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Anxiety Toward Mathematics on High School Students (An Empirical Study in CETIS 15 Veracruz-Mexico)

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ABSTRACT

Background: Math Anxiety is a feeling of tension and anxiety that interferes with the manipulation of numbers and with the mathematical problems resolution (Richardson and Suinn, 1972). In order to provide prevention and treatment to this, Muñoz and Mato (2007) designed a test in order to measure students' anxiety toward mathematics in five fundamental factors. **Objective:** Identify if there is anxiety toward mathematics in students of CETIS. **Results:** The results obtained from the Bartlett test of Sphericity KMO (0.841), X^2 2,719.024 with 10 df, Sig. 0.000 $p< 0.01$, MSA (AEVA **.806**[a]**;** ATEMP **.795**[a]**;** ANUM **.860**[a]**;** ASR **.902**[a]**;** APRMAT **.903**[a]) allow us to know that the variables of Muñoz and Mato scale allow us to understand the student's anxiety toward mathematics. The result confirms the hypothesis that the students of CETIS 15 have a feel anxiety toward mathematics and it becomes clear that the highest level of this anxiety is presented during the evaluations. **Conclusion:** With this result, may be considered by the authorities of CETIS 15 for creating strategies in order to reduce the level of students' anxiety toward mathematics.

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INTRODUCTION

Within the math´s teaching-learning process there are a large number of factors that influence this. At the same time that cognitive factors, it is important to take into account that the emotional aspects have a role of utmost importance, a bad experience in this subject could mark decisively the development of the student regard to this.

It is common for mathematics teachers to perceive the negative reactions of their students with respect to the subject matter, and as in most cases, this attitude is a determining factor in math´s student performance. The importance that gives students to math and the rejection toward these is very strong, that´s why many of the students when they have to select their subjects or to choose a university career, based its decision to the amount of math that will be during the course or career selected (Perez-Tyteca, 2012).

According to Sanchez-Mendías, Segovia and Miñán (2011), teacher´s attitudes either negative or positive, can be transmitted to the students, in other words, if a professor has anxiety toward his subject, very probably his students will have too.

Another important fact refers to the results of the Mexican National Assessment of Academic Achievement in Schools (ENLACE) carried out at various educational levels in the country since 2006. ENLACE is a test of the Mexican educational system that is applied in public and private schools in order to generate a single national scale that provide comparable information about the knowledge and skills that students have in the evaluated issues. The results of this test in mathematics is below average in terms of good understanding and excellent and more than 50% of the students have insufficient knowledge about the subject.

At this point resides the importance of math teachers with a positive attitude and encouraging, because given the low results, it is essential to improve the achievement of students in mathematics and avoid a deficient teaching-learning process, which is particularly damaging to the student.

Codina y Marugan (1986) indicates that teacher´s attitude inside a classroom is going to be reflected positively or negatively to his students, that's why a committed and interested teacher transmits to his students a reflection about the importance of the subject.

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However, it is common that students with anti-mathematical profiles recognized that almost never had a good math´s teacher. It should be noted that anxiety is an emotional factor in all the students that usually is not felt, until they face situations of evaluation of any subject that they perceived as complex and that represents a challenge for them, as the mathematics.

That is why many researches have focus on the study of anxiety toward mathematics, that in the literature it has been called as math anxiety. This way Perez-Tyteca, Castro, Segovia, Castro, Fernandez and Cano (2009) reported that *"math anxiety manifests itself through a series of symptoms, such as: tension, nervousness, worry, angst, irritability, impatience, confusion, fear and mental block""*.

These authors believe that it is important to define anxiety levels toward mathematics, for which it is necessary to measure this variable in order to be able to design the necessary teaching tools. Other authors such as Richardson and Suinn (1972) defined the anxiety mathematics as the *"feeling of tension and anxiety that interfere in the manipulation of numbers and in the resolution of math problems in a wide variety of academic and everyday situations"* (p. 551).

Tobias (1978) y Tobias y Weissbrod (1980, p 65) stated that "math describes the anxiety panic, defenselessness, paralysis, and mental disorganization that arises when a subject is required to solve a math problem". Another reference is Fennema and Sherman (1976 p-4), who believe that math anxiety is in "a series of feelings of anxiety, terror, nervousness and physical symptoms that arise associated to mathematics".

