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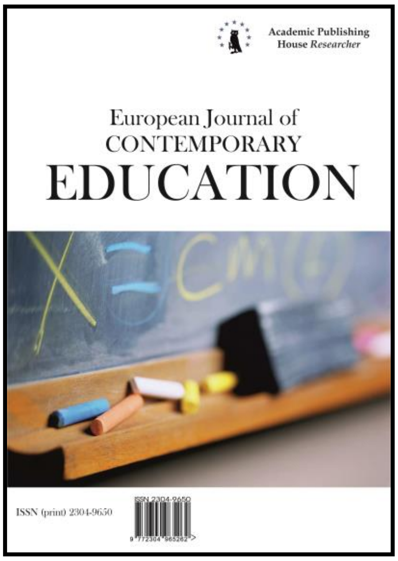

Factorial Analysis to Measure Anxiety towards Mathematics: an Empirical Study in High School

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Abstract

The aim of study focused in identify if there are a set of variables that explain the level of anxiety towards mathematics in Telebachillerato students. For this, the test designed by Muñoz and Mato-Vázquez (2007) was used. The test comprises by 24 items with 5 dimensions. In order to get data, were surveyed 201 regular students enrolled in the academic year 2018. The reliability and internal consistency of the instrument is α= 0.7921 in this study. The main findings show that the level of anxiety towards mathematics in the students is generated into the institution because the evaluations and their temporality are given precisely in the classrooms where numbers and mathematical operations are study.

Keywords: anxiety, mathematics, students.

1. Background of study

When we hear about mathematics, some people associate it with feelings of fear, anxiety, and hatred. Some people even point out that they can show rejection or emotional blockage (Mato, De la Torre 2010, Eccius, Lara-Barragán, 2016).

The interest to discover not only the attitude towards mathematics but also its level of performance has been so much that in 1997 the Program for the International Evaluation of Students is created (PISA) which is promoted by the Organization for Economic Cooperation and Development (OECD). This program is applied every three years and serves as education and learning development when evaluating science, reading and mathematics competencies in 15-year-old students (OECD, 2017).

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The high participation demand for the evaluation of non-members of the OECD has given rise to the PISA pilot project for Development (PISA-D) with the only objective that this be inclusive when evaluating students with ages ranging from 14 to 16 years, in the non-school system and that is mostly accessible to those countries with medium and low incomes that will be incorporated after 2021 (OECD, 2017).

It is necessary to identify what is understood by mathematical competence to be able to measure what is being evaluated on these young people and discover which areas make the young student more anxious when facing a mathematical event, evaluation or mathematical problem.

The concept of mathematical competence according to PISA 2015 includes the ability to reason, formulate, use and interpret those tools, procedures and mathematical facts in which decisions are issued after having analyzed the phenomena that occur in the world (OECD, 2017).

Mathematics is important in a person's life because it is by means of numbers that an order, logic and reason are given to the events that occur in their environment. Therefore when PISA 2015 evaluated young people, the percentage of Mexican students by level of performance in mathematics shows 26 % below level 1, 31 % is at performance level 1, 27 % at level 2, 13 % at level 3 and only 4 % is at performance level 4, this according to the National Institute for the Evaluation of Education (INEE, 2016).

Therefore, those Mexican students who obtained a performance below level 1 will only be able to carry out basic mathematical operations and using only whole numbers, making mathematics likely to be useless in the future to develop thoughts of abstract analysis and make decisions that bring them closer to greater opportunities or benefits in their productive life (INEE, 2016). If these were the results in middle school, how will the level of mathematics performance in basic education be?

The National Plan for Learning Evaluation (PLANEA, 2018 for its acronyms in Spanish) applied a test to 1,623,135 Mexican sixth grade students in both official and private schools.

The results are not encouraging in the area of mathematics, 59 % are in level 1 insufficient domain, which means that children will solve basic operations, calculate regular perimeters and interpret bar graphs; 18 % is in level 2 basic domain, where they can solve operations with decimal numbers, calculate perimeters of irregular figures and calculate percentages.

