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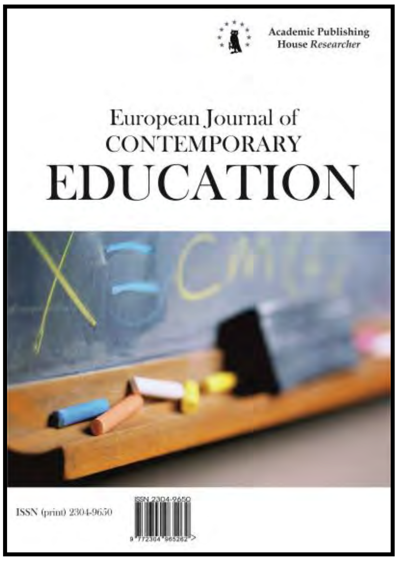

Anxiety Determinants Towards Mathematics in Mexican High School Students

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Abstract

The study aimed to measure the level of anxiety towards mathematics in high school students and if they differs by gender and institution. For this, the scale designed by Muñoz-Cantero and Mato-Vázquez (2007) was applied to 536 Mexican students from three different institutions in the public sector. This instrument is divided into five factors: anxiety towards the evaluation, towards the temporality, towards the understanding of the problems, towards the numbers and the mathematical operations and towards real life situations. The data matrix was analyzed using the Cronbach's alpha coefficient to validate its consistency, from which a very acceptable value of .932 was obtained. The analysis confirmed that the data matrix is not an identity matrix and presents acceptable correlations between variables, confirming the extraction of five factors that explain 63.38 % of total assimilable variance. In addition, the ANOVA test was calculated with the F statistic and its significance to prove the hypothesis of equality of means. A significant difference of means by gender was found in four of the five factors. Only anxiety towards real-life mathematical situations had no significant difference in means. Otherwise, the academic institution variable show difference between groups only in anxiety towards real-life mathematical situation. The Levene statistic was calculated for both variables to prove the hypothesis of equality of population variances. The gender variable presented equality of population variances in the five factors. The institution variable had not equality in population variances in anxiety towards mathematical problems comprehension and anxiety towards real-life mathematical situation.

Keywords: Anxiety, attitude, mathematics, evaluation, skills, students, mexicans.

1. Introduction

Mathematics is an ancient science, of the utmost importance in any area of society. It originated in different cultures in order to solve man's everyday problems. Despite this, it is

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sometimes seen as a problem and its learning process at any level is considered a difficult task for the student and perceived as a hard, rigorous and formal subject (Farias, Pérez, 2010). For students, anxiety towards mathematics is perhaps the origin of phobias or school rejection (Muñoz-Cantero, Mato-Vázquez, 2007).

Despite the fact that mathematics is of substantial importance in our lives, Mexico has great limitations in this regard, as evidenced by the results of the Program for International Student Assessment (PISA) that the OECD carried out in 2018. The results of this evaluation reveal that 44 % of students in Mexico reach level 2 in mathematics. This means that they can recognize and interpret mathematical operations without direct instruction, for example, calculate the value of a product in different currencies or even compare two distances with two alternative routes (OECD, 2019).

The report acknowledges that the average performance in Mexico has maintained a flat trend line since its participation in the test began. This leads us to question whether poor performance in this subject is directly linked to math anxiety.

In this sense, Larracilla-Salazar, Moreno-García and García-Santillán (2019), point out that the teaching of mathematics is frequently related to complexity, difficulty, problems without practical application in daily life and other aspects that lead to negatively assimilate it. For some, these are only activities that involve following a sequence of actions without really knowing why and for what (Balbuena et al., 1991).

Paradigms for teaching mathematics have been in constant evolution since the last decades of the 20th century. In more recent years, complexity logic and competence models have arisen, so not only do mathematical skills include knowledge, but also procedural skills, attitudinal and metacognitive dimensions ought to be considered (García-Santillán et al., 2016).

Based on the evidence provided by various studies, it is essential to include anxiety towards mathematics and its influence on students' performance as part of the learning process (García-Santillán et al., 2016). But up to this point, do we really understand what math anxiety is? At the time Hembree (1990) defined it as: "a state of mind supported by fear and terror. This emotion is unpleasant, and has special characteristics such as feelings of insecurity and helplessness in dangerous situations".

