



Does Mathematics Anxiety Have Any Impact on Secondary School Pupils' Friend Choices?

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Abstract: This research was conducted in order to determine whether math anxiety was effective in the selection of secondary school students. This research, in which the mixed method was adopted, was conducted in a secondary school at Siirt. The participants (157 pupils) were determined by convenient sampling method from the four different classes (two 5th grade and two 8th grade). Math anxiety levels of the students were determined by the Mathematics Anxiety Scale. Sociometry technique was used to determine the informal friends groups in each class. For this purpose, a friend preference form was used. Students' friends preferences were transformed into data matrix and Hierarchical Clustering Analysis was used to form informal friends groups for each class. Math anxiety scores of informal groups were compared with Kruskal Wallis test. Accordingly, there were significant differences between the mathematical scores of the informal groups in the branches of the 5th and 8th grades. This finding was evaluated that mathematics anxiety may be a factor in the selection of friends.

Keywords: *Math anxiety, informal friendship groups, social friendship.*

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Introduction

Anxiety is a state of feeling that every human being experiences. Anxiety is an important factor in the formation and development of personality and in the manifestation of behavior (Kartopu, 2012). It causes fear when a person is faced with a thing or event that he or she perceives as a threat. Anxiety appears when unrealistic meaning is attached to an event or a situation (Manav, 2011).

Anxiety is considered a symptom of the instincts of survival and self-protection (Gectan, 2005). This is because anxiety helps to accelerate the reflexes and concentrate so that one can evaluate and respond to potential threats (Mental Health Foundation, 2014). For this reason, moderate levels of anxiety increase the perceptiveness of a person, causing him or her to feel more energetic than usual. Thus, the person becomes more awake, more creative and achieves a high level of motivation. However, low levels of anxiety cause low motivation. High levels of anxiety, on the other hand, make one like a rabbit caught in the headlights (Arem, 1993).

There are many types of anxiety such as exam anxiety, math anxiety, and death anxiety (Sarıkaya, 2013). Math anxiety is a type of situational anxiety that arises when a person is confronted with math questions (Erdogan, Kesici & Sahin, 2011). While researchers offer different definitions for math anxiety, it is described in general as the combination of the tension that is experienced when working on math problems and prevents them from being solved, the irrational fear that one experiences while solving math problems, the emotional reaction that negatively affects the ability to learn new things based on past negative experiences, the negative attitudes towards learning math, the fear of failure, exam pressures and/or lack of self-confidence (Godbey, 1997).

Math anxiety can be said to be one of the biggest obstacles interfering with math performance. Indeed, there are several studies showing that there is inverse relationship between academic achievement and math anxiety (Baloglu, 1999; Devine, Fawcett, Szűcs & Dowker, 2012; Kesici, 2016; Kilic, 2011; Lee & Stankov, 2013; Ma, 1999; Sad, Kis, Demir & Ozer, 2016; Yildirim, 2011). It has also been determined that mathematics anxiety is a significant predictor of success in math and negatively affects it (Akgul, 2008; Kesici & Asililoglu, 2017; Lee & Stankov, 2013; Shores & Shannon, 2007). Math anxiety causes pupils to avoid math (Yenilmez & Ozabaci, 2003) and to bunk off school (Kurum, 2012). Moreover, it exerts a major influence on pupils' choice of schools and profession, so much so that they tend to choose those

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involving as little math as possible (Ma, 1999). For this reason, it is very important to investigate various aspects of math anxiety.

Truttschel (2002) stated that rumors about the difficulty of math had undeniable impact on the development of math anxiety. Such rumors cause fear and anxiety. Conversations about the so-called inscrutability and the intractable nature of math, along with exposure to conversations with family members and friends where past negative experiences with math are shared, can have an effect on the development of math anxiety (Kesici, 2018; Truttschel, 2002). For this reason, the study of math anxiety in the context of friend groups will be useful for mathematics education.

Human beings are naturally social creatures and they feel the emerging need to socialize with other people around them. Social norms like belonging to a group, the need to express oneself, liking others or being liked are necessary needs of an individual according to Maslow (Retrieved from Demirel, 2011). For this reason, a large part of our lives are spent in various groups of at least two people who come together to realize a certain purpose. People come together in different groups for various reasons to feel safe, to be social, to fulfill themselves, to obtain respect, or to relax and finally to escape from stress, all of which are regarded as social phenomena by Kagitcibasi & Cemalcilar (2014). Groups are very important for helping an individual to socialize. Through socialization, we adopt norms and values of the society we live in as well as building personalities according to our surroundings and thus our potential talents emerge and develop with the help of society's values and norms (Akyuz, 1992).

