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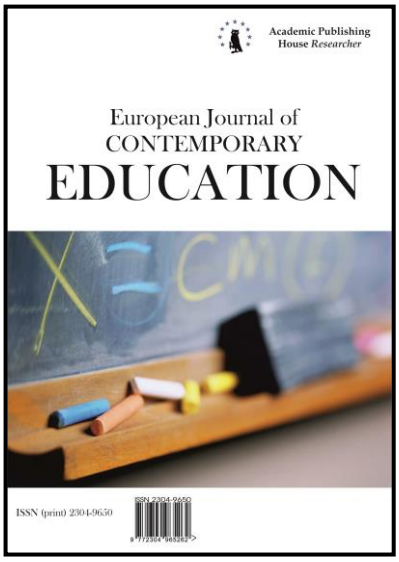

Anxiety Toward Mathematics: Empirical Evidence on High School Students

Milka Elena Escalera-Chávez [a], Arturo García-Santillán [b, *], Violeta S. Molchanova [c, d]

[a] Unidad Académica Multidisciplinaria Zona Media, UASLP, Rioverde San Luis Potosí, México
[b] UCC Business School, Universidad Cristóbal Colón, Veracruz, México
[c] International Network Center for Fundamental and Applied Research, Washington, USA
[d] Volgograd State University, Volgograd, Russian Federation

Abstract

In Mexico there is a complicated situation regarding the subject of mathematics, especially in the high school students who have shown low performance in the results of the tests applied by international and national organizations. Therefore, the aim of the study is focuses on testing whether the variables of the scale proposed by Fennema and Sherman (1976), measure level anxiety towards mathematics in of high school students, in the Mexican context. The study is carried out from the hypothetical-deductive paradigm, of non-experimental design and cross-sectional. For the analysis of the data, a structural equation model (AMOS) is used. The main findings show significant weights only in five of the twelve variables proposed by the theoretical model of Fennema and Sherman. These findings correspond to variables that measure anxiety towards solve mathematical problems, which makes that the student in a situation of nervousness and irritation.

Keywords: anxiety toward math, problema solve, high school students.

1. Introduction

Nowaday, mathematics has a transcendental role in all areas of knowledge. Its importance lies in the significant role it has in human activities because it promotes the development of skills in quantitative, logical and analytical thinking. These skills allow to the student who is the subject of study, to successfully enter the workplace (Larrazolo et al., 2013; Guagcha, 2017).

In relation to the subject of mathematics, in Mexico there is a complicated situation, especially in the high school students, who have shown low yields in the results in the PISA tests (Programme International Students Assesment) as well, in the Assessment of Learning (Planea,

* Corresponding author
E-mail addresses: agarcias@ucc.mx (A. García-Santillán), milkaech@uaslp.mx (M.E. Escalera-Chávez), v.molchanova_1991@list.ru (V.S. Molchanova)

2017; SEP, 2017). The results indicated that in Mathematics, 6 of each 10 students are located in level I (66 %); almost 2 of each 10 are at level II (23 %); at level III, only 8 of each 100 students (8 %); at level IV, 3 of each 100 (2.5 %).

On the same idea, the OECD report (2014) indicates that students have anxiety levels above average. Figure 1 shows each factors that cause anxiety in school assignments. Also, the report presented by the OECD shows data that indicates that girls have higher levels of anxiety than boys, they also point out that anxiety is common among high performance students. Another data indicates that 82% of high performance girls, sayed worry about qualifications.