Other definitions indicate that it is the feeling of tension and anxiety that interferes with the manipulation of mathematical problems both in the academic context and in everyday life (Richardson, Suinn, 1972). Similarly, math anxiety is defined as a feeling of tension, apprehension, or fear that interferes with mathematical performance and is suffered by 5 % to 20 % of the population (McLeod, 1994).

Research Question

The arguments previously presented make the following questionable: Is there an underlying structure that can explain anxiety towards mathematics in students of upper secondary education? Similarly, it is questioned whether these anxiety levels differ according to the academic institution. Finally, it is convenient to know if there are differences based on gender. To respond to these concerns, the study aims to determine if there is a set of factors that explains the level of anxiety towards mathematics in upper secondary education students and if there are differences by academic institution and gender.

The importance of the study lies in the concern of the academic authorities who were part of the process, due to the low performance of some groups in the subject of mathematics. It is also important to emphasize that the student's mathematical understanding is of the utmost importance for his interaction in daily life activities. Therefore, this research, within its scope and limitations, seeks to provide some evidence that adds to the existing studies on this phenomenon.

Likewise, this analysis tries to obtain, through the model of anxiety towards mathematics proposed by Muñoz-Cantero and Mato-Vázquez (2007), the necessary data to explain those factors that are present in students of upper secondary education and that influence their learning process. This would somehow provide the basis for the definition of new teaching-learning strategies in the institutions that participated in this study.

Literature review

Theoretical studies show that anxiety towards mathematics has generated special interest in previous decades, so from the theoretical review it is sought to understand how the construct of mathematical anxiety has been defined (García-Santillán et al., 2018).

In this sense, we find that Pólya in 1945 (cited by Estrada, Diez-Palomar, 2011) pointed out that a positive or negative attitude towards failures has an important influence on the ability to solve mathematical problems. It is false to think that the solution to a problem is a matter of an intellectual nature; emotions and determination play a very important role. He also mentions that: "a somewhat lukewarm determination, a vague desire to do as little as possible can suffice for a routine problem that arises in class; but, to solve a serious scientific problem, a will power capable of withstanding years of work and bitter failures is needed" (sic).

Gough's seminal studies (1954) coin the name of mathemaphobia; stating that this is the main reason why students fail this subject. Studies were conducted subsequently on the effects of attitudes towards mathematics, discovering that they are correlated with previous experiences and with factors such as intelligence and achievement (Aiken, Dreger, 1961). However, a review of the literature leads us to discover that the term anxiety towards mathematics as we know it, became present in the 1970s, as referred to in their work by Richardson and Suinn (1972) Fennema and Sherman (1976) and Tobías (1976) cited in Larracilla et al (2019).

Both Richardson and Suinn (1972) and Fennema and Sherman (1976) coincide in viewing anxiety towards mathematics as a feeling of terror and nervousness that arises when performing mathematical homework. Tobías (1976 cited in Larracilla et al, 2019), raises it as a key to succeed on a day-to-day basis, because in addition to intelligence and ability, attitude is another important factor in the study of the phenomenon (Aiken, 1976).

Avia and Ruiz (1987) come to the conclusion that this phobia must be addressed from the most common forms of therapy in anxiety problems; that is, desensitization and cognitive treatments. Analogously, Hart (1989) considers this phenomenon in a more complex way and from a multidimensional perspective, whose peculiarity is the emotions towards mathematics and the beliefs about the subject. This results in avoidance behavior, that is, at higher levels of anxiety the individual tends to avoid activities that involve mathematics (Hembree, 1990).

In other studies, they have considered that gender influences anxiety towards mathematics, with women having the highest levels of anxiety (Hembree, 1990; Ma, 1999). Other authors consider that this relationship is not so clear and consider that women are more capable than men to admit their anxiety (Ashcraft, Ridley, 2005). In addition, it is pertinent to point out that teachers' beliefs, attitudes and emotions affect students' learning (Carpenter, Fennema, 1992), therefore, the lack of adequate schemes in the teaching method suggests a blockage in the understanding and performance of mathematical tasks (Auzmendi, 1992).

