STUDENT PERCEPTION TOWARD MATHEMATICS ASSESSMENT, TEMPORALITY TOWARD EXAMS, THE UNDERSTANDING TOWARD PROBLEMS ASSOCIATED TO THE NUMBERS AND MATHEMATICAL OPERATIONS IN REAL LIFE. REALLY ARE FACTORS GENERATORS OF ANXIETY TOWARD MATH?

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ABSTRACT

In our globalized world, the challenges are strong, and therefore it is necessary to attack the problem (phenomena) immediately and find solutions that allow that students develop greatest skill and competencies in mathematics.A survey was personally administered to 299 students from two high schools at Tuxtepec, Oaxaca in Mexico. Statistical procedure was the factorial analysis with an extracted principal component in order to Measure data as refer García-Santillán, Venegas-Martínez and Escalera-Chávez (2013)**.** The Bartlett's Sphericity test and the KMO index (0.875), X^2 calculated, 1257.558 with 10 df > X^2 tabulated, Sig. 0.000 p< 0.01, MSA (ANSIEVAL .832; ANSITEM .871; ANSICOM .918; ANSINUM .863; ANSISIMA .914) allow us to know that the variables of Muñoz and Mato-Vázquez scale, help us to understand the student's anxiety toward mathematics. It is necessary to find new ways of teaching and learning process that allows, from the basic levels of education, to stimulate the interest of students toward mathematics.

Keywords: Anxiety, Mathematics, Attitude, Students.

1.- INTRODUCTION

The subject of mathematics teaching is frequently heard in academic discourse. In a theoretical approach, anxiety is a factor that has been examined by several researchers, following the seminal work of Fennema and Sherman (1976). They designed a scale of 108 factors to measure the level of student s anxiety toward mathematics, and very spcifically, anxiety toward statistics.

Blanco (2008) carried out a critical review about students' attitude toward statistics. He measured specifically students' attitude toward statistic, during teaching-learning process, as well as some indicators of efficiency and student performance. His study refers the research of Glencross and Cherian (1992, 1995) who cited the most important studies in the Anglo-Saxon context such as: Statistics Attitudes Survey- SAS (Roberts & Bilderback, 1980); Roberts and Saxe (1982) Validity of a Statistics Attitude Survey; Attitudes toward Statistics- ATS (Wise, 1985); Statistics Attitude Scale (McCall, Belli & Madjini, 1991); Statistics Attitude Inventory (Zeidner, 1991); Students Attitudes Toward Statistics (Sutarso, 1992); Attitude Toward Statistics (Miller, Behrens, Green & Newman, 1993); Survey of Attitudes Toward Statistics –SATS (Schau, Stevens, Dauphinee & Del Vecchio, 1993, 1995); Quantitative Attitudes Questionnaire (Chang, 1996), and Auzmendi (1991, 1992).

In the world, some institutions like Organization for Economic Cooperation and Development (2012)(OECD) have established evaluations in order to measure mathematics, like the International Program Student Assessment (PISA, for its acronym in Spanish) that measures reading comprehension, math and science skills in elementary school students.

Latin American countries have had the lowest scores in these kinds of tests. In Mexico, for example, the Ministry of Education created in 2006 the National Assessment of Academic Achievement of School (Secretaría de Educación Pública, SEP, for its acronym in Spanish) to basic education and in 2008 the test was adapted to high school students. Mathematics results showed that 63.7% of the students of the last grade of school have a poor level of mathematical skill (SEP, 2013).

This fact has been a cause for new action plans of Mexican university authorities, focusing on identifying the possible causes of this phenomenon called "low performance in math skills". The first step in this plan is to identify student s attitude towards mathematics. An empirical reference is the work of García-Santillán, Moreno-García, Carlos, Zamudio and Garduño, (2012), they replicated the scale of Auzmendi (1991, 1992). Their results show that if students perceive the usefulness of statistics in their professional life, then enjoy the subject and this creates confidence in their abilities to use it as a tool, but results show also that when motivation is inadequate, students feel fear of discipline.