On the other hand, 15 % is in level 3 satisfactory domain, where they can solve operations with fractions, recognize situations where it is required to calculate perimeters and identify the mode in a set of data; only 8 % is in the level 4 outstanding domain where they solve operations with decimals, fractions and conversions, calculate perimeters and areas of regular and irregular figures and can calculate the average and median of a set of data.

The lowest average score in mathematics by state in Mexico was obtained by the state of Guerrero with 453 points, in second place is Tabasco with 479 points and the third place corresponds to Veracruz with 487 points. The highest average score was obtained by the states of Aguascalientes with 533 points, Mexico City with 534 points and Jalisco with 535 points.

The results also show a comparison of the evaluation between the years 2015-2018, where the highest average score in both years in the area of mathematics is obtained by the girls with five more points in 2018 with an average of 507 points and the boys with one more point in 2018 with 499 points (PLANEA, 2018).

Unlike the results presented in PISA 2015 where the boys are those who obtained 7 points more than the girls and it increases in students with a high level of performance with 16 points (OECD, 2016).

A similar result regarding gender is that obtained in the Plan 2017 evaluation in the Upper Secondary Education (EMS), where the boys obtain an average score in the area of mathematics of 513 and the girls obtain 488 points, therefore, it is the boys who get a higher score in the education and learning of mathematics.

Likewise, it is reported that it is the girls who are in level 1 of performance with 70.5 %, with respect to the boys who are in that level with a 61.4 %, which means that it is the girls who present greater difficulty to carry out operations with fractions, variables or unknown quantities, as well as difficulty analyzing the relationship between these two variables.

In terms of age, those who are studying middle and high school on a regular basis obtain a higher score in mathematics, that is, those who are 16 years old or less with an average of 514 points, unlike those who study it but whose age is 19 years or more, showing an average of

467 points, which implies a low score for those who are older due to various factors such as having dropped out of school, changing residence, failing some school cycles or postponing entry to school (PLANEA , 2017).

It is important to note the relevance given to these evaluations, which serve as an indicator of the current level of teaching and learning of mathematics in Mexican education. However, the following question arises: will it be possible that the level of performance shown derives from the attitude that the student has towards mathematics?, that is, will the low level of performance be due to what the student believes, feels and does in the presence of mathematics?

The concern to know more about the attitude that young people show towards mathematics is not recent, there are different seminal authors (Sarason et al., 1958; Aiken, Dreger, 1961; Richardson, Suinn, 1972; Aiken, 1976; Fennema, Sherman, 1976; Michaels, Forsyth, 1977; Sepie, Keeling, 1978; Sandman, 1980; Roberts, Bilderback, 1980; Brassell et al., 1980; Plake, Parker, 1982; Wise, 1985; McConghy, 1985, 1987; Auzmendi, 1991; Satake, Amato, 1995; Suinn, Winston, 2003; Mato, 2006; Muñoz y Mato, 2007; Adelson, McCoach, 2011; García-Santillán et al., 2013, 2015, 2016, 2017, 2018) who start this journey to discover the variables that underlie mathematical anxiety.

Likewise, they show empirical evidence providing greater knowledge about the possible causes and effects, which makes it possible to develop action plans to improve students' attitudes towards mathematics.

The construct of mathematical anxiety includes those factors such as attitudes, thoughts or beliefs and emotions that exert in the individual, the tendency to react with rejection, panic, anguish or fear, nervousness or stress in the presence or manipulation of numbers, taking a mathematics class and/or performing mathematical tasks/operations (Richardson, Suinn, 1972; Furner, Berman, 2003, Bursal, Paznokas, 2006, Rosário et al., 2008).

For the aforementioned, this study seeks to answer the following research question: what is the set of variables that explain mathematical anxiety in students from a rural Telebachillerato in the state of Veracruz? In addition, it seeks to answer which the dimensions that exert greater mathematical anxiety in students are.