The works of McLeod (1988, 1992 and 1994) provided evidence that suggests that the affective level is fundamental in both the teaching and learning of mathematics. Gil, Blanco and Guerrero (2005) mention beliefs, attitudes and emotions in their studies as the main components of the affective domain, and as a result the predisposition to success and/or failure of students when facing this subject. Likewise, age is considered another determining factor in the disposition of mathematics students (Watt, 2000).

Regarding this, Gil et al (2005) refer to the works of Mandler (1984, 1985, 1988, 1989a and 1989b) and Weiner (1986); from the first they point out the Discrepancy Theory, which explains the way in which students' beliefs and their integration with problem-solving situations lead to an affective response. The discrepancy occurs when the classroom instruction is totally different from what the students expect, which leads to stress. As for Weiner (1986), Gil et al (2005) mention the Attribution Theory, which raises the process of cognition-emotion, that is, after the result of an event, there is a total positive or negative reaction (primitive emotion) based on perceived success or failure on the outcome (primary assessment). Likewise, it studies and involves seven emotions (anger, guilt, shame, hopelessness, pride and self-esteem, compassion and gratitude), hence these contributions help to understand students' emotions.

Given its importance, there is an extensive literature on the matter, since this study phenomenon could not be more contradictory. On the one hand, mathematical knowledge is essential in modern societies and, on the other, the multiple studies carried out show a number of attitudes that make it an inaccessible knowledge (Núñez et al., 2002) since it interrupts cognitive performance in the extent to which the mathematical task depends on working memory (Ashcraft, 2002).

In the same work, Ashcraft (2002) reveals that the higher the complexity of the mathematical task, the higher the level of anxiety and therefore people tend to avoid not only tasks, but also professional careers. This is derived from the doubts that arise about their intellectual capacities, motivated by the frustration of previous failures that block the possibilities of learning and therefore they determine themselves as incapable of achieving success and predisposed to fail again (Blanco and Guerrero, 2002 , cited by Gil, et. al., 2005).

Other studies underpin the relevance of effective mastery in teaching and learning in teachers, as evidenced by the works of Muñoz-Cantero and Mato-Vázquez (2007), Rosario, Núñez, Salgado, González-Pineda, Valle, Joly and Bernardo (2008), Sánchez, Segovia and Miñan (2011), Pérez-Tyteca (2012), Palacios, Hidalgo, Moroto and Ortega (2013), Nortes and Nortes (2014, 2017), Maroto (2015) and Gómez-Chacón (2016). Hence, García-Santillán, Escalera y Martínez (2013) considers it necessary for the teacher to work on the affective part, so that the student puts aside the emotional blockage caused by mathematics.

Therefore, it is very important to develop instruments that allow to evaluate and determine anxiety towards mathematics. Among the most used is the MARS (The Mathematics Anxiety Rating Scale), a test made up of 98 items on the Likert scale that evaluates everyday and formal situations. It was designed by Richardson and Suinn, (1972) to obtain a measure of anxiety towards the manipulation of numerical aspects and the use of mathematical concepts.

Later, Fennema and Sherman (1976) elaborated a mathematical anxiety scale (MAS), in order to evaluate the feelings of fear, nervousness and bodily symptoms associated with mathematical homework in secondary school students.

Given the complexity of the MARS, in subsequent years, various authors have made adaptations of this instrument, such is the case of Suinn and Edwards (1982) who made a version for primary and secondary education students (MARS-A). Similarly, Plake and Parker (1982) elaborated a reduction with the same variables to increase its effectiveness. Later Alexander and Martray (1989) provide the AMARS, derived from MARS that contains only 25 items. Another adaptation for children from the fourth year of primary school is the Math Anxiety Scale for Children (MASC), which comprises 22 items (Chiu, Henry, 1990).

Likewise, Gierl and Bisanz (1995) developed the mathematical survey (MAXS), in order to be used at younger ages. Thomas and Dowker (2000) developed the Mathematics Anxiety Questionnaire (MAQ), whose answers are presented in images, with the aim of evaluating experiences of happiness and stress due to arithmetic problems.