Pupils also form various groups at school. The most important of these groups is the group of pupils who share the same classroom. This group can be considered as a formal group because the classes are determined by the school. Pupils in the same classroom (formal group) form friendship groups (informal groups) based on shared interests and motivation (Kayaoglu, Gokdag & Kirel, 2013). Individual factors such as intelligence and shared interests are influential in the formation of these friendship groups and in intra-group communication (Kagitcibasi & Cemalcilar, 2014). Within this context, Alkan (2010) stated that pupils suffering from math anxiety make friends with the other suffering ones, leading to the reinforcement of negative opinions about math. In social psychology, the reasons cited for individuals forming groups are to gain a sense of security and to relax by escaping from stress (Kayaoglu, Gokdag & Kirel, 2013). Alkan (2010) stated that pupils with math anxieties are humiliated and ridiculed by hardworking pupils, and that these pupils become friends with other pupils with similar anxieties and feel more comfortable that way. Therefore, math anxiety can be an effective factor in choosing friends among the students.

In this study, the relationship between math anxiety and friendship groups was investigated. Are the groups of informal friendships formed in the classroom environment consisting of homogeneous groups in terms of math anxiety? Therefore, whether or not math anxiety is effective in choosing friends is an interesting research topic. Knowing whether mathematics is effective in the choice of friends and the formation of informal groups of friends can be a guideline for educators in mathematics teaching. Teachers can prevent math anxiety, which is one of the most important obstacles to mathematics achievement, and develop strategies to reduce the anxiety levels of students with a high level of math anxiety. Thus, it can be said that examining whether math anxiety is effective in the selection of friends is important in terms of group dynamics.

Research Objective

In this study, the hypothesis that the informal friendship groups formed in the classroom environment will differ in terms of math anxiety was tested. As the first year of secondary school is the 5th grade and the final year the 8th grade, we anticipate the bonds of friendship among pupils from higher grades to be more pronounced. This study has been carried out to determine whether there is a relationship between pupils' choice of friends and math anxiety. The study seeks the answer to the following questions:

1. Does math anxiety differ according to the informal fellowship groups in the 5th grade?
2. Does math anxiety differ according to the informal fellowship groups in the 8th grade?

Methodology

Research Design

This study was carried out with a mixed method where both qualitative and quantitative methods were used. The mixed method contributes to a better understanding of complex social phenomena with the possibilities offered by different methods (Creswell, 2003). In qualitative scope of the research, by using case study and sociometry technique, friend groups were determined through clustering analysis based on similarity factor. Sociometry is a method used to reveal the social structure of a group by determining the social distance between the individuals in it (Tan, 1992). In quantitative scope of the research, mathematical anxiety scores of friend groups were compared survey technique.

Participants

A convenience sample consists of 5th and 8th grade of a state secondary school at Siirt province from Turkey. To reach the whole target population is challenging so in this study convenience sample and study groups were formed

according to accessibility. The convenience sample and study groups were formed according to accessibility (Kilic, 2013). The study group which consisted of 157 pupils is the students studying at two branches of the grade levels. 5th grade pupils were chosen due to new friendships between pupils from different primary schools, while 8th grade pupils were chosen due to longer friendships among pupils. Because secondary schools start and end with classroom level 5 to 8 in Turkey. The relationship between informal friendship groups and math anxiety was determined by selecting two different branches on a classroom level to obtain more reliable results. The branches were coded as 5A, 5B, 8A and 8B. The data collection tool was implemented by the school teacher in the classroom. Necessary explanations were made to the students. The students were asked to select the students for the group work in the classroom according to their friends' preference form and it is also emphasized that they should not show their friends preferences to anybody. Details of survey respondents are given in Table 1.

Table 1. Distribution of Participants by Class and Gender

Class	Female	Male	Total
5-A	19	20	39
5-B	18	21	39
8-A	19	20	39
8-B	18	22	40

Instruments

The 'Choices of Friends Questionnaire' and 'Math Anxiety Scale' were used as data collection tools in this study. The data collection tool was conducted under the supervision of the researchers and the class teachers. Prior to administering the tools class teachers were informed. How the coding would be performed and all other necessary explanations were made to the students by class teachers. Detailed information about the instruments is given below.