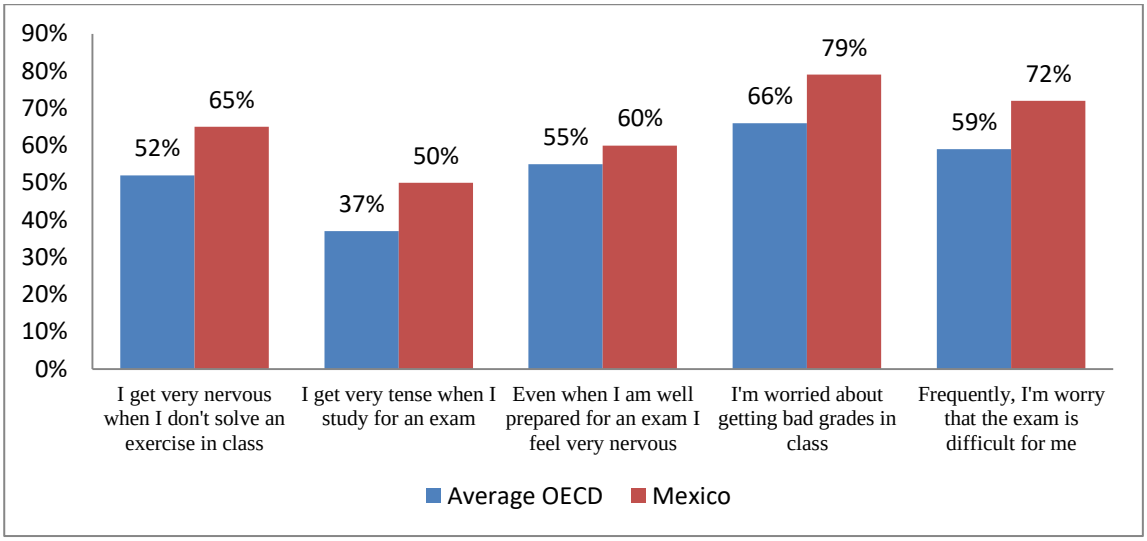

Fig. 1. Anxiety toward task (source OECD, 2017)

Based on the data reported by international and national institutions about the problem of anxiety towards mathematics, it is established as the main purpose: to prove the factor validity of the scale that measures anxiety towards mathematics proposed by Fennema and Sherman (1976), in high school students. With the findings of the study, it is expected to be able to provide empirical evidence about the anxiety towards mathematics presented by the students. The above is intended to provide information for professors and academic authorities to develop new teaching strategies that contribute to improving the quality of education in high school students and thus be competent internationally.

3. Literature review

Al-Fraidan and Al-Khalaf (2012) cited by Dedeen et al. (2014) point out that, in almost all countries the tests are used as a tool for evaluating their achievements. As a result, there is great concern for both students and teachers around the world to get better test results. However, a determining factor in the level of performance in the student is the anxiety that the student shows in certain situations where mathematics is used.

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While a reasonable level of anxiety is useful for motivating a student, a high level of anxiety can interfere with the way students perform (Strand, 2003). Many students suffer from mathematical anxiety which causes their performance to be low, even they do not even feel able to solve situations that involve mathematical processes. In addition, students with mathematical anxiety try to avoid careers and environments that require mathematical skills (Armstrong, 1985; Wigfield, Meece, 1988, Ashcraft, 2002).

Mathematical anxiety describes feelings of nervousness, tension or irritability that many students experience when performing mathematical operations in a mathematical context (Richardson, Suinn, 1972, cited in Pérez et al., 2013). On the other hand, Tobias and Weissbrod (cited in Pérez et al, 2013), state that "mathematical anxiety describes the panic, impotence, paralysis and mental disorganization that emerge when a student is required to solve a mathematical problem".

The results reported by Muñoz and Mato (2007) showed that exams are a main cause for the level of anxiety in the student be high. This evidence is consistent with Zeidner (1998, cited by Macías and Hernández, 2008), who pointed out that mathematical anxiety is an important cause for students to obtain poor performance in mathematical learning. Also noted that the anxiety caused by the exams is significantly associated with the low academic performance of the students. In this idea, Stuart, (2000) has pointed out that very often the lack of confidence in mathematical skills may cause anxiety, this added to other factors that can also cause anxiety such as the attitude that teachers usually have in teaching process, as well as the attitudes of classmates and the attitudes of family members.

In the same idea Dursun (2015) makes a difference between students' attitude towards mathematics and their anxiety levels, according to the types of school. An example of this, in vocational high schools they have lower levels, while in high school of sciences, the level of anxiety is higher. Escalera et al (2016) show evidence that the anxiety towards mathematics is different according to the level of study: either at the elementary level, secondary, high school and college where professional training is given.

Hence, anxiety towards evaluation is the variable that most contributes to increase the level of anxiety in students at the school level of: secondary, high school and professional, but not in students of the elementary level, who will not show some type of anxiety towards math.

About anxiety towards mathematics, it has been studied by many researchers. Some pioneering works are attributed to Fenneman and Sherman (1976) who designed a scale that measures this phenomenon. Their findings have indicated that affective variables, including attitudes, have an impact on the effort the student is willing to make to achieve mathematical learning.