This is how Muñoz-Cantero and Mato-Vázquez (2007), when considering anxiety as "the root of many cases of school refusal", developed a questionnaire to assess the students' anxiety towards mathematics. They applied a 24-item test prepared by them to a sample of 1,220 Compulsory Secondary Education students in A Coruña, obtaining a Cronbach's Alpha reliability of 0.95.

Other studies such as those of Rosario et al (2008) carried out an investigation in two independent samples of 533 and 796 high school students, whose participants were slightly more than 50 % women and the rest were men. Their findings showed differences in the tests based on gender, with women being more anxious than men. In addition, they presented evidence that anxiety decreases when math performance increases. In the second sample they confirmed the first results.

In order to determine which factors predict anxiety in the face of mathematics, Tejedor, Auxiliadora, García-Orza, Carratala and Navas (2009) carried out a study on 55 sixth grade students. Results shows that the anxiety and the opinion that the children have on their performance in this subject are the best predictors. They also observed consequences of anxiety towards mathematics on a physiological level such as increased sweating and heart rate.

Meanwhile, Estrada and Díez-Palomar (2011) investigated the relationship between the affective and cognitive dimension from three points of view: age, level of studies achieved, and dimensions related to learning. The instrument was applied to 177 relatives of students from a primary and a secondary school, both in Spain. The study reached the following conclusions: first, there is no significant relationship between age and attitude towards mathematics; second, there is a certain relationship between the level of studies reached and the feeling towards mathematics;

and finally, there is a clear relationship between the emotional and cognitive dimensions in learning mathematics.

Later García-Santillán et al (2016) carried out an investigation in a sample of 303 university students. For the study they used the Muñoz-Cantero and Mato-Vázquez scale (2007) and the findings indicate that the factor anxiety towards mathematics in real life situations is the one that has the highest incidence in students, although there is a close relationship between all factors of his study. In contrast to the above, García-Santillán, Schnell and Ramos-Hernández (2017) conducted a study of higher-level students, the results of which indicate that anxiety towards mathematical situations in daily life is the factor with the least weight. The highest levels were occupied by anxiety about understanding math problems and anxiety about numbers.

Other studies have provided evidence that there are differences by gender, as is the case of Nortes and Nortes (2017). In a study they conducted with future primary school teachers, they showed that women are more motivated but at the same time more anxious than men towards evaluations. The difference is that they are more confident. Result that coincides with that found by Pérez-Tyteca, Castro, Segovia, Castro, Fernández and Cano (2009), Nortes and Nortes (2014) and Agüero, Meza, Suárez and Schmidt (2017). On the other hand, García-Santillán et al (2018) found no differences in gender in an investigation carried out with 200 high school students, similar to the results of Yenilmez, Girginer and Uzun (2007) and Wilson (2012).

Finally, after analyzing the state of the art, it is clear that anxiety towards mathematics is a topic of great relevance both in the academic field and in everyday life. Therefore, to answer the research questions and to achieve the objectives, the following hypotheses are established:

H1: There is a structure of factors that explain the level of anxiety towards mathematics in upper secondary school students.

H2: Anxiety towards mathematics differs by gender and academic institution.

Methodology

It is a non-experimental study since the independent factors that modify the effect (Y) are not manipulated, a cross-sectioned study approached from the quantitative paradigm, of a descriptive, correlational, exploratory and explanatory type, considering that the objective is to find a set of factors that allow to explain the phenomenon of mathematical anxiety.

Participants

The participants are high school students from the following academic institutions: Colegio Madrid de Veracruz, Colegio de Educación Profesional Técnica del Estado de Veracruz (CONALEP – Veracruz Campus) and the Telebachilletaro Cotaxtla, all belonging to the state of Veracruz, Mexico. The inclusion criteria were: students enrolled in the aforementioned academic institutions, who were in the second, fourth or sixth semester, and who had agreed to answer the survey voluntarily and without coercion from the educational authorities. Their participation was anonymous.