Jackson y Leffingwell (1999) noted that people had their first confrontation with the stress in mathematics when they get into the university level, although they claim that developed their anxiety levels in mathematics prior to admission to the university.

For its part, Perry (2004) identifies three varieties of anxiety in university students: a) moderate math anxiety, b) mathematics anxiety that comes with the student for a long time ago and that began as a consequence of the performance of some professor and c) the anxiety caused by the mechanical method and lacking in understanding to learn the math concepts (Perez-Tyteca, et al 2009).

The foregoing has generated great interest to researchers for knowing the reasons and the causes of anxiety toward mathematics, and is the reason why we made this study , which focuses on the mathematical levels of anxiety present in the students at *"Centro de Estudios Tecnológicos Industrial y de Servicios No. 15 (CETIS 15) "Epigmenio Gonzales"*.

The CETIS are official middle-level schools endorsed by the Public Education Ministry that have as mission to form people with technological expertise in industrial, commercial and services areas, through the preparation of technical professionals and high school graduates. There are 168 CETIS in the country, and given the importance that these schools have in the technical training of many Mexicans, this study realize to identify the level of anxiety toward mathematics in the students of the CETIS 15 located in the city of Veracruz, Veracruz, Mexico.

1.1. Statement of problem:

A positive or negative attitude to face a problem may be (determinant) to solve it, to find or not the solution such as regards Poloya (1945) cited in Estrada and Diez-Palomar (2011) in his words:

"Sería un error el creer que la solución de un problema es un "asunto puramente intelectual", la determinación, las emociones, juegan un papel importante. Una determinación un tanto tibia, un vago deseo de hacer lo menos posible pueden bastar a un problema de rutina que se plantea en la clase; pero, para resolver un problema científico serio, hace falta una fuerza de voluntad capaz de resistir años de trabajo y de amargos fracasos" (Póloya, 1945, p. 80-81)

"It would be a mistake to believe that the solution of a problem is just an "intellectual matter", the determination, the emotions, play an important role. Low determination, a vague desire to do the least possible could be enough for a routine problem that arises in the class; but, to solve a seriously scientific problem, it needs willpower to be able to withstand years of work and bitter failures" (Poloya, 1945, p. 80-81)

Cooper and Robinson (1991) and Carmona (2004) cited in Muñoz and Mato (2007) speak that anxiety toward mathematics of most of young people was formed since they were children and it was developing at the same time they were progressing in their studies. This leads them to conclude that students, who have math´s abilities, avoid studying it because they perceived it as an impediment to pass a school year or in some cases, to get the degree.

It is therefore very advantageous to change anxiety toward mathematics in mathematical confidence, not only because this would bring professional and economic advantages, but also because students would receive a psychological stimulus when they had success.

According to Morris (1991) anxiety can lead students to failure in their tasks or evaluations and unleashing a vicious cycle in the student grow accustomed to the daily to failure, not only in mathematics but also in other subjects.

To study this problem, Munoz and Mato (2007) developed and designed a test that measured the anxiety toward mathematics in order to provide prevention and treatment for this. The test includes five fundamental factors: anxiety toward evaluation, anxiety toward temporality, understanding of math´s problems anxiety, numbers and math operations anxiety and anxiety toward real-life math situations.

The study of Muñoz and Mato (2007) that has been considered by many researchers in different educational levels, will serve as a benchmark in this research to know which is the level of anxiety toward mathematics in the students of CETIS 15 and in this way, to know if student population take decisions based on their emotions about the level of mathematics that need to manage.

1.2. Research Question:

From the arguments described in the initial approach, the following question arises:

R_{Q1}: Are there any anxiety toward mathematics in students of CETIS 15?

R_{Q2}: What is the level of anxiety toward mathematics in students of CETIS 15?

From this question, it was fixed the following:

1.3. Objective:

S_{O1}: Identify if there is anxiety toward mathematics in students of CETIS 15.

S_{O2}: measure the level of math anxiety in students of CETIS 15.

The importance and the benefits that this research could develop lie in the arguments set forth below:

1.4. Justification:

Study of anxiety toward mathematics aims to create awareness about the importance of the subject and the teaching-learning process when students takes important decisions such as the types of subjects that are going to choose or the type of university career that are going to consider. The mathematical knowledge is important in people´s life.

It is important to understand and make good use of mathematics in daily life. The National Council of Teachers of Mathematics (2004) indicates that the need for the use of mathematics had never been as great as today and this need will increase because mathematics are essential for life, are part of the cultural heritage and are necessary for the job.