Th escale designed by Fenemma and Sherman (1976) has been replicated in several studies, for example: (Kloosterman, Stage, 1992; Martin, 2002; Leedy et al., 2003; Pérez-Tyteca, 2007) among others. For this reason, we have selected this scale to measure the level of anxiety in high school students in the municipalities of Querétaro and San Luis Potosí, within the Mexican context. Thus, in order to carried out the empirical study, the method that will be used for this purpose is described below:

Methodology design

The study is carried out applying the hypothetical-deductive method. The hypothesis to be tested in the study seeks to demonstrate whether the structure of items of the mathematical anxiety scale proposed by Fennema and Sherman (1976) can be explained with the data of the sample under study.

The study is quantitative, non-experimental, cross-sectional, confirmatory because it is our interest to see if the model proposed by Fennema and Sherman (1976), measures anxiety towards mathematics in high school students. The sample is not probabilistic since the selection of cases to surve was chosen according to the authorization given by the academic authorities.

Sample. Were survey 264 students face to face from the first and third semester of high school level, belonging to the three schools in the municipalities of Rioverde S.L.P, Ciudad Fernández S.L.P, and Arroyo Seco Queretaro. The inclusion criterion establishes that the student surveyed must be enrolled and also must be in some course, relating to mathematics.

Instrument/questionnaire. The Fennema and Sherman scale (1976) was applied, which is composed of 12 items, structured on a Likert scale with 5 possible answers ranging from 1 (totally disagree) to 5 totally agree and the score of the questionnaire goes from 12 to 60 points

4. Results

The results obtained from the data analysis are shown below: Table 1 describes the sociodemographic characteristics of the sample under study.

Table 1. Socio-demogrphic data of the sample

Variable		%	Variable		%
Gender	Male	50	Semester	First	50
	Female	50		Third	50
Age	14 years old	4.5	Municipalities	Arroyo Seco	32.2
	15 years old	40.9		Rioverde	33.3
	16 years old	38.6		Cd. Fernández	34.5
	17 years old	14.4			
	18 years old	1.5			

Source: own

The sample data described in table 1 indicate that 32.2 % of the students belong to the municipality of Arroyo Seco, Querétaro, 32.2 % to the municipality of Rioverde San Luis Potosí and 34.5 % to the municipality of Ciudad Fernández San Luis Potosí. It is also observed that the gender is made up of 50 % men and 50 % women, the age ranges from 15 to 18 years, 40.9 % is 15 years old and only 1.5 % is 18 years old. Finally 50 % corresponds to the first semester and the other 50 % to the third semester.

Through the confirmatory analysis with structural equations, the relationship between the variables proposed by Fenemma and Sherman scale (1976), could be explored, hence the sequence diagram for the confirmatory factor analysis is shown in Figure 1.

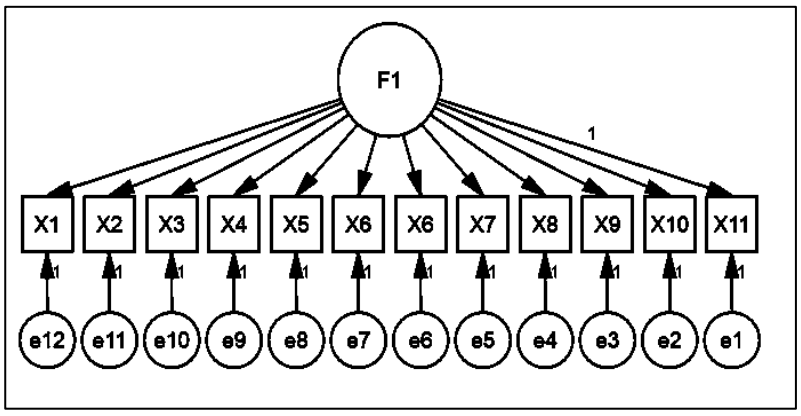

Fig. 1. Secuence Model (source: Fennema, Sherman, 1976)

Afterward, the diagram becomes a structural equation model, as shown in Table 2.

Table 2. Notation for measurement model

Exogenus indicator		Exogenus construct		Error
X_1	=	$\lambda^X{}_{1.1}\xi_1$	+	e_1
X_2	=	$\lambda^X{}_{2.1}\xi_1$	+	e_2
X_3	=	$\lambda^X{}_{3.1}\xi_1$	+	e_3
X_4	=	$\lambda^X{}_{4.1}\xi_1$	+	e_4
X_5	=	$\lambda^X{}_{5.1}\xi_1$	+	e_5
X_6	=	$\lambda^X{}_{6.1}\xi_1$	+	e_6
X_7	=	$\lambda^X{}_{7.1}\xi_1$	+	e_7
X_8	=	$\lambda^X{}_{8.1}\xi_1$	+	e_8
X_9	=	$\lambda^X{}_{9.1}\xi_1$	+	e_9
X_{10}	=	$\lambda^X{}_{10.1}\xi_1$	+	e_{10}
X_{11}	=	$\lambda^X{}_{11.1}\xi_1$	+	e_{11}
X_{12}	=	$\lambda^X{}_{12.1}\xi_1$	+	e_{12}

Source: own

For the data entry, a correlation matrix was used, hence Table 3 shows the correlation matrix of the twelve variables proposed by Fennema and Sherman (1976).