Sample

The sample is non-probabilistic for convenience, since the contact was direct with the academic authorities of the schools and the test was applied to the students present at that time through them. The information collection was carried out in the months of April and May of 2019. The total sample was 536 students; of which 252 belonged to Madrid School, 143 to the Technical Professional Education College in Veracruz (CONALEP – Veracruz Campus) and 141 to the Telebachillerato Cotaxtla.

Instrument

The "Test of anxiety towards mathematics" scale designed by Muñoz-Cantero and Mato-Vázquez (2007) was used. This instrument is divided into five factors and 24 items: anxiety towards the evaluation, towards the temporality, towards the understanding of the problems, towards the numbers and the mathematical operations and towards real life situations (Table 1). The response options are presented in a Likert-type format that ranges from 1 to 5, where: 5 means totally agree, up to 1 meaning totally disagree. In addition, the survey included the following sociodemographic variables: gender, age, marital status, employment status, income, medical care, and relationship with the head of the family.

2. Results

Table 1. Dimensions and indicators of the anxiety towards mathematics scale

Code	Factors	Items
X1AE	Anxiety towards evaluation.	1, 2, 8, 10, 11, 14, 15, 18, 20, 22, 23.
X2AT	Anxiety towards temporality.	4, 6, 7, 12
X3ACPM	Anxiety towards mathematical problems comprehension	5, 17, 19
X4ANOM	Anxiety towards numbers and mathematical problems	3, 13, 16
X5ASM	Anxiety towards mathematical situations of real life	9, 21, 24

Source: Muñoz-Cantero and Mato-Vázquez (2007)

Procedure

In the first instance, the data matrix is validated to determine the internal consistency of the items using Cronbach's alpha coefficient, accepting as a minimum value $\alpha = 0.7$ (Celina, Campo-Arias, 2005). Considering that the instrument is of a scale type, it is recommended to use the polychoric correlation matrix (Richaud, 2005; Ogasawaras, 2011) for the Exploratory Factor Analysis with component extraction and Varimax orthogonal rotation.

For this, the Bartlett test of sphericity is calculated with the Kaiser-Meyer-Olkin (KMO), the anti-image matrix to obtain the values of sample adequacy per variable, the value of the determinant, considering that values close to zero show high correlations. Then the factorial weights and their communalities are calculated, which allow us to identify the total variance. In addition, to test the hypothesis that says there is a difference by gender and by institution, the one-way ANOVA is used.

Data analysis

The data matrix was validated with Cronbach's Alpha index, whose value of .932 demonstrates high internal consistency (Hair et al., 1979).

Exploratory Factorial Analysis for the H1 test

To find the structure that underlies in mathematical anxiety, first of all it must be shown that the data matrix is not an identity matrix, that is, that all the correlations become 1. We will seek to show that the data matrix presents acceptable correlations and the value of the determinant is close to zero.

For this, the polychoric correlation matrix and its determinant, the sample adequacy measure for each factor of the instrument, as well as the Bartlett sphericity test were calculated to validate the relevance of the use of exploratory factorial analysis. Results are shown in Table 2.

Table 2. Correlation matrix[a] and sample adequacy measure

Correlation	X1AE	X2AT	X3ACPM	X4ANOM	X5ASM	MSA
X1AE	1	0.784	0.663	0.733	0.349	.826[a]
X2AT		1	0.68	0.752	0.427	.841[a]
X3ACPM			1	0.728	0.545	.871[a]
X4ANOM				1	0.486	.868[a]
X5ASM					1	.848[a]

a. Determinant = .041

The correlations between the study factors, the value of the determinant close to zero and the sample adequacy measure by factor (> .5) provide evidence of a robust matrix whose factorial scores make the use of the technique relevant. In addition, the Bartlett sphericity test yields Chi^2 values of 1694.96 with df = 10 and p = 0 and the KMO measure of .851 support the use of the technique for factoring the data matrix.

Next, Table 3 shows the extraction of the five factors of the dimensions of the Muñoz-Cantero and Mato-Vázquez (2007) scale, with orthogonal Varimax rotations to identify the highest factorial weights of the extraction. In the same Table 3 the initial auto values are observed with their corresponding proportion of the variance, as well as the total accumulated variance.