So, the objective of this study is: to analyze the set of variables that explain mathematical anxiety in students from a rural Telebachillerato in the state of Veracruz. Similarly, it seeks to demonstrate the dimensions that exert greater mathematical anxiety in students. For this purpose it is necessary to analyze and discuss the theoretical and empirical foundations that have explained this construct.

2. Theoretical revision

In 1952, Mandler and Sarason sought to discover the effects that generate anxiety when facing different situations, so they designed an instrument to evaluate the symptoms of anxiety experienced by individuals. Their findings showed that anxiety was more evident in relevant tasks than in those that were not and the level of anxiety was reduced when the task was satisfactorily fulfilled.

This was the starting point so that later on, more scales related to anxiety were elaborated (Sarason et al., 1958) and where anxiety that was present before an evaluation in general began to emerge (Richardson, Suinn, 1972; Sarason, 1977, 1984).

Along with previous research Feierabend (1960) defines attitude as the predisposition of a person to respond either negatively or positively to a situation or to another person. However, that attitude was focused on the effects caused on the individual when in the presence of mathematics, and also points out that the findings of gender difference to solve mathematical problems were not due to any mental deficiency, skills or knowledge but by the attitude they showed to solve them.

After Aiken and Dreger (1961) designed an instrument to identify the mathematical attitude, they discovered that attitudes will be affected when individuals have some experience with mathematics. They also notice a difference in gender: unlike men, attitude in women predicts mathematical achievement.

Both anxiety and mathematical attitude have been extensively researched and for this purpose several scales have been designed that demonstrated an acceptable Cronbach Alpha (AC α) reliability index (Table 1 and 1b).

Table 1. Attitude and Anxiety Scales towards Mathematics

Escales	Items	AC α
TASC - Sarason, Davidson, Lighthall, & Waite (1958)	30	0.85
Atittude toward Math Scale– Aiken & Dreger (1961)	20	0.94
MARS - Richardson & Suinn (1972)	98	0.89, 0.96
Debilitating Anxiety Scale towards Mathematics – Sztela (1973)	10	0.83
Attitude Scales towards Mathematics – Aiken (1974)	21	0.95, 0.85
Attitude Scales towards Mathematics – Fennema & Sherman (1976)	108	0.89
Attitudes to Mathematics Questionnaire – Michaels & Forsyth (1977)	44	0.51, 0.61, 0.78
Anxiety Scale towards Mathematics – Sepie & Keeling (1978)	20	0.90
Inventory of Attitudes towards Mathematics – Sandman (1980)	28	0.69, 0.89
Inventory of Attitudes towards Mathematics – Roberts & Bilderback (1980)	33	0.93, 0.95
Anxiety Scale towards Mathematics – Cruise & Wilkins (1980)	51	0.67, 0.94
Mathematics Anxiety Questionnaire – Meece (1981)	19	0.81
MASC - Plake and Parker (1982)	22	0.97
Attitudes towards Statistics -Wise (1985)	29	0.92, 0.90
Attitude Scales towards Mathematics – McConghy (1985, 1987)	14	0.79

Source: Own elaboration based on the literature review.

Table 1b. Attitude and Anxiety toward Math scales

Escala	Items	CA α
SMARS – Alexander and Martray (1989)	25	0.71
Scale of Attitudes towards Statistics and Mathematics - Auzmendi (1991)	25	0.87, 0.92
EAHM-V – Bazán and Sotero (1998)	31	0.90
MARS, Mathematical Anxiety Scale, brief version – Suinn and Winston (2003)	30	0.96
Mathematics Anxiety Questionnaire of Muñoz and Mato (2007)	24	0.95
Attitudes towards mathematics – Alemany and Lara (2010)	37	0.92
Inventory of Attitude towards Mathematics short version – Lim and Chapman (2013)	19	0.93
Scale Attitude towards Mathematics, short form, – Yasar (2014)	19	0.96
Scale of Attitudes towards Mathematics – Palacios, Arias and Arias (2014)	32	0.95

Source: Own elaboration based on the literature review

From the information shown in Tables 1 and 1b, we can observe the diversity of scales that have been developed over these years with respect to anxiety and attitude towards mathematics, showing its acceptable reliability index and factorial structure shown by these instruments.