This study will show the relationship between student´s level of anxiety toward mathematics and the importance of these when they need to decide. The evidence found is going to allow not only to know the levels of anxiety toward mathematics of the student population of the CETIS 15, but to identify the importance of mathematics in the decision process of the students.

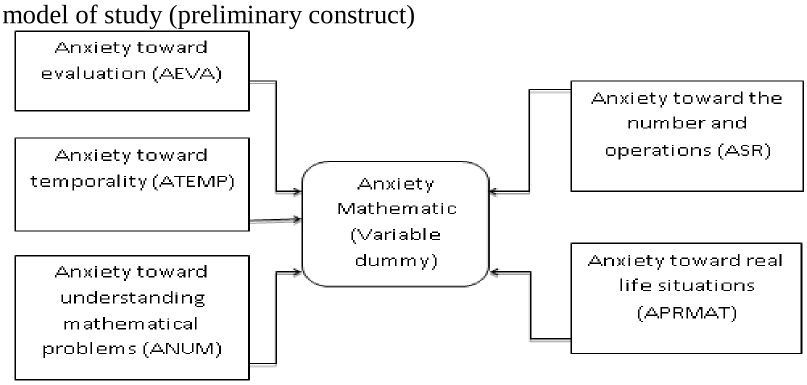
This research aims to generate information and data that may serve as a guide to both teachers and students to achieve a better development of the teaching-learning process in mathematics, all this, in order to assist the understanding and proper use of math.

Math anxiety is studied for more than forty years, and continues to be a topic of current interest. This is evidenced by the inclusion of the PISA study, which showed that a large part of the students evaluated in mathematics express feelings of insecurity and emotional stress when faced with them. According to this study, students who feel anxiety toward mathematics are not interested in them.

The continuity that several researchers have been given to this topic remarks that anxiety toward mathematics has been a constant among the students who have had to pursue this subject. But in addition the good results from other countries show that this is a problem that can be fought, starting with the teachers and bringing results beneficial to the students.

With these elements is shown the route of the theoretical model to be followed for this study, which integrates five dimensions of theoretical construct proposed by Muñoz and Mato (2007). This model is based on the seminal theory of anxiety, whose seminal work of Fennema and Sherman (1976) has derived many empirical studies in finding answers that may explain the phenomenon of study.

1.4.1. Theoretical model of study (preliminary construct)



Source: own

2. *Theoretical framework and hypothesis:*

The theoretical framework of this research, analyze and discuss theories of mathematics anxiety, highlighting the seminal work of Fennema and Sherman (1976) from which emanate the following postulates.

Mathematics education considers math anxiety as part of the attitude, to Fennema and Sherman (1976) math anxiety is part of the attitude toward math. According to these authors, math anxiety develops with *"a feeling of anxiety, fear, nervousness, and associated physical symptoms that arise doing math "*. They also discovered that students who experienced lower levels of anxiety toward mathematics were those who had more favorable attitude to these, and that it was not enough with the willingness that a student had to learn math, but that there were other determining factors such as motivation toward learning.

In this sense, authors note that *"self-confidence is the confidence that a subject has in his own ability to learn and perform a successfully mathematics task"*. For them, self-confidence is widely related to the level of effort that students have to perform mathematical activities. These authors claim that even if a student has low performance in mathematics because of anxiety toward these, when control his performance, attitude toward mathematics and self-concept, anxiety toward mathematics greatly reduced or even disappears.

According to these investigations, sexist environment in classrooms increase anxiety toward mathematics in girls students. Fennema and Sherman (1976) found, working with a group of students that there were differences between the anxiety felt by girls and anxiety felt by boys, being girls which suffer more anxiety toward mathematics, they also identified that if student both boys and girls, will curse the same number of math courses, the differences between anxiety levels toward mathematics would disappear and it would be the same in both sexes.

Fennema and Sherman (1976) scale contains 108 items, distributed in 12 groups with the following subscales:

1) Mathematics success.
2) Mathematics as men´s domain.
3) Father´s attitude toward math.
4) Mother´s attitude toward math.
5) Motivation.
6) Professor's attitude toward math.
7) Anxiety doing math.
8) Confidence in oneself as mathematics student.
9) Math´s usefulness.

