachers

One teacher suggested some effective strategies as follows: “Teachers can do more exercise on each topic. Then students need to apply what they learn. For example, when they learn how to measure the length and how to calculate the area of a rectangle, they can measure the length of their table, calculate the area of their classroom....” (T (19)).

Another teacher suggested that “Teachers can teach math concepts with games and puzzles. Teachers can use awarding methods to motivate students such as giving stickers or with oral awards. There is a need for one-to-one interaction between each individual student and teacher. I think students need to be tested for discalculi and other types of learning problems, too” (T (53)).

Another teacher pointed out that “A link should be established between mathematics and daily life. The importance of mathematics for human life should be explained to children. It is necessary to comprehend the logic of the mathematics course and to make students believe in the necessity of mathematics. It is necessary to ensure that students use mathematics in daily life. For example, when the topic about money was completed, students can go to the canteen and buy a sandwich and calculate the amount of money they will pay...” (T (57)).

One of the experienced teachers suggested that “Effective math teaching strategies should be used by the teachers to increase the engagement of the students such as using induction technique, drama, play, repetition. Students can be grouped according to their level of math knowledge. When a student becomes successful at one level, he/she can start a next level....”.

Another teacher suggested that “ *Quality of training of undergraduate degree at universities can be improved. All teacher candidates need to take courses comprising effective math teaching strategies, strategies to lower anxiety level of students in math course, learning problems and discalculi. These courses can be given as an inservice training course to all math teachers*” (T (42)).

Conclusion and Discussion

Although mathematics has an important place in human life, it is the one of the basic courses that students behave prejudiced and are most afraid of, have a negative attitude towards learning mathematics (Aliasgar et al., 2010), and have a low level of interest in mathematics (Peker & Mirasyedioğlu, 2003). Many researchers supported the idea that many students have math anxiety (Richardson & Suinn, 1972; Fennema and Sherman, 1976; Tobias and Weissbrod, 1980; Mcleod, 1993, Jackson and Leffingel, 1999; Şahin, 2000, Başar, Ünal & Yalçın, 2001; Carmona, 2004; Üldaş, 2005; Alkan, 2010) and there are many factors that cause math anxiety and are not dependent on a single cause (Fennema and Sherman, 1976; Butterworth, 1999; Fiore, 1999). Math anxiety is one of the issues that educators should focus on with importance and seriousness and it is important to determine anxiety levels to determine the factors that cause student failure. This is the first study that aimed to determine the factors that cause elementary school students to feel fear and anxiety about mathematics, and to identify the strategies that the teachers can use to reduce and eliminate these factors in North Cyprus. For this purpose, the case study based on qualitative approach was used in the study. Researchers created an online questionnaire. The questionnaire was finalized in line with the literature search, feedback from the experts and the pilot study to ensure the reliability of the study. In the first part of the questionnaire, there are questions to determine the demographic features of the participants. In the second part, there are semi-structured questions to determine the opinions of the teachers about the factors that cause students to develop fear and anxiety towards mathematics. The third part of the questionnaire comprises a semi-structured question to identify the strategies that the teachers can use to reduce and eliminate the factors that cause anxiety development in children towards maths. Researchers collected the data from randomly selected 65 classroom teachers working in various primary schools of Northern Cyprus in the 2019-2020 Academic Year. The data in the computer environment were analyzed using the content analysis method.

Participant teachers expressed 9 different student-related factors that cause students to develop fear and anxiety towards math. These factors are lack of knowledge of students from a previous class, dyscalculia, not understanding the logic of the problem, failure to grasp the importance of mathematics in daily life, afraid to answer a question wrong, being bored or afraid of reading long problem sentences, inability to read fluently, lack of concentration, not being in intelligence-enhancing environments. The idea that math anxiety can be related to the student is advocated by many researchers (Perry, 2004; Pérez et al., 2009; Kesici & Erdogan, 2010; Devine et al., 2012; Devine et al., 2012; Seng, 2015)

Teachers explained 5 different teacher-related factors that cause students to develop fear and anxiety towards math course. These factors are insufficient knowledge of effective teaching strategies, not using different methods to endear math lesson, not explaining the need of using math in daily life, not doing reinforcement activities about each topic, and not sparing sufficient time for each student. The idea that math anxiety of the students may be related to teachers is supported by many researchers (Curtain, 1999 cited in Yenilmez & Özabacı, 2003). These factors are stated as teacher's attitude (Bekdemir et al, 2004; Tretter, 2012; Clark, 2013), teachers' narrative style, teacher's character (Swanon, 2006), teaching method (Baloğlu, 2001, Alkan, 2009) and teachers' math anxiety and math teaching anxiety (Peker, 2006).

Participants stated 6 different factors related with parents that cause students to develop fear and anxiety towards math course. These factors are parents' pressure on students always to get high marks, negative statements of parents, comparison with successful students, not being able to

help their children with math at home, not allowing students to use his/her math knowledge in daily life, and crowded families. Dossel, 1993; Curtain, 1999 cited in Yenilmez & Özabacı, 2003 and Fraser & Honeyford, 2000 supported the idea that math anxiety of the students may be related to parents' frustration and despair.

Teachers mentioned about 4 more factors which may cause students to develop fear and anxiety towards math course as follows: huge size curriculum, crowded classrooms, insufficient course materials, and inappropriate evaluation system. Participant teachers suggested 6 different strategies to reduce and eliminate the factors that cause students to develop fear and anxiety towards mathematics. These strategies are one-to-one interaction between student and teacher, motivating students, relating math with daily life, using effective teaching strategies, testing students for dyscalculia, and in-service training to teachers. Similar types of strategies are suggested by many researchers in the literature such as treating each student as a unique individual (Gresham, 2010; Keklikçi & Yilmazer, 2013); revealing the relationship of mathematics with real life, increasing interest and motivation of students in the course, and learning mathematics (Temel, 2012) and creating classrooms in which questions can be asked, ideas can be explained, rational thinking and reflections can be made (Haylock, 2007). Posamentier (2017) put forward 9 strategies for motivating students in mathematics. These strategies are calling attention to a void in students' knowledge such as presenting simple exercises involving familiar situations and then presenting ones with unfamiliar situations on the same topic. showing a sequential achievement, leading students to discover a pattern, presenting a challenge, enticing the class with a "gee-whiz" mathematical result such as class discussion of the famous birthday problem, indicating the usefulness of a topic, using recreational mathematics such as games, paradoxes and puzzles, telling a pertinent story, getting students involved in justifying mathematical curiosities such as the sum of the digits of a number is divisible by 9, the original number is also divisible by 9. Importance of interaction between each student and teacher is also emphasized by Yackel & Cobb, 1996; Cheeseman, 2009 and also it is claimed that student motivation and engagement can be supported by monitoring the progress of the students, providing prompts (Clarke et.al., 2002; Sullivan et al., 2006; Hackenberg, 2010).

The study is thought to contribute to the classroom teachers and the literature as it is a research aimed at identifying the factors that prevent effective mathematics teaching and the data will help teachers rethink and redesign the math courses based on data obtained. Designing teacher training programs about effective math teaching strategies to primary school teachers as in-service training and evaluation of the outcomes of such programmes are highly suggested by the researchers.

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