Table 3. Rotated component matrix[a] by dimension

Dimensions	Component 1	2	3	4	5
X5ASM	.952				
X1AE		.844			
X3ACPM			.835		
X2AT				.806	
X4ANOM					.799
Auto valores iniciales	9.893	2.404	1.202	.903	.809
% de varianza x factor	41.222	10.018	5.008	3.764	3.370
Varianza acumulada %	41.222	51.240	56.248	60.013	63.383

Extraction method: Main components analysis. Rotation method: Varimax with Kaiser Standarization. [a.] Rotation converged in 5 iterations.

The data shown in Table 3 prove the existence of a scale of five factors, which makes it clear that they align with the proposal of Muñoz-Cantero and Mato-Vázquez (2007), however, the arrangement of the indicators seems to be perceived by the students in a different way. Table 4 describes the comparison between the indicators of the original scale and the factors of the rotated matrix.

Table 4. Comparison of ítems by dimension

Code	Original Scale Items	Rotated Scale Items
X1AE	1, 2, 8, 10, 11, 14, 15, 18, 20, 22, 23.	1, 11, 2, 4, 15, 20, 7, 18
X2AT	4, 6, 7, 12	19, 13, 6, 17, 16, 24, 3, 10, 5
X3ACPM	5, 17, 19	23, 14
X4ANOM	3, 13, 16	9, 21
X5ASM	9, 21, 24	8

One-way ANOVA for H2

For the test, it is analyzed if there is a difference in means by gender and by academic institution, so the ANOVA test is calculated with the F statistic and its significance, as well as the Levene statistic to prove the hypothesis of equality of means and the hypothesis of equality of population variances.

Table 5. ANOVA of gender and Institution

Factors		Gender				Educational institution		
		gl	Quadratic mean	F	Sig.	Quadratic mean	F	Sig.
X1AE	Between groups	2	2754.08	28.31	.00	181.87	1.70	.18
	Within groups	533	97.29			106.95		
X2AT	Between groups	2	241.88	13.87	.00	1.36	.07	.93
	Within groups	533	17.43			18.34		

X3ACPM	Between groups	2	143.99	14.18	.00	23.50	2.22	.11
	Within groups	533	10.15			10.60		
X4ANOM	Between groups	2	169.53	15.39	.00	32.16	2.79	.06
	Within groups	533	11.02			11.54		
X5ASM	Between groups	2	8.31	.87	.417	54.94	5.91	.00
	Within groups	533	9.48			9.30		

As observed in Table 5 ANOVA, the values of the F statistic with the level of significance ($p \leq .05$.) in the case of the gender variable, is presented in four of the five factors: X1AE, X2AT, X3ACPM, X4ANOM. For the X5ASM factor the value is $p \geq .05$. As for the academic institution variable, the behavior is different, since the first four factors (X1AE, X2AT, X3ACPM, X4ANOM) present p values ≥ .05, but not the X5ASM factor, which presents a p value ≤ .05. Based on the theoretical criterion that indicates that if the intra class significance value (sig.) is ≤ less than or equal to 0.05, the hypothesis of equality of means must be rejected. This implies that there is a difference of means. On the contrary if it is higher than .05, equality of means is accepted, which means that there are no significant differences between the groups.

On the other hand, the hypothesis of population variances is contrasted and for this the Levene statistic is calculated with gl1 and gl2. Therefore, the theoretical criterion establishes that if p = ≤ 0.05, the hypothesis of equality of variances is rejected. Otherwise if it is > the hypothesis of equality of variances is accepted (Table 6).

Table 6. Homogeneity of variances' test

Dimensions	Gender Levene Statistical	df1	df2	Sig.	Educational Institution Levene Statistical	df1	df2	Sig.
X1AE	1.803	1	533	.180	.178	2	533	.837
X2AT	.183	1	533	.669	.488	2	533	.614
X3ACPM	.066	1	533	.797	3.438	2	533	.033
X4ANOM	2.279	1	533	.132	1.044	2	533	.353
X5ASM	1.555	1	533	.213	3.419	2	533	.033

The p values > .05 give evidence of equality of variances in all the factors of the gender variable. Otherwise in the academic institution variable, X3ACPM and X5ASM (≤ 0.05) suggests that the hypothesis of equality of variances should be rejected, but not in the rest of the factors.