2.1. Empirical studies:

Gonzales (2000) cited in Muñoz and Mato (2008), point out that mathematics problem is not recent and that society considers necessary math knowledge. These authors demonstrated in their studies that persons with a minimum level of literacy perceive mathematics boring and difficult, in addition to have insecurity doing simple math problems. It is important to consider that environment in which attitude toward mathematics develops - almost always negative – found frequently the enabling environment for their development in school mathematics.

Table 1: Scales of anxiety toward mathematics.

AUTHOR	MEASURE OF ANXIETY	ITEMS	α
Cole and Oetting (1968) Frank and Rickard (1988)	Scale of anxiety toward specific concepts of Cole and Oetting	20	0.84 / 0.95
Richardson and Suin (1972)	MARS of Richardson and Suinn	98	0.78 / 0.95 0.96 / 0.99
Richardson and Suin (1972)	MARS-α in Richardson and Suinn	98	0.89 / 0.96
Plake and Parker (1982)	ADR in Plake and Parker	22	0.97
Alexander and Martray (1989)	Alexander and SMARS Martray	25	0.71
Saranson, Davidson, Lihthall and Waite (1958)	Tasc CHESSSYSTEM'S LATEST CHESS of Saranson	30	0.85
Sztela (1971)	Scale of debilitating anxiety toward mathematics of Sztela	10	0.83
Keelin and assessinq (1978)	Scale of anxiety toward mathematics and Keeling assessinq	20	0.90
Cruise and wilkings (1980)	Scale of anxiety toward the statistics of Cruise and Wilkins	51	0.67 / 0.94
Meece (1981)	Questionnaire of anxiety toward mathematics of Meece	19	0.81

Source: taken from Muñoz and Mato (2007)

Table 2: Dimensions of anxiety toward mathematics.

Author	Anxiety toward mathematics	Numeric Anxiety	Anxiety tests	Professor Anxiety	Anxiety toward the abstract mathematics	Welcome	Accordance	Disagreement	Concern	Fear	Confidence	Emotion
Suinn and Richardson (1972) MARS	x											
Saranson (1971) SAD									x			x
Rounds and Hendel (1982) MARS		x	x									
Plake and parquer (1982) ADR		x	x									
Frary and Ling (1983)	x											
Resnick, Viehe and Segal (1982) MARS		x	x	x								
Alexander and Cobb (1984) MARS		x	x									
Suin, Taylor and Edwards (1988) MARS			x									
Chiu and Henry (1980) ADR												
Brown and Gray (1992) MARS		x			x							
MECE, Wigfield and Eccles (1990						x	x	x	x	x	x	
Pretorius Norman (1992)	x											
Bessant (1995)						x	x	x	x	x	x	

Source: taken from Muñoz and Mato (2007)

Considering that several studies show that while students increase their level of education, their interest in math decreases, at the same time their positive attitude (Hernández and Socas, 1999). According to McLeod (1992), the condition (emotion) turns out to be the main component, i.e. What is going to determine subsequent attitude toward mathematics, in other words, if people will have a positive or negative attitude toward these. Therefore there are three important facets related with math experience: beliefs about mathematics, positive and negative emotions, and positive and negative attitudes toward mathematics in similar situations.

Tobias (1993) and Gonzales (2000), show that in order to improve mathematical knowledge is necessary to intervene and to do this it is necessary to have the appropriate tools to evaluate. Mato and Muñoz (2007) identified some scales used to measure anxiety toward mathematics, the number of items, the dimensions of those scales and its indicator of reliability Cronbach's Alpha "α" as part of its preliminary work for the construction of a new scale, same as shown in the following tables.

Muñoz and Mato (2007) decided to design a test that let them measure anxiety toward mathematics in order to evaluate anxiety according to social reality, in addition to help teachers to prevent and treat anxiety toward mathematics. As result they obtained an instrument of 24 items with an overall reliability of Cronbach's Alpha of 0.9504 in the final sample.

Their instrument was divided into five factors. The first factor, anxiety toward evaluation, refers to the anxiety of the student to be evaluated or test anxiety of math´s test anxiety. The second factor, anxiety toward temporality, refers to the anxiety of the students toward time they have to resolve a test or a class exercises. The third factor, anxiety toward understanding math problems regards the fear experienced by students from having to understand math problems. The fourth factor, anxiety toward numbers and math operations, refers to the fear of the student when works with numbers. And finally the fifth factor, math anxiety about real life´s situation regards the fear felt by the student to face mathematics in real life.