Mathematics has been part of our lives since childhood, and gives us training, helping us to rationally expand our decisions in our minds for day-to-day perception (Camarena-Gallardo, 2014). However, this topic has been addressed by several researchers for a long time, since the perception of mathematics does not always have an answer, but occasionally generates stress or anxiety (Gi et al., 2006).

Fennema and Sherman (1976) designed a Likert-type scale to measure attitudes towards exact sciences, which is comprised of 108 items divided into 9 factors that provide the confidence that men and women have towards learning mathematics, success in learning, the attitudes of the father/mother towards the study of mathematics, and even the attitudes of the teacher towards the study of mathematics.

On the other hand, Galbraith and Hines, (1998, 2000) as well as different scientists have modified this scale trying to measure other factors that people present more frequently towards the subject of mathematics, for example: the link of computers and mathematics, trust, etcetera.

Following the premises outlined above, there are different approaches to the theoretical studies that try to explain the performance of students in exact sciences. In this case we can mention the works of Dreger and Aiken (1957) where they identify different factors or emotional reactions towards arithmetic and mathematics and based on that phenomenon, they designed a set of instruments to measure anxiety

In this sense, Fennema and Sherman (1976) consider mathematical anxiety as part of the attitude and as a sub-construct within the attitude towards mathematics. Therefore, in their empirical research they indicate that students, who experienced less anxiety towards mathematics, were those who also had a more favorable attitude. However, they clarify that it is not enough with the disposition that a student has to get a mathematical learning, pointing out that the attitude is "a feeling of anxiety, terror, nervousness and associated physical symptoms that arise when doing mathematics".

In a theoretical approach it can be observed that students' anxiety towards mathematics has been a subject studied in different areas and levels: Dutton and Blum (1968) also conducted surveys with variables, such as state trait anxiety, confidence, in the same way in secondary education and university students (Muñoz, Mato, 2007; Pérez-Tyteca et al., 2009).

In a similar way, García-Santillán, Edel and Escalera-Chávez (2010) designed an instrument called EAPH.MF which is formed by 31 items in conjunction with a Likert-type scale, having as a primary objective the measuring of attitudes and perception of financial mathematics through the history of mathematics, simulators, computer programs and virtual learning variables.

Over time, several models or constructs are being created, such as the work of Pérez-Tyteca (2012) that determines anxiety, self-analysis and utility in mathematics, while developing measurements to show whether there is interaction among them resulting in a statistically significant association.

Later in another study, Eccius-Wellman and Lara-Barragan (2016) developed a questionnaire with 20 items in a Likert-type scale on mathematical anxiety, in which one can analyze attitudes, emotions and beliefs towards that topic.

Derived from the aforementioned theoretical-empirical arguments, the methodological procedure to be followed is described in the following lines.

3. Method

The empirical study is of non-experimental design, since the independent variables (X) were not manipulated, this in order not to condition the results (Y) and their generalization. The application of the questionnaire and the collection of data is cross-sectioned, its analysis and interpretation was done in a single moment of the study. This research focuses on identifying factors that generate anxiety towards mathematics in students, so it is a correlational explanatory study, in order to discover the set of underlying variables that explain this phenomenon from the model proposed by Muñoz and Mato (2007).

Population

The key informants are students of Upper Secondary Education level in Veracruz, Ver., in a Telebachillerato of municipal scope, which is part of the School Supervision in Veracruz (2017) that depends on the Telebachillerato General Direction.