Choice of Friends Questionnaire: The sociometry technique was used to determine the choice of friends of pupils who took part in the research. For this purpose a choice of friend questionnaire was prepared for the pupils. In the questionnaire, the pupils were asked to give the names of six of their friends who they would like to do their homework with, who they would like to go on a picnic or a school trip with, as well as the names of those who they would like to hang out with the most. A $n \times n$ -type matrix was created for n students with same class. The a_{ij} element of the matrix defined as for $i \neq j$, $a_{ij} = 1$ if i^{th} student choice j^{th} student; $a_{ij} = 0$ if i^{th} student didn't choice j^{th} student. The row of this matrix considering as cases and hierarchical cluster analysis. This matrix was considered as data in the HCA and the friends groups in the class were determined in this way.

Math anxiety scale: this study used the Math Anxiety Scale (MAS) to determine the pupils' levels of anxiety. The scale is made up of 10 items and has a 5 point Likert-type design. A high score indicates high math anxiety. The Cronbach Alpha reliability coefficient of the MAS developed with pupils in the 7th grade was reported as 0.88 (Bindak, 2005). The construct validity of the math anxiety scale was reexamined with the data collected in this study. In the Explanatory Factor Analysis (EFA), the Kaise-Malkin-Olkin (KMO) coefficient was = .89, and the Bartlett Test was 607.71 ($df = 45$, $p < 0.01$). The scale had a single factor and that 48.45% of the variance was accounted for by the single factor. Factor load values of the items in the scale were between 0.58 and 0.80. The item-total correlations of the items in the scale were found to be between 0.43 and 0.71. The Cronbach Alpha reliability of the scale was calculated to be 0.88. These findings are in acceptable limits (Bayram, 2012; Can, 2014).

Data analysis

The data were collected during the fall term 2016-2017 in November. Data collected from a secondary school in the province of Siirt. The 'Choice of Friends Questionnaire' and the 'Math Anxiety Scale' were applied at the same time in the classrooms. Data collected with the sociometry technique was analyzed for each class separately. The pupils' choice of friends was subjected to hierarchical cluster analysis in SPSS on the basis of similarity. The subject of clustering is the pupils' choice of friends. The number of clusters was not known at the beginning. The Ward method was used for cluster formation while the Squared Euclidian Distance was used for distance measurement. The dendrogram obtained from the hierarchical cluster analysis was taken as the basis for determining pupil sociometric groups. For this purpose, each pupil was coded with their pupil number in the classroom list. A matrix was obtained by inserting the pupil codes into both the rows and columns by taking into account the pupil numbers. The friends preferred by each pupil were written in the column where each pupil's name was written taking into account the order of preference in his/her row in the matrix (ranked as 1,2,..,6 according to the order of preference where 0 means 'not preferred'). A group needs to have at least two people in interaction with each other; therefore, groups that were composed of at least two students after clustering analysis were regarded as one student friend group (Kayaoglu, Gokdag & Kirel, 2013).

The anxiety score medians of pupil groups obtained with this method were compared with the Kruskal-Wallis H Test (KWH), which is a non-parametric variance analysis technique. In the case of significant differences between the

groups, the results of the Mann-Whitney U Test were taken into account along with Bonferroni correction as the post-hoc test.

Results

Comparison of math anxiety scores of informal groups friends for 5A classroom

In the study, the pupils' choice of friends in the 5-A branch were examined through clustering analysis. The results obtained of hierarchical cluster analysis (HCA) are given in Figure 1.