In theory, according to these authors, math teachers need to intervene to do positive the experiences of students in their first years of study, although they say that in many occasions the academic success and the condition for any subject not always go hand in hand.

There are occasions in which students have negative attitudes toward mathematics, but even so, gets good notes in order to pass the course, this does not mean that later these students does not try to distance themselves as much as they can about math.

These authors also analyze the facilities, the working material for practice, computers, as well as have younger teachers, like more conducive environment to prevent and treat anxiety toward mathematics. This does not mean that most experienced professors are not capable of imparting good classes; the advantage of young teachers is that generally they are more excited about their work and have more patience to students.

Respect the way and methods of teaching, it was identified that students learn easier with the means they are accustomed to use, the electronic media that allow teach in a more didactic way, resulting as a consequence a more positive and less traumatic experience with respect to mathematics, which brings a very low level of anxiety or even close to zero.

Finally Muñoz and Mato (2008) encourage teachers to be innovative with their educational system in order to deal with issues such as attitudes and behavior during learning. They ensure that innovate actions taken by teachers in the teaching-learning process of mathematics help to correct and prevent the negative attitudes toward the subject, because this not only affects students with low performance, but also affects the students with a good performance having a negative attitude toward mathematics.

With the above arguments exposed, we assume that:

H_1: There is math anxiety in students of CETIS 15.

H_2: The latent variables: anxiety toward evaluation, anxiety toward temporality, anxiety about understanding mathematical problems, anxiety toward numbers and math operations and real-life math situations anxiety help to measure the level of anxiety of the students toward math.

H_3: **A**nxiety toward mathematics can be explained at least by one factor.

3. Methodology:

3.1. Kind of study:

This study is not experimental, cross-sectional and explicative. Do not be experimental, because independent variables are not manipulated, hence, the effects (dependent variables) are not conditioned toward certain result. It is cross-sectional type, considering that is performed at one moment, collecting data in the field application of the instrument, their analysis and interpretation. The study is explanatory, considering that we seek to measure anxiety levels toward mathematics based on the scale of Muñoz and Mato (2007).

3.2. Population and sample:

The samples are students (registered), who are enrolled in the first, third and fifth semester of High School Education in the CETIS 15 during the period July-December 2013. The following inclusion criteria were applied:

a-. All students registered. b-. Mexican students. c-. Indistinct Gender. d-. Indistinct Age.

Because the number of students currently registered numbers was not a very large population, we consider appropriate to apply the instrument to all students involved, hence it we decided to conduct a census, ie, a method non-probability for convenience and then that the choice of sample did not depend on the probability, but rather, of purpose of the research.

Since the quantitative approach and to certain design, the usefulness of a non-probabilistic sample resides not so much in a "representatively" of elements, rather on a careful and controlled choice of people previously features defined to the problem statement. For this reason, 1,000 students were surveyed. Were subsequently captured and analyzed data with the SPSS v.16 (statistical Package for Social Science).

The following table shows the stratification of the sample to which was applied the census.

Table 3: Stratification of populations.

	Male	Female	Total
First	210	306	516
Third	125	125	250
Fifth	102	132	234
Total	$\sum = 437$	$\sum = 563$	$\sum = 1000$

Source: own

3.3. Test:

We utilized the scale designed by Muñoz and Mato (2007), which consists of 24 items which are integrated into five dimensions that seek to measure the level of student anxiety toward mathematics. Each dimension incorporates the items shown in the table below.

Table 4: Dimensions of scale Anxiety toward mathematics

Code	Dimensions	Items
AEVA	Anxiety toward evaluation	1,2,8,10,11,14, 15,18,20,22,23
ATEMP	Anxiety toward temporality	4,6,7,12
ANUM	Anxiety toward understanding mathematical problems	5,17,19
ASR	Anxiety toward the number and operations	3,13,16
APRMAT	Anxiety toward real life situations	9,21,24

Source: develop on based of Mato and Muñoz Scale (2007)

The scale used is type Likert, with values ranging from: SN = means nothing (1), PV = Rarely (2), N = Neutral (3), MV = Most times (4) SM = always much (5).