The students surveyed in the Telebachillerato belong to the public sector. The school has three grades of study, so general high school is completed in 3 years and only in the morning shifts (Centros Educativos, 2017).

The population surveyed is approximately of 200 to 211 students enrolled in the semester of the school period July-December 2017. Students' ages range from 13 to 20 years, and are studying in the Telebachillerato Adolfo Ruíz Cortines, belonging to the municipality of Veracruz, Ver.

Among the inclusion criteria that were taken into account is that the students were registered at the time of the survey, that they are studying the first, third and fifth semester and that they voluntarily accept to answer the questionnaire. At all times they were told that the data collected would be treated confidentially so they were not asked to write down their names, only the sociodemographic data.

Sample

For this study, a stratified simple random sample was considered at the beginning. However, as the application of the test developed, we were asked by the school authorities to apply the questionnaire to as many students as possible since it would be convenient for them. Therefore, the sample was extended to a census since at all times it was intended to survey all the students enrolled and who were present in the telebachillerato facilities. Under this consideration, the sample was not probabilistic for convenience, having succeeded in surveying ± 211 students in total, which were supervised in case any doubts arouse these were solved at that moment. In the end, ten surveys had to be discarded due to failures in filling in.

Instrument

For the purposes of this empirical study, an Anxiety towards Mathematics Questionnaire designed by Muñoz and Mato is used (2007) whose internal consistency Cronbach alpha was originally 0.9504 and consists of 24 statements which are integrated into the following dimensions that determine the anxiety towards mathematics (Table 2):

Table 2: Test Structure by dimensions

Dimensions	Items
Anxiety before the evaluation	1, 2, 8, 10, 11, 14, 15, 18, 20, 22, 23
Anxiety in the face of temporality	4, 6, 7, 12
Anxiety in the understanding of mathematical problems	5, 17, 19
Anxiety in front of numbers and mathematical operations	3, 13, 16
Anxiety in real-life mathematical situations	9, 21, 24

Source: Taken from Muñoz and Mato (2007)

The following sociodemographic profile is included in the applied questionnaire: gender, age and school grade. The questionnaire is a Likert-type scale with an answer option ranging from 1 to 5, where 1 means nothing and 5 means a lot.

3. Statistical procedure

For data analysis, it is first necessary to check their reliability and internal consistency, to subsequently verify if the data are normally distributed. Another assumption is the randomness hypothesis, which is necessary to verify it from the test of runs of the mean. In this way, if the data present a multivariate normality, the factorization is carried out using the Exploratory Factor Analysis (EFA).

The steps to follow for the analysis of the data start first with the measurement of their reliability. We know that if the Cronbach alpha index (AC) is closest to 1, it will have greater reliability, being an acceptable value what Hair et al. (2009), whose pointing out that from 0.80 it is a good internal consistency although > 0.7 is accepted according to the theoretical criterion. Therefore AC can be established as a function of the number of items and the average of the correlations between the items: $\alpha = \dfrac{N * \bar{r}}{1 + (N - 1) * \bar{r}}$

Where: N = Number of items, $\bar{r}$ = is the average correlation between the items.

Then to verify the null hypothesis that establishes that the sample was extracted from a population with normal distribution, the analysis of the data is carried out using the Kolmorogov-Smirnov test, using the D statistic, which suggests the maximum difference: $D = máx\left|F_n(x) - F_o(x)\right|$

where: Fn (x) corresponds to the sampling distribution and Fo (x) is the theoretical function that corresponds to the normal population on which the null hypothesis is based.

Then the criterion to be considered is, if the sample is large in its composition (without excluded data) and its randomness is demonstrated, then the number of runs (R) could be approximated by a normal distribution of parameters.

