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Mathematics: an Academic Discipline that Generate Anxiety in College Students

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Abstract

Mathematics is very important in the workplace. Companies, through mathematical models, can filter and interpret the data obtained from sales reports, customer feedback or web traffic, in order to improve the company's strategy and optimize processes and results. However, a problem arises: for the students who will soon enter the work force, mathematics generates anxiety and so, they try to avoid it. This study aims to examine whether there is a difference in university students regarding math anxiety in terms of gender, career, age and semester, as well as the causes of this anxiety. It is a study that is approached from the hypothetical-deductive and cross-sectional method. The sampling was simple random and it was made up by 343 college students from the majors of the administrative economic area. The instrument used is the scale designed by Auzmendi (1992), of which only the anxiety factor was used. The Kruskal-Wallis test was used to analyze the data. The findings indicate that anxiety towards mathematics is the same in men and women, there are no differences in relation to the age and major of the students, but there is a difference regarding the course that the student attends.

Keywords: mathematics, anxiety, college students.

1. Introduction

As mathematics have become an essential discipline in the work field, Kent et al. (2007) indicate two main reasons for such importance: one is the increase of information technologies in work practices and the second is the response to satisfy the client's demands, since every mathematical procedure at work, no matter how simple, is a part of a wide range of decisions and

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judgements about processes or products; hence, Vázquez (2017) states that "mathematics is the hidden tread that controls the flow in the new world, real and virtual".

With mathematical models, companies can filter and interpret the data obtained by sales reports, client feedback or web traffic, in order to improve the company's strategy and optimize processes and results. These models correlate the different layers of information regarding the goal of the organization or are useful to take advantage of an opportunity. However, in the work place mathematics is considered a problematic issue and business owners have been informing for some time on their employees' deficit of knowledge and abilities in this subject. Considering the ideas presented before, it can be inferred that mathematics should be considered a relevant matter in a student's life (Cockcroft, 1985).

Some students have understood that mathematics is fundamental in the current world: they are even used to optimize the mixtures of food or chemical products, for instance; additionally, it has been used in marketing to choose advertising media and suitable distribution channels, while some government entities have used it to minimize the costs of managing solid wastes that contaminate air and water (Narro, 1996).

On the other hand, others do not consider the existence of a relationship between mathematics and the work place, such as Soltaní et al (2013) and Jurdak & Shahin (2001), quoted by FitzSimons, 2013, who argue about this discipline only being viewed as a theoretical tool which is often far from reality. In Mexico, Sánchez & Olivares (2016) mentioned that this is precisely the way it is taught and stated "it is because of our educational system, because of how mathematics is presented to students. It is not taught as something attractive and many students see it as something boring" (Sánchez, Olivares, 2016: 1). Because of the former Furner & Berman (2003) consider important for students to realize that mathematics has applications outside the classroom and is necessary in people's daily lives, in the activities they undertake and even at home, to mention a few examples.

Another argument on this matter is the anxiety students manifest towards this subject, as pointed out by international organizations (such as PISA), which has reported that one of the causes of a low level in mathematics is the anxiety present in the student when taking the test (PISA, 2015; 2018). Furner & Berma (2013) indicate that when students feel less anxiety and trust their skills, performance in standardized tests is better and their score improves.

Anxiety, in the educational field has been conceptualized by Hembree (1990) as "*a mood sustained by qualities such as fear and terror. This emotion is unpleasant and has as special characteristics feelings of insecurity and impotence in the face of dangerous situations*" (p. 33). In this regard, Pérez-Tyteca (2012) mentions mathematical anxiety to be manifested through a series of "symptoms", such as: stress, nervousness, concern, restlessness, irritability, confusion, fear and mental block.