3.4. Statistical procedure:

For evaluation and interpretation of the data collected, we follow the statistical procedure of multivariate factorial analysis proposed by García-Santillán, Venegas-Martínez, Escalera-Chávez and Córdova-

Rangel (2013) and García-Santillán, Escalera-Chávez and Venegas-Martínez (2013), those who carried out the statistical procedure Multivariate Exploratory Factorial Analysis to measure the student attitude toward mathematics, replying Auzmendi scale. For this, we established the following criterion: Statistical hypothesis: Ho: ρ=0 there is no correlation Hi: ρ≠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. Under null hyphotesis, this statistical is asymptotically distributed with $\chi 2$ with p(p-1)/2 freedom degrees, a significance level: α = 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 5):

Table 5: Data matrix.

Students	Variables
1	X11 X12 … .X1p
2	X21 X22 … .X2p
…	… ….
1000 cases	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:

$$X = Af + u \ \hat{U} \ X = FA' + U \quad (1)$$

Where:

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

With a variance equal to:

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

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

This equation corresponds to the communalities and the specificity of variable *Xi*. Thus, the variance of each variable can be divided into two parts (García-Santillán *et al*, 2013):
A) In their communalities hi^2 representing the variance explained by common factors, and…….
B) The specificity Ψ_I that represents the specific variance of each variable.

Thus obtaining:

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

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

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

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

Finally, 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. This is given by the following expression:

$$KMO = \frac{\sum_{j^1 i}\sum_{i^1 j} r_{ij}^2}{\sum_{j^1 i}\sum_{i^1 j} r_{ij}^2 + \sum_{j^1 i}\sum_{i^1 j} r_{ij(p)}^2} \quad (6)$$

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. This is given by the following expression:

$$MSA = \frac{\sum_{i^1 j} r_{ij}^2}{\sum_{i^1 j} r_{ij}^2 + \sum_{i^1 j} r_{ij(p)}^2}; i = 1, \ldots, p \quad (7)$$

Where: rij (p) it is partial coefficient of the correlation among variables *Xi* and *Xj* in all of cases.

4. Analysis and discussion:

4.1. Relibiliaty test:

An analysis of instrument reliability was carried out using Cronbach's alpha coefficient. This coefficient is a coefficient of reliability or internal consistency that takes values between 0 and 1, which helps to check if the instrument is reliable, and can be performed stable and consistent measurements, from the following formula:

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

Where: N = Number of items (or latent variables), $\bar{r}$ = it is mean correlation among items.

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 (Hair, 1999). Thus, the Cronbach's alpha can be set as a function of the number of items and the average of correlations among the items. The results of the processed cases are shown in Table 6.

Table 6: Reliability test.

Alfa de Cronbach's	Cases	%	Alpha
Valid cases	994	99.4	α= 0.929
Excluded(a)	6	0.6	
Total	1000	1000	24 factors
Dimensions	AEVA, ATEMP, ANUM ASR, APRMAT		α= 0.775 with 5 factors

(a) List wise deletion based on all, variables in the procedure
Source: own

The overall result obtained (0.929) and grouped into five dimensions is (0.775), both are very acceptable if we take the reference to Hair, et al (1999) α>0.6, therefore, we can say that the instruments (the scale) have the characteristics of consistency and reliability which is required for the study, so the validity of test is confirmed.

4.2.- Data analysis:

a) Correlations matrix:

Table 7 shows the values obtained from correlations of the variables studied, where we can see the mostly are inter-correlated and the correlation among variables present high values (>0.05), with the exception of the variable ASR vs. AEVA; ATEMP; ANUM and APRMAT vs. ASR whose values are lower than <0.05 however are positive values and whether show positive correlations. This result leads us to believe that there is a correlation among the set of variables in the model, both practical as well as statistical, which means, that factorial analysis is appropriate.

Table 7: Correlations Matrix

		AEVA	ATEMP	ANUM	ASR	APRMAT
Correlations	AEVA	1.000				
	ATEMP	.802	1.000			
	ANUM	.720	.723	1.000		
	ASR	.379	.333	.424	1.000	.
	APRMAT	.599	.595	.641	.382	1.000
Sig. (Unilateral)	AEVA					
	ATEMP	.000				
	ANUM	.000	.000			
	ASR	.000	.000	.000		
	APRMAT	.000	.000	.000	.000	

(a) Determinant = .063
Source: own

Furthermore, the value of the determinant (0.063) is slightly higher than the theoretical recommended value (<0.05), which also gives evidence for the presence of significant correlations in the set of variables studied. It should be noted that these correlations lower 0.05 if they present positive values. We must remember that, with the transformation of the determinant of correlation matrix, the Bartlett test of Sphericity was obtained, as shown in Table 8, and is given from the equation:

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

b) Bartlett test of Sphericity:

In Table 8, the results of the Bartlett test of Sphericity, *KMO, MSA,* X^2, with significance (p <0.01) are shown. Observed values X^2 (2,719.024 with 10 df) shows that are high, the measure of sampling adequacy (overall) KMO (0.841) is located in the rank of acceptance because, this should be higher than 0.5, indicating that the variables are intercorrelated.