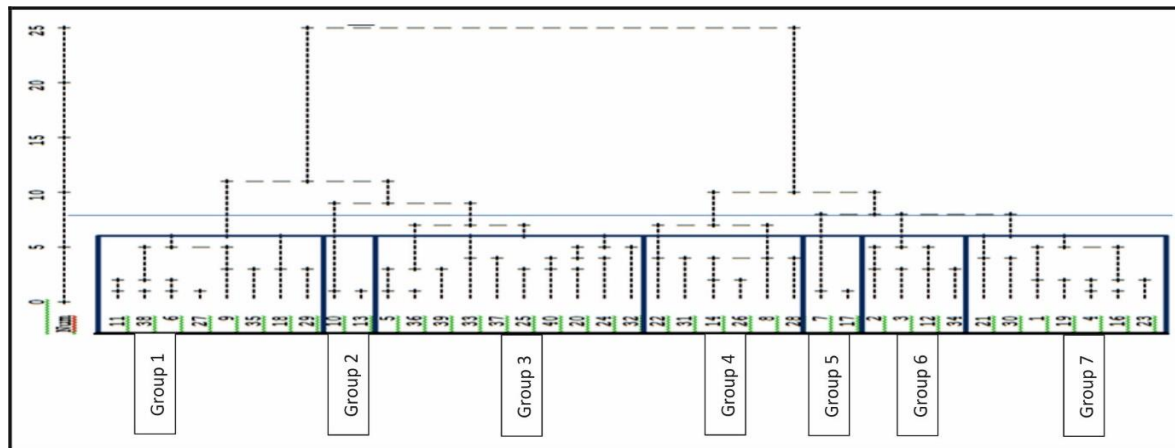


Figure 1. Dendrogram From Cluster Analysis Based on Friendship for 5-A Class

As seen in Figure 1, the choice of friends of 5-A pupils were collected into 7 groups. The Kruskal-Wallis variance analysis results for the comparisons of the mean anxiety scores of pupils in each group and the groups are given in Table 2.

Table 2. Results of KWH Test For the Comparison of Math Anxiety Scores of 5-A Group of Students

Group	N	Mean Rank	χ^2	p	Difference
1	8	27.63	18.224	0.006	1-2
2	2	9.75			1-5
3	10	2.85			1-7
4	6	27.67			3-7
5	2	3.75			4-7
6	4	16.5			
7	7	10.21			

As shown in Table 2, it was determined that there was statistically significant difference between groups' math anxiety scores ($\chi^2 = 18.224$; $df = 6$; $p < 0.05$). According to the Mann-Whitney U Test performed between groups of two, it was determined that there was a statistically significant difference between the 1st group and the 2nd, 5th and 7th groups, as well as between the 7th group and the 3rd and 4th groups.

Comparison of math anxiety scores of informal groups friends for 5B classroom

In the research, the pupils' choice of friends in the 2nd branch was examined through clustering analysis. The results obtained of HCA are given in Figure 2.

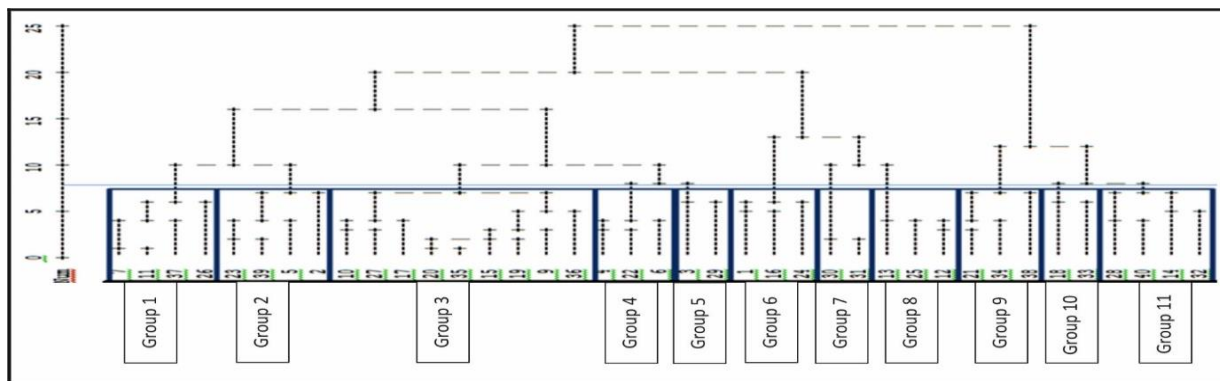


Figure 2. Dendrogram From Cluster Analysis Based on Friendship For 5-B Class

As seen in Figure 2, the choice of friends of 5-B pupils was collected into 11 groups. The KWH variance analysis results for the comparisons of the mean anxiety scores of pupils in each group and the groups are given in Table 3.

Table 3. Results for the Comparison of Math Anxiety Scores of 5-B Group of Students

Group	N	Mean Rank	χ^2	p
1	4	11.13	7.69	0.659
2	4	20.0		
3	9	23.56		
4	3	27.17		
5	2	17.75		
6	3	18.67		
7	2	16.0		
8	3	15.83		
9	3	13.5		
10	2	22.0		
11	4	26.63		

As shown in Table 3, there was no statistically significant difference between the math anxiety scores of the groups ($\chi^2 = 7.69$; $df = 10$; $p > 0.05$).

Comparison of math anxiety scores of informal groups friends for 8A classroom

The pupils' choice of friends in the 1st branch was examined through clustering analysis. The results obtained of HCA are given in Figure 3.