Math anxiety can be defined as an "irrational fear to mathematics that interferes with the manipulation of numbers and the solving of mathematical problems in a variety of daily and academic situations" (Buckley, Ribordy, 1982: 1, quoted by Furner, Berma, 2013). The National Council of Teachers of Mathematics (NCTM) recognizes mathematic anxiety as a problem and this issue has been the studied by several researchers, such as Delgado, Espinoza & Fonseca (2017), who investigated the relationship between mathematical anxiety and the variables of gender and academic performance in students from the National University of Costa Rica, revealing that the more math anxiety is present in students, their academic performance is lower; on the other hand, Soneira & Mato, (2020) evaluated anxiety in engineering college students and their results show students to have anxiety towards evaluation and anxiety towards numbers and mathematical operation, being anxiety towards evaluation the one with the highest presence.

Mathematical anxiety is a widely spread phenomenon that has become very normal among college students nowadays and some authors point out to college teachers being aware of the problem starting during childhood (Perry, 2004, quoted by Pérez-Tyteca, 2012). On this matter, García-Santillán, Wurzinger & Tejada (2015) found anxiety towards mathematics being present in elementary school students. Furthermore, the Third International Mathematics and Sciences Study showed mathematics scores to be reduced as the students advance from grades 4 to 12 (Backhoff, Solano, 2003).

Pérez-Tyteca et al. (2008) have highlighted that six out of every ten college students, regardless of their study field, show anxiety symptoms when facing mathematics; likewise, they

mention that there is a difference in relation to the major of the students, as the ones enrolled in the Science Faculty show slightly lower levels of mathematics anxiety than the ones in the Faculty of Arts, Psychology or Sociology.

Regarding the topic of anxiety, a study by García-Santillán, Escalera-Chávez, Moreno-García & Santana-Villegas (2016) proved anxiety to be a factor that prevents students from achieving a good performance during the learning process. Along those lines, a recent study done in a Mexican nautical school by García-Santillán, Moreno-García, Schnell & Ramos-Hernández (2016) showed that mathematical anxiety to daily life situations does not generate a lot of anxiety for the student, in contrast to the anxiety towards the understanding of mathematical problems and anxiety towards the numbers of mathematical operations.

A research by Garcia-Santillan et al. (2017), considering 100 students from the Administrative-Economic in the Veracruz Institute of Technology, evidenced that students suffer from anxiety towards exams, anxiety while solving problems, anxiety before a test, anxiety related to mathematics text books and anxiety to the simple fact of hearing about mathematics. The facts aforementioned contribute in a 66.2 % to the explanation of the phenomenon.

Anxiety towards mathematics has also been examined in relation to gender; some authors (Karimi, Venkatesan 2009; Vitasari et al., 2010, quoted by Pérez-Tyteca et al., 2008), indicate that men suffer less anxiety than women. Cumhur & Tezer (2019) studied the anxiety towards mathematics in 100 college students enrolled in 10 different departments of the Economic and Administrative Faculty of a private college in the academic course 2018–2019. The results reveal the lack of a significative difference in the level of anxiety among students in relation to gender; furthermore, most admitted not to be stressed either before or after mathematics class and thinking about this subject did not cause stress for them. However, other authors have proved there is a significant difference in relation to gender (Goetz et al., 2013, Pourmoslemi et al., 2013, Karimi, Venkatesan, 2009).

One of the goals of any educational system is for students to obtain the best learning and improve their skill levels in every discipline – mathematics is not the exception – which is why college institutions strive for an excellent integral education with constant improvements that encourage the maximum learning goal of the students. Therefore, the results of this research will make a contribution to these institutions by providing evidence on the feeling of anxiety shown by students towards mathematics and with this information, they can implement strategies that promote a better training and talent improvement of the college students.

The role of college education institutions has always been of great significance but in these times, it has become more important in a society where there are settings requiring people to undertake interrelated and interdependent problems from an increasingly complex and including stance (López, 2018). A proper mathematics teaching process will enable students to acquire the knowledge and skill that can be applied in these new scenarios.