Table 3. Correalations matrix

Item	X12	X13	X14	X15	X16	X17	X6	X7	X8	X9	X10
X12	1										
X13	0.55	1									
X14	0.45	0.43	1								
X15	0.31	0.32	0.39	1							
X16	0.33	0.39	0.31	0.47	1						
X17	0.51	0.49	0.49	0.54	0.594	1					
X6	0.35	0.23	0.3	0.29	0.286	0.29	1				
X7	0.17	0.14	0.14	0.23	0.153	0.2	0.27	1			
X8	0.16	0.07	0.13	0.06	-0.01	0.05	0.16	0.14	1		
X9	0.23	0.28	0.22	0.24	0.295	0.3	0.39	0.09	0.21	1	
X10	0.27	0.29	0.22	0.22	0.223	0.26	0.39	0.07	0.18	0.7	1
X11	0.26	0.38	0.2	0.2	0.23	0.28	0.31	0.15	0.05	0.46	0.47

Source: own

In orde to estimate the model, asymtotically distribution free was used to measure the fit of the model. In Figure 2 shows the estimation of the parameters and in Table 4, it show the indexes of goodnes of fit of the obtained model. We can observe the value of Chi square is 4.477 with significance level of 0.345 above the minimum level of 0.05 indicating an acceptable fit. Also, the goodnes of fit Index (GFI) is presented, which shows a value of 0.990 that is high and the value of the Root Mean Square Error of Approximation (RMSEA)

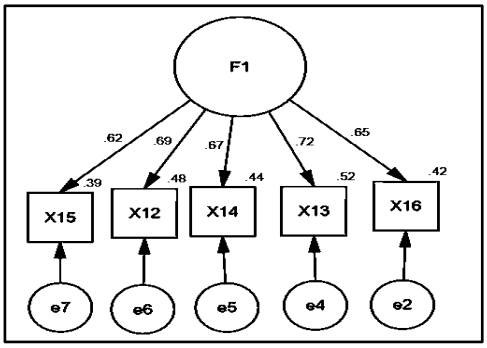

Fig. 2. Sample data model (source: own)

Table 4. Adjusted index of the model

CMIN	DF	P	CMIN/DF	GFI	CFI	RMSEA
4.477	4	0.345	1.119	.990	.995	0.022

Source: own

In the sample data model, significant weights were obtained only in five of the twelve variables proposed by Fennema and Sherman (1976), which correspond to variables that measure mostly, anxiety towards problem solving mathematicians, which gives us evidence to think that this generates a situation of nervousness and irritation in the student. Likewise, the reliability and variance extracted from the construct that integrates the five variables were evaluated. The Table 5 shows a reliability of 0.871, this value is greater than recommended (0.50) and the variance extracted is also greater (0.76) than 0.50.

Table 5. Reliability and variance of the construct

	Estimate	Error	Reliability	Squared weights	Variance	RVE
X_{16}	0.646	0.354		0.417		
X_{13}	0.719	0.281		0.517		
X_{14}	0.665	0.335		0.442		
X_{12}	0.695	0.305		0.483		
X_{15}	0.622	0.378		0.387		
	3.3470	**1.6530**	**0.8714**	**2.246**	**0.58**	**0.76**

Source: own

5. Conclusion

The study was carried out with the purpose of validating a measuring instrument about anxiety towards mathematics proposed by Fennema and Sherman (1976), in high school students.

According to the results in this work, we may say that the students feel anxiety towards mathematics. Furthermore, the results show that the model proposed by Fennema and Sherman (1976), only five of the twelve variables are significant in the field studied.

These variables provide evidence that students at this school level suffer anxiety towards problem-solving, which causes them nervousness and irritability. Regarding the variables that showed the most significant statistical values in this study, it can be a guide for academic authorities to develop teaching and learning strategies for high school students that help improve academic performance.

This strategic plan seeks to reduce the poor performance in the subjects of mathematics, science and reading, which are evaluated by national and international organizations (Planea, 2017; OECD, 2014; SEP, 2017).

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