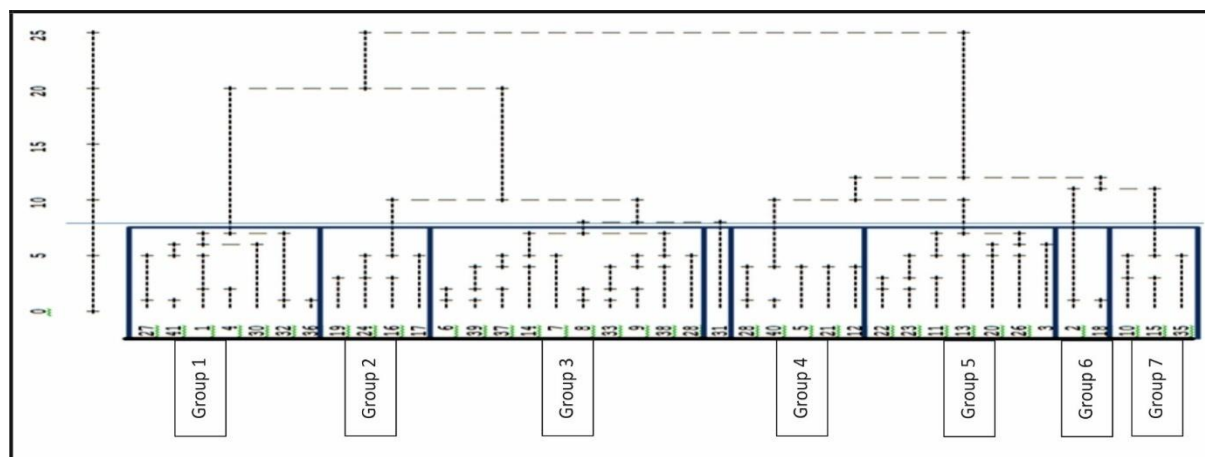


Figure 3. Dendrogram From Cluster Analysis Based on Friendship for 8-A Class

As seen in Figure 3, the choice of friends of 8-A pupils were clustered into 7 groups. The nonparametric variance analysis results for the comparisons of the median anxiety scores of pupils in each group are given in Table 4.

Table 4. Results for the Comparison of Math Anxiety Scores of 8-A Group of Students

Group	N	Mean Rank	χ^2	p	Difference
1	7	8.14	19.217	0.004	1-2
2	4	21.5			1-3
3	10	25.5			1-7
4	5	15.7			
5	7	14.79			
6	2	35.75			
7	3	29.83			

As shown in Table 4, it was determined that there was a statistically significant difference between the groups' math anxiety scores ($\chi^2 = 19.217$; $df = 6$; $p < 0.05$). According to the Mann-Whitney U Test performed between groups of two, it was determined that there was a statistically significant difference between the 1st group and the 2nd, 3rd and 7th groups.

Comparison of math anxiety scores of informal groups friends for 8B classroom

The dendrogram of the pupils' choice of friends in the 8th grade and 2nd branch is seen in Figure 4. As seen in Figure 4, the choice of friends of 8-B pupils was clustering into 5 groups.

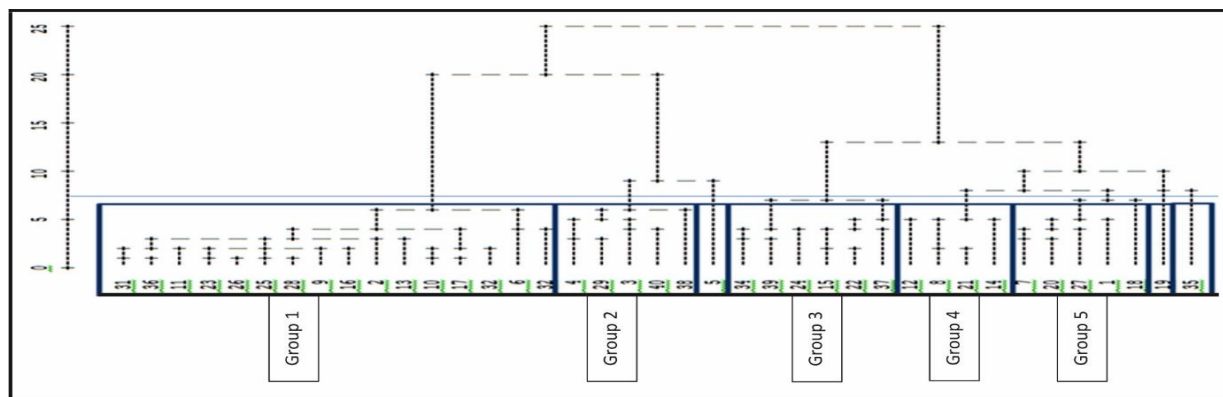


Figure 4. Dendrogram From Cluster Analysis Based on Friendship for 8-B Class.