Even though there is enough literature on anxiety towards mathematics, there is still a lack of research on the anxiety caused by this discipline in students from social science majors. For said reason, this study poses the following goal: examine if there is a difference related to gender, major, age and course in the level of anxiety towards mathematics among the students from the social sciences majors in the Medium Zone Multi-disciplinary Academic Unit of the Autonomous University of San Luis Potosí (UASLP for its acronym in Spanish), a college in Mexico.

Research hypothesis

Hi_1: The level of anxiety towards mathematics in the students from social sciences majors in the UASLP is different in men and women.

Hi_2: The level of anxiety towards mathematics in the students from social sciences majors in the UASLP is different depending on the major they are enrolled in.

Hi_3: The level of anxiety towards mathematics in the students from social sciences majors in the UASLP is different according to the student's age.

Hi_4: The level of anxiety towards mathematics in the students from social sciences majors in the UASLP is different because of the course (semester) they are studying.

2. Methodology

Research design. This research is approached from a hypothetic deductive-method, since it seeks to corroborate the hypotheses through the obtention of data. The design is non

experimental considering that the independent variables are not manipulated to intentionally modify the effect (Y). It is also transversally cut because the instrument was applied in a single moment in time.

Participants. The key informants for the study are the students from the Medium Zone Multi-disciplinary Academic Unit of the UASLP. The sampling type was simple random and the sample was made up by 343 students, from which 66 % were women and 34 % were men. 43.7 % were in the Business major, 29.4 % in the Public Accountant and Finances major and 26.8 % in the Marketing major.

Instrument. The instrument used in this research was the scale posed by Auzmendi (1992), which is made up by 29 items from five factors: anxiety, liking, motivation, usefulness and trust. The scale is designed with Likert format questions of five points, where 1 is completely disagree and 5 completely agree. Also, for this study, the only considered construct was anxiety. To measure the reliability and internal consistency of the instrument Cronbach's alpha was measured, obtaining a value of 0.5633.

Procedure for data measurement. The gathered data was summited to a statistical analysis of mean difference. In order to this, the H test of Kruskal-Wallis was done and the calculations were processed using the software SPSS v.25. Since the purpose is to determine the difference between anxiety towards mathematics and the gender, age, course (semester) and major, this is the technique that allows for the comparison of variances among groups.

3. Results

From the 343 students surveyed in the college, 61.5 % show high anxiety levels and a large percent are women (Table 1). However, this does not prove there is a difference between men and women. In order to see if there are differences in relation to gender, the Kruskal-Wallis H test was used, as well as to check if anxiety was different among the students depending on the major they are studying.

Table 1. Anxiety level

Level	Male	Female	Total
Low	12.5%	26.0%	38.5%
High	20.2%	41.3%	**61.5%**
Total	32.7%	67.3%	100.0%

Source: own

As shown on Table 2, there were no significant differences in anxiety towards mathematics since value p > 0.05 and the difference between the medium range of the gender and major variables is small; consequently, there is evidence to support the null hypothesis, which indicates that the population means for these groups are all the same, meaning there is no difference in relation to gender.

Table 2. Mean range and significance of gender and major

		Mean range	Kruskal-Wallis H	sig.
Gender	Male	154.06	1.777	.183
	Female	168.84		
Mayor			.940	.625
	LA	164.17		
	LM	156.73		
	CP	170.45		

Source: own

Regarding age, the results on Table 3 show the value p > 0.05, hence the null hypothesis is rejected, meaning there are no significant differences between anxiety towards mathematics and the age of the students.

Table 3. Mean range and significance of age

Age	Mean range	Age	Mean range	Kruskal-Wallis H	Sig.
17	150.81	24	134.67		
18	151.87	25	259.13		
19	147.16	26	140.50	16.514	.169
20	168.81	27	74.50		
21	190.21	28	147.50		
22	165.60	33	17.50		
23	180.74				

Source: own

However, there is a significant difference regarding the course (semester) they are studying as the value of p < 0.05. Table 4 shows the mean range of the variable course (semester) and its significance. It is possible to see a higher difference between the first and seventh semesters.