Also García-Santillán, Escalera-Chavez and Venegas-Martínez (2013) measured student's perception towards financial mathematics in two institutions (one private and other public). Results reported that students perception toward financial mathematics is improved when the class is conducted as a workshop and teachers use information technologies, such as virtual learning communities, programming in spreadsheet, financial simulators among others didactic strategies. Based on the above arguments, the question and objective are:

RQ_1: What variables explain students' anxiety toward mathematics?

O1: Identify the set of variables that explain student anxiety toward mathematics

2.- HYPOTHESES

For studying the superiority of comprehensive income to net income for firm performance, we test the following hypotheses:

***Hi1:* Students' attitude toward mathematics could be explain by a set of variables**

3.- RESEARCH METHOD

3.1.- Participants

The sample conformed of 299 students were surveyed in 2015. Sample consisted of two high school students from Tuxtepec, Oaxaca Mexico. Students were from the first, third and fifth level.

3.2.- Instruments

The study used the test designed by Muñoz and Mato-Vázquez (2007) denominated "anxiety test toward mathematics.

3.3.- Procedure

For evaluation and interpretation of the data collected, we follow the statistical procedure of multivariate factor analysis. For this, we established the following criterion: Statistical hypothesis: Ho: =0 there is no correlation Hi: $\rho \neq 0$ there is a correlation.

The statistical test is $\chi 2$ and the Barlett s test of sphericity KMO (Kaiser-Meyer-Olkin), and aditionally the value of MSA (Measure sample adequacy) for each variable of model. This statistical is asymptotically distributed with p(p-1)/2 freedom degrees, a significance level: $\alpha = 0.01$, *p<0.01 or <0.05* load factorial of 0.70 ; and loads increased to 0.55

If Ho is true, values worth 1 and its logarithm would be zero, therefore the statistical test s worth zero, otherwise with high values of $\chi 2$ and a low determinant, it would suggest that there is a high correlation, then if the critical value: $\chi 2$ calc > $\chi 2$ tables, there is evidence to reject of *Ho. S*o, the decision rule is; Criterion: KMO > 0.5 ; MSA >0.5 ; p<0.01 Thus: decision is reject: Ho if $\chi 2$ calc > $\chi 2$ tables.

In order to measure data obtained, we follow the procedure proposed recently by García-Santillán et al. (2013) and obtains the following matrix:

Table 1 Data matrix of students

Students	Variables
1	X11 X12 … .X1p
2	X21 X22 … .X2p
…	… ….
299	Xn1 Xn2 … .Xnp

Source: own

Where:

X11, X12….. Xn1 is given by the following equation: X1 = F1 a11+ a12F2 + …… + a1kFk + u1; X2 = F1 a21+ a22F2 + …… + a2kFk + u2 … …… Xp = ap1F1 + ap2F2 + …… + apkFk + up

Therefore, the expression is as follows:

X= Af + u X = FA' + U (1)

Where:

Data Matrix	Factorial load Matrix	Factorial Matrix
$X = \begin{pmatrix} x_1 \\ x_2 \\ \dots \\ x_p \end{pmatrix}, f = \begin{pmatrix} F_1 \\ F_2 \\ \dots \\ F_3 \end{pmatrix}, u = \begin{pmatrix} u_1 \\ u_2 \\ \dots \\ u_3 \end{pmatrix}$	$A = \begin{pmatrix} a_{11} & a_{12} & \dots & a_{1k} \\ a_{21} & a_{22} & \dots & a_{2k} \\ \dots & \dots & \dots & \dots \\ a_{p1} & a_{p2} & \dots & a_{pk} \end{pmatrix}$	$F = \begin{pmatrix} f_{11} & f_{12} & \dots & f_{ik} \\ f_{21} & f_{22} & \dots & f_{2k} \\ \dots & \dots & \dots & \dots \\ f_{p1} & f_{p2} & \dots & f_{pk} \end{pmatrix}$