As seen in Figure 4, the choice of friends of 8-B pupils was collected into 5 groups. The statistical results for the comparisons of the mean anxiety scores of pupils in each group and the groups are given in Table 5.

Table 5. Results for the Comparison of Math Anxiety Scores of 8-B Group of Students

Grup	N	Mean Rank	χ^2	p
1	16	16.72	2.391	0.664
2	5	16.5		
3	6	24.08		
4	4	19.63		
5	5	18.6		

As shown in Table 5, there was no statistically significant difference between the math anxiety scores of the groups ($\chi^2 = 2.391$; $df = 4$; $p > 0.05$).

Conclusion

It was hypothesized in this study that there would be a significant relationship between the students' maths anxiety and informally established friendship choices, which was concluded to be as such though not totally but partially.

There was a significant difference about math anxiety scores of friendship groups in only one of the 5th graders. The findings are interesting in that the fifth grade is the first level of secondary school as well as the first class in which students from different primary schools see each other for the first time. Given that the study was conducted on the first days of the education year, it can be thought that the student did not know each other well, and therefore, friendship preferences of them was not very concrete initially.

There was a significant difference about math anxiety scores of friendship groups in only one of the 8th grade classrooms in the study. Grade 8th students are from a class level in which long-term friendship relations are maintained compared to the 5th grader as they have got to know each other for three years at secondary school. For this reason, it can be said that informal friendship relations and informal group structures in class 8th are more stable and continuous compared to 5th graders.

It was further observed that there was a significant difference in one of each branches of the math anxiety informal fellowship groups of the 5th grades, where new friendship relations started and in the 8th grade classes where longer friendship relations were maintained. Therefore, it might be concluded that maths anxiety could be a predictor of friendship choices in differing grade levels according to the duration of establishment of such relationships. In that regard, the findings of this study do not contradict with Truttschel (2002) and Alkan's (2010) views. However, it would be more relevant and impressive if more studies within this context were conducted with different graders and longer periods.

Conversations between friends about the so-called complex nature of math along with exposure to conversations where past negative experiences with math are shared can have an effect on the development of math anxiety (Truttschel, 2002). Therefore, it would be advisable for teachers employing collaborative education practices to be cautious against the formation of collaborative groups made up of pupils with high levels of math anxiety. Otherwise, maths anxiety could be increased and lead to the failure in maths proficiency.

In social psychology, a group is accepted to have an impact on change of attitudes. It has also been reported that such a group generates a motivating effect for the accomplishment of easy tasks (Kagitcibasi & Cemalcilar, 2014). Therefore, math anxiety can be reduced by using group dynamics. In the literature, it has been determined that there is a reversed relationship between math anxiety and math attitude (Kesici & Asilioglu, 2017; Rencher, 2011; Tuncer & Yilmaz, 2016; Yaratan & Kasapoglu, 2012). Therefore, pupils with math anxiety can benefit from group dynamics and develop positive attitudes towards math, via reducing anxiety levels. To that end, a pupil with math anxiety should be put in a group of pupils with a positive attitude towards mathematics. The group members should be made to get involved in activities in which the pupil with math anxiety has a keen interest and is successful at doing. Furthermore, the pupils in the group can be assigned uncomplicated math tasks, homework and projects on the basic fundamentals of math that will help them develop a better understanding of mathematical concepts and applications. Thus, pupils with math anxiety can get a taste of success in math and their attitude towards math can be improved by support from their friends.

This study shows that math anxiety might affect the students' choice of their friends. Thus, it can be concluded that math anxiety has a potential to affect individual's life deeply like friendship choice. For this reason, teachers shouldn't ignore not only their students' cognitive development but also their development in other areas such as social life, psychological welfares and so on. Present study support the idea that teachers should pay attention to their students' academic success and to their social situation (students' relationships with their friendship, their social environment etc.) for students' happiness. Students' friendship has the potential to affect achieving the acquisition of goals. These findings could shed light on how students could be helped to make use of group dynamics in their targeted situations to help themselves to get best outcome of their learning environments.

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