Table 4. Mean range and significance of semester

Semester	Average range	Kruskal-Wallis H	Sig.
1	138.13	14.185	007
3	168.79		
5	166.17		
7	195.55		
9	168.08		

Source: own

Figure 1 clearly shows the difference between means. Likewise, it can be seen in Table 5 that the most significant difference (0.002) is between the first and seventh semester. These significance values have been adjusted with the Bonferroni correction.

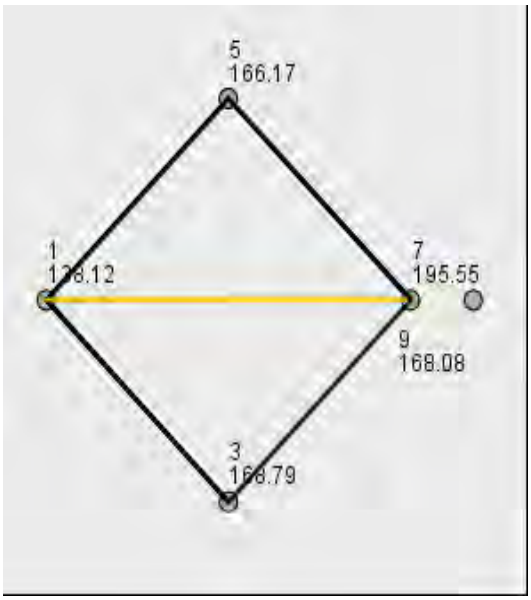

Fig. 1. Comparison between courses (semesters)

Table 5. Constrast statistics among semesters

Sample	Constrast statistic	Error	Statistical deviance of contrast	Sig.	Adjus. Sig.
1-7	-57.426	15.562	-3.690	0.000	0.002
1-3	-30.668	14.146	-2.168	0.030	0.302
1-5	-28.042	14.666	-1.912	0.056	0.559
5-7	-29.384	16.52	-1.779	0.075	0.753
3-7	-26.758	16.059	-1.666	0.096	0.957
1-9	-29.958	24.162	-1.24	0.215	1.000
9-7	27.468	25.33	1.084	0.278	1.000
5-3	2.626	15.193	0.173	0.863	1.000
5-9	-1.917	24.79	-0.077	0.938	1.000
9-3	0.709	24.486	0.029	0.977	1.000

Source: own

With these results, there is statistical evidence to say that the population means for these groups are not all the same, thus it can be concluded that there is a difference in the anxiety towards mathematics experienced by students, according to the course (semester) they are currently enrolled in.

4. Conclusion

In the first place, the results of this research have allowed to obtain evidence about a high percentage of students enrolled in social sciences majors of the UASLP who manifest anxiety towards mathematics and this level of anxiety is present in students from the following three majors: Business, Public Accountant and Marketing.

Another finding was that math anxiety is present in both men and women, since no significant difference was found between them and neither according to their age, although there was a difference in relation to the course (semester) they were studying and this difference is higher between the first and seventh semester. A possible explanation for this could be the subjects taken by the students in the seventh semester, since the contents may include more mathematics.

It is important to highlight that these results are not different from the research done in other college institutions (Garcia-Santillan et al., 2017; García-Santillán et al., 2016) and also match what international organizations have found about anxiety towards mathematics being a relevant problem among students (PISA, 2015, 2018).

The academic authorities of the country could come up with new strategies for the teaching and learning processes of mathematics, so that from their statutes, new regulations can be established on the matter. On their end, academic authorities of public and private institutions offering instruction at all levels of study could reinforce their didactic strategies for such purpose, that is, to redesign the teaching processes used in the learning units and contents taught in mathematics and other related subjects.

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