Tabla 8: Bartlett test, KMO, X^2

Measure sampling adequacy of Kaiser-Meyer-Olkin.		0.841
Bartlett test of Sphericity	Chi-square approximation	2719.024
	df	10
	Sig.	0.000

Source: own

c) Measure of sampling adequacy (MSA):

In Table 9 indicates the partial factor of the relationship strengths among two variables and the values that shown indicates that all have values greater than 0.75, this suggests that the implementation of factorial analysis is good. 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 0.795[a] to 0.903[a], are significant and it is confirmed that factor analysis it is optimal to explain the phenomenon studied.

Tabla 9. Anti-image Matrix

Variables	AEVA	ATEMP	ANUM	ASR	APRMAT
AEVA	0.806[a]				
ATEMP	-0.560	0.795[a]			
ANUM	-0.249	-0.295	0.860[a]		
ASR	-0.095	0.051	-0.180	0.902[a]	
APRMAT	-0.129	-0.128	-0.289	-0.139	0.903[a]

a. Measure of sampling adequacy (Source: own)

d) Components Matrix, Communalities, Eigenvalue and total Variance:

Once that has been determined than the Factorial Analysis is an appropriate technique for analyzing the data, we proceed to examine the factors and components, hence in Table 10 shows the component matrix and communalities as well as eigenvalues, whose explanatory power will explain the total variance.

Table 10: Components Matrix, Communalities , Eigenvalue and total Variance.

	Component 1	Communalities	
AEVA	0.886	0.785	
ATEMP	0.877	0.769	
ANUM	0.882	0.779	
ASR	0.570	0.324	
APRMAT	0.799	0.639	
Eigenvalue	3.296		
Total Variance	0.6591		
	Extraction sums of squared loadings		
Component 1	Total	% of variance	% accumulated
	3.296	65.91	65.91
Extraction method: Principal component analysis (Source: own)			

Based on the criterion of eigenvalue greater than 1 (3.296) suggests the presence of 1 factor, from whose explanatory power may explain the total variance in 65.91% of total variation in the data. Furthermore, in the same Table 10 factorial 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 AEVA (0.886) the largest weight (anxiety towards evaluation), followed by ANUM (.882) (Anxiety toward understanding mathematical problems) and less factorial weight, but always observing behavior >0.5 is ASR (0.570 Anxiety toward the number and operations). And at the side of the proportion of variance explained through the communalities, we have AEVA (0.785) the highest value, and at the opposite extreme or lesser value we have ASR (0.324).

4.3. - Conclusions and discussions:

Based on the results, sufficient evidence was obtained in order to rejection of the null hypothesis, hence, the research hypothesis which states that students “CETIS 15” have anxiety toward mathematics and it becomes clear, that the highest level of anxiety occurs during his evaluation.

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

In this study, it could be established that the variable “anxiety towards evaluation (AEVA with 0.886 of factorial weight and 0.785 of communalities -variance proportion-) is the factor that most explain the problem, moreover, in the other hand, an extreme case, only this variable could explain the student anxiety toward this subject. The others factors, Anxiety toward understanding problems (ANUM with 0.882 of factorial weight and 0.779 of communalities -variance proportion-), “Anxiety toward temporality” (ATEMP with 0.877 of factorial weight and 0.769 of communalities -variance proportion-), Anxiety and mathematics in real life situations (APRMAT with 0.799 of factorial weight and 0.639 of communalities -variance proportion-), Anxiety face numbers and mathematical operations (ASR, 0.570 factorial weight and 0.324 of communalities -variance proportion-), all they, reflect the situation faced students to facing Mathematics, within and outside the classroom.

In this way it also confirms the hypothesis that the anxiety may be explained by at least one factor, “anxiety about the evaluation” and the rest of the latent variables allow us to measure the level of students anxiety and may be considered by the authorities of CETIS 15 for creating strategies in order to reduce the level of students anxiety toward mathematics.

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