With a variance equal to:

$$\mathrm{Var}(X_i) = \sum_{j=1}^{k} a_{ij}^2 + \Psi_i = h_i^2 + \Psi_i; i = 1, \ldots, p \qquad (2)$$

$$h_i^2 = \mathrm{Var}\left(\sum_{j=1}^{k} a_{ij} F_j \right) \ldots y \ldots \Psi_i = \mathrm{VAr}(u_i) \qquad (3)$$

This equation corresponds to the communalities and the specificity of variable *Xi*. Thus, the variance of each variable can be divided into two parts:

A) In their communalities h_i^2 representing the variance explained by common factors, and
B) The specificity Y_I that represents the specific variance of each variable.

Thus obtaining:

$$\mathrm{Cov}(X_i, X_l) = \mathrm{Cov}\left(\sum_{j=1}^{k} a_{ij} F_j, \sum_{j=1}^{k} a_{lj} F_j \right) = \sum_{j=1}^{k} a_{ij} a_{lj} \quad \forall i \neq l \qquad (4)$$

With the transformation of the correlation matrix determinants, we obtained Bartlett s test of Sphericity, and it is given by the following equation:

$$d_R = -\left[n - 1 - \frac{1}{6}(2p+5) \ln |R| \right] = -\left[n - \frac{2p+11}{6} \right] \sum_{j=1}^{p} \log(\lambda_j) \qquad (5)$$

Where:
N = sample size, ln= natural logarithm, lj (j=1, …….., p) values pertaining of R, R = correlation matrix.

In order to compare the magnitude of the observed coefficients correlation with the magnitudes of the coefficients partial correlation, it is carried out a measurement of the sample adequacy (KMO) proposal by Kaiser, Meyer and Olkin, and similar to KMO index, the measure of sampling adequacy for each variable (MSA) can be calculated, in which it only includes the coefficients of the variable to be tested. Both measurements are given by the following expressions:

$$KMO = \frac{\sum_{j \neq i} \sum_{i \neq j} r_{ij}^2}{\sum_{j \neq i} \sum_{i \neq j} r_{ij}^2 + \sum_{j \neq i} \sum_{i \neq j} r_{ij(p)}^2} \qquad MSA = \frac{\sum_{r_j} r_{ij}^2}{\sum_{r_j} r_{ij}^2 + \sum_{r_j} r_{ij(p)}^2}; i = 1, ..., p \quad (6)$$

Where: rij (p) is the ratio of the partial correlation among variables *Xi* and *Xj* in all cases. Thus, with all above mentioned. Now we have the next empirical outcomes.

4.- DATAL ANALYSIS

To analyze data obtained from the application of the test of Muñoz and Mato-Vázquez (2007), a reliability test was performed using coefficient Cronbach's alpha (α). Cronbach's alpha (α) is a squared correlation coefficient which measures the consistency of the items averaging all correlations among all questions. The closer it gets to 1, is better reliability, considering that starting from 0.80 is a very acceptable value. Thus, the Cronbach's alpha can be set as a function of the number of items and the average of correlations among the items.

$$\partial = \frac{N * \bar{r}}{1 + (N-1) * \bar{r}}$$

Where: N = Number of items (or latent variables), ***r*=** average of correlations among the items.

5.- RESULTS

The information collected from population (299) high school students was processed. The results that are shown in Table 2 were obtained:

Table 2. Reliability test

Concept	Cases	%	**α**
Valid cases	296	99.0	α=0.953
Excluded (a)	3	1.0	
Total	299	100.0	25 factors
Dimensions	ANSIEVAL, ANSITEM, ANSICOM, ANSINUM, ANSISIMA		α= 0.839 with 5 dimensions

a. List wise deletion based on all, variables in the procedure

The result obtained from the total items is (0.953) and grouped into five dimensions is (0.839), both are very acceptable if we take the reference to Hair, Anderson, Tatham and Black (1999) α>0.6, therefore, the scale have characteristics of consistency and reliability which is required for the study, so the validity of test is confirmed.