3. Discussion

It is clear that the phenomenon of mathematical anxiety encompasses various aspects of the individual, which makes it more complex, as Hart (1989) has pointed out. This author has referred that this phenomenon should be approached from a multidimensional perspective, where emotions and beliefs constitute an important element for the individual to avoid activities where mathematics are involved, as Hembree (1990) had pointed out.

The results of this research coincides with other studies that have found various explanations for this phenomenon, ranging from psychological, teaching and environmental aspects, as Eccius-Wellman and Lara-Barragan (2016) have pointed out.

By finding a robust structure in theoretical terms, the scale of Muñoz-Cantero and Mato-Vázquez (2007) allows us to find the multidimensional proposal of Hart (1989) and Hembree (1990). The scale collects feelings associated with the psychological profile such as anxiety towards mathematical evaluations, the understanding of mathematics topics and above all, when the individual is faced with real life situations where mathematical aspects are involved.

García-Santillán et al (2016) used this same scale by Muñoz-Cantero and Mato-Vázquez (2007) in the Mexican context with 303 university students who presented a higher level of anxiety towards mathematics in real life situations, and as a whole, a close relationship between all factors of the scale. This coincides with this empirical study, since the anxiety that presented the highest level was that related to real-life mathematical situations, followed by anxiety towards evaluation.

In contrast, García-Santillán, Schnell and Ramos-Hernández (2017) used the same scale with university students. They showed that anxiety towards mathematical situations in everyday life is the factor with the least weight, while the highest levels were occupied by anxiety before understanding math problems and anxiety about numbers.

On the other hand, the results of the hypothesis test about difference by gender and by academic institution to which the participating students correspond are discussed.

The results show that in the gender variable there is a difference in means in four of the five factors (X1AE, X2AT, X3ACPM, X4ANOM), but not in the dimension of anxiety towards real life mathematical situations (X5ASM). In addition, evidence indicates that there is equality in population variances with respect to gender. In the academic institution variable, dimensions of anxiety towards the understanding of mathematical problems (X3ACPM) and anxiety towards real-life mathematical situations (X5ASM) values ≤ 0.05 were observed. Therefore, the hypothesis of equality of variances in these factors is rejected, not so in the rest of the factors.

There are studies that have shown that gender has a significant impact on anxiety towards mathematics, and that it is in women where higher levels of anxiety have been observed, as demonstrated by Hembree, (1990) and Ma (1999). However, other studies postulate that this assertion is not clear, that rather it is women who are able to admit that they have anxiety towards mathematics (Ashcraft, Ridley, 2005).

On the other hand, García-Santillán et al (2018), carried out a study with 200 high school students, and found no gender differences, contrasting their results with this empirical study. Other studies that found differences by gender were documented in the work of Yenilmez, Girginer and Uzun (2007) and Wilson (2012). In the case of Nortes and Nortes (2017) they showed that women have greater motivation but at the same time more anxiety than men towards evaluations; the difference is that they are more confident. The results presented by Pérez-Tyteca, Castro, Segovia, Castro, Fernández and Cano (2009), Nortes and Nortes (2014) and Agüero, Meza, Suárez and Schmidt (2017) are similar.

4. Conclusion

The results of this research made possible to demonstrate the existence of a structure that underlies the explanation of the phenomenon of mathematical anxiety in the Mexican students population analyzed. This phenomenon of anxiety seems to be determined in general by gender but not by the academic institution of the students. Particularly, students that participated in this research showed a different behavior in the anxiety they feel towards mathematical situations of real life. This way, there is not anxiety towards mathematical situation of real life different between men and women, but it is different by the academic institution they belong.

To summarize, we can think that the phenomenon of anxiety towards mathematics is and will be a topic in the academic and scientific discourse. It is desirable to continue analyzing different populations and different context to find more elements to explain the phenomenon and to propose solutions.

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