The main characteristics about population of study, like: gender, semester or grade are described, and after this, the result from the factorial analysis with extracted components rotated.

The students surveyed were 52% female and 48% male; 29% first semester, 8% second semester, 42% third semester, 2% forth semester, 17% fifth semester and 2% sixth semester.

a) Bartlett's test of Sphericity

To make sure that the procedure factorial analysis which was applied in this case, is appropriate and that contributes to explain the phenomenon, the Bartlett test of Sphericity with KMO, and the measure of sample adequacy of each variable (MSA) was performed, all this, with the aim of identify whether there is any correlation among the variables that are being studied and allow us justify the use of this technique.

The Bartlett test of Sphericity is a statistic used to test the null hypothesis which states that the correlation matrix is an identity matrix, which presents a variation across 0 and 1, and small values demonstrate that factor analysis would not be appropriate, because the correlations between pairs of variables cannot be explained by other variables. In this case there are lack of strong correlations between the variables, then the factorial model would not be suitable, if the value in KMO is <0.5, i.e., with that value may not be used factorial analysis with the sample data which are analyzed.

Table 3 shows the results of the Bartlett test of Sphericity, *KMO, MSA,* X^2*,* with significance ($p < 0.01$). Observed values X^2 (1,257.558 with 10 df) shows that are high, the measure of sampling adequacy (overall) KMO (.875) is located in the rank of acceptance because, this should be higher than 0.5, indicating that the variables are intercorrelated.

Table 3 Correlation matrix- KMO, MSA, X2

Variable	MSA	KMO	Bartlett test of Sphericity (X^2)
ANSIEVAL	.832		
ANSITEM	.871		
ANSICOM	.918	0.875	1257.558 df 10
ANSINUM	.863		
ANSISIMA	.914		

Therefore, values displayed in the above table are very well suited to perform a factor analysis, therefore, the null hypothesis which refers to variables not correlated is rejected, being on the contrary, this means that the variables included in the model let explain the phenomenon, in a way that may be perform factor analysis.

b) Measure of sampling adequacy (MSA)

Another difference is the measure of sampling adequacy (MSA), the values shown in Table 4, reveals that each variable exceeds the threshold value of 0.5, which indicates the strength of relationships between variables and therefore appropriateness factor analysis.

In the diagonal of the correlation matrix anti-image, we can observe measures sampling adequacy for every variable (MSA). To determine if the selected factorial model is appropriate to explain the information collected, the values in the diagonal of the matrix of correlations anti-image should have a value close to 1.00, hence, the correlation coefficients anti-image that appear in diagonal, range from 0.832[a] to 0.918[a], are significant and it is confirmed that factor analysis it is optimal to explain the phenomenon studied.

Table 4 Anti-image Matrix

		ANSIEVAL	ANSITEM	ANSICOM	ANSINUM	ANSISIMA
Covariance anti-image	ANSIEVAL	,188	-,116	-,048	-,082	,004
	ANSITEM		,265	-,051	-,024	,004
	ANSICOM			,296	-,078	-,063
	ANSINUM				,218	-,112
	ANSISIMA					,550
Correlation anti-image	ANSIEVAL	**,832**[a]	-,522	-,206	-,405	,012
	ANSITEM		**,871**[a]	-,183	-,101	,010
	ANSICOM			**,918**[a]	-,309	-,157
	ANSINUM				**,863**[a]	-,325
	ANSISIMA					**,914**[a]

a. Measure of sampling adequacy

Table 5 shows the values of correlations obtained from the variables studied, where we can see that they are all inter-correlated and the correlation among the variables present high values (> 0.5) in all the cases shown, which leads us to think that there is an concordance among the set of variables in the model, practice as well as statistics, which means, that factorial analysis is appropriate.

Table 5. Correlations Matrix

		ANSIEVAL	ANSITEM	ANSICOM	ANSINUM	ANSISIMA
Correlations	ANSIEVAL	1.000				
	ANSITEM	.846	1.000			
	ANSICOM	.789	.747	1.000		
	ANSINUM	.839	.765	.800	1.000	
	ANSISIMA	.569	.523	.600	.659	1.000

(a) Determinant = .014

Moreover the value of the determinant (0.014) is lower than <0.05 which also gives evidence of the presence of significant correlations in the set of variables studied. Let us remember that, with the transformation of the correlation matrix determinants, we obtained Bartlett s test of Sphericity as shown in table 2, and is given starting from the equation:

$$d_R = -\left[n - 1 - \frac{1}{6}\left(2p + 5\right)\ln\left|R\right|\right] = -\left[n - \frac{2p + 11}{6}\right]\sum_{j=1}^{p}\log(\lambda_j)$$

(5)

c) Components Matrix, Communalities, Eigenvalue and total Variance

Once that Factor Analysis is accepted like the appropriate technique to analyze data, we proceed to examine the factors and components. Table 6 shows the component matrix and communalities as well as eigenvalues, whose explanatory power will explain the total variance.

Table 6. Components Matrix, Communalities, Eigenvalue and total Variance

	Component 1	Communalities
ANSIEVAL	0.927	.900
ANSITEM	0.889	.866
ANSICOM	0.899	.812
ANSINUM	0.928	.861
ANSISIMA	0.746	.982
Eigenvalue	3.874	
Total Variance	77.482%	

Source: own

Based on the criterion of eigenvalue greater than 1 (3.874) suggests the presence of 1 factor (graphic 1), from whose explanatory power may explain the total variance in 77.48% of total variation in the data.

Furthermore, in Table 6 factor weights obtained by the extraction principal components method are shown. The above corresponding to each factors that integrate component 1, where it may notice that all have a factorial weight > 0.50, being ANSINUM (.928) the largest weight (anxiety towards numerical operations), followed by ANSIEVAL (.927) and less factorial weight, but always observing behavior >0.5 is ANSISIMA (.746). And at the side of the proportion of variance explained through the communalities, we have ANSISIMA (.982) the highest value, and at the opposite extreme or lesser value we have ANSICOM (.812).

6.- DISCUSSION OR CONCLUSIONS

This paper shows how the factors: “anxiety towards mathematics assessment”, “anxiety toward temporality”, “anxiety toward understanding problems”, “anxiety towards numbers and mathematical operations “ and “anxiety toward mathematics in real life situations”, help us to understand the students anxiety toward mathematics. The findings are consistent with other authors such McLeod (1992, 1994) and Muñoz and Mato-Vázquez (2007), which reveal that the presence of student anxiety in the learning process of mathematics, which was becoming to a negative impact on student learn.

The study of mathematics could be analyzed from different perspectives, from the perspective of the contents of mathematics, from the student perception and attitude, considering their needs, their expectations regarding their usefulness in the future, their attitudes, beliefs and feelings to confront them, the greatest myths that emerged around them, from the point of view of teachers, from the educational system, their curricula and teaching-learning models involved, among others.

This study focused on the student and their emotions towards mathematics, considering the appearance from anxiety as a determinant of object of study, based on the ideas of McLeod (1992, 1994), who emphasizes the need to incorporate the affective side on the analyzes, in order to have a bigger picture and that we may understand the complexity of the subject.

In this study, results show that “anxiety towards evaluation (ANSIEVAL) mostly explain the problem. The others factors, “Anxiety toward temporality” (ANSITEM), Anxiety toward understanding problems (ANSICOM), Anxiety face numbers and mathematical operations (ANSINUM) Anxiety and mathematics in real life situations (ANSISIMA) show the result of confronting the student to the study of mathematics.

In our globalized world, competition have become more aggressive, the challenges are strong, and therefore it is necessary to attack the problem (phenomena) immediately and find solutions that allow that students develop greatest skill and competencies in mathematics. Then, it is necessary to find new ways of teaching and learning process that allows, from the basic levels of education, to stimulate the interest of students. As a result, it is expected that students appreciate the wide application of the field of mathematics and live the learning process with a positive attitude, which generate enjoyment and satisfaction and not frustration

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