Therefore it is known that: $\sigma_R = \sqrt{\dfrac{2n_1n_2(2n_1n_2 - n)}{n^2(n-1)}}$ So we have to: $Z = \dfrac{R + c - \mu_R}{\sigma_R}$

Where: c = 0.5 si $R<\mu_R$ *y* c = 0.5 si $R>\mu_R$

Subsequently, to perform the EFA, the calculation procedure of Bartlett's Sphericity Test with Kaiser, Chi2 with *n gl* is followed from the following expression:

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

That satisfies the following expression:

$$\left[n - \frac{2p + 11}{6}\right]log \frac{\left[\frac{1}{p - m}\left(trazR^* - \left(\sum_{a=1}^{m}\lambda_a\right)\right)\right]^{p-m}}{\left|R^*\right| \Big/ \prod_{a=1}^{m}\lambda_a}$$

Where: n = sample size; p = number of variables; ln = natural logarithm and R = correlation matrix

Similarly, from the transformation of the determinant in the correlation matrix, the power of the correlations between the analyzed variables can be identified according to:

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

Where: n = sample size; ln = natural logarithm, = values belonging to R $\lambda_j(j = 1...p)$ and R = correlation matrix

The KMO and MSA values are given by:

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

Where: rij (p) = Is the partial correlation coefficient of the correlation between the variables Xi and Xj in all cases.

In this way, to test the null hypothesis, we take the critical value of Chi2 calculated, if it is greater than the value of tables, we have evidence for the rejection of Ho, otherwise we cannot reject it.

Finally, the components are extracted according to the criterion of eigenvalues > a 1 and its corresponding commonality whose sum is the percentage of variance explained from:

$$h_i^2 = Var\left(\sum_{j=1}^{k} a_{ij}F_j\right) \ldots\ldots y \ldots\ldots\ldots \psi_i = Var\left(u_i\right) \text{ y } Var(X_i) = \sum_{j=1}^{k} a_{ij}^2 + \Psi_i = h_i^2 + \Psi_i; i = 1, \ldots\ldots, p$$

4. Data analysis

To answer the questions and achieve the objectives set out in this research, the following hypotheses are tested:

Hi1 There is a set of variables that explain the mathematical anxiety in students of a rural Telebachillerato of the State of Veracruz.

Ho1. There is not a set of variables that can explain the level of anxiety towards mathematics in students of a rural Telebachillerato of the State of Veracruz.

In addition, we try to contrast the normality and randomness hypothesis of the data, hence: Ho2: The sample comes from a population with normal distribution, Hi2: The sample does not come from a normal distribution, likewise: Ho3: The sample is random, Hi3: The sample is not random.

The data obtained related to the student's profile about gender and age, are described first:

Table 3. Gender

GENDER		Frequency	Percentage	Percentage valid	Percentage accumulated
Valid	MAN	132	65.7	65.7	65.7
	WOMAN	69	34.3	34.3	100.0
	Total	201	100.0	100.0	

Tabla 4. AGE

AGE		Frequency	Percentage	Percentage valid	Percentage accumulated
Valid	from 12 to 15	3	1.5	1.5	1.5
	>16 <TO 20	88	43.8	43.8	45.3
	>21 <TO 23	106	52.7	52.7	98.0
	>TO 30	4	2.0	2.0	100.0
	Total	201	100.0	100.0	

The highest percentage in terms of gender was among males (65.7 %) and in age, the concentration was between 16 and 23 years of age, almost 96.5 %. Subsequently, we aimed to validate the database to measure its internal consistency, hence table 5 shows the value obtained from Cronbach's alpha (α=0.792) which is acceptable in the theoretical terms suggested by Hair et al. (2009).

Table 5. Summary of the processing of the cases

		N	%	Cronbach's alpha	N dimensions
Cases	Valid	201	100.0		
	Excluded[a]	0	.0	0.792	5
	Total	201	100.0		

a. Deletion by list is based on all the procedure variables.

To verify the null hypothesis that establishes that the sample was extracted from a population with normal distribution, the analysis of the data is carried out using the Kolmorogov-Smirnov test, using the D statistic, which suggests the maximum difference: $D = máx\left|F_n(x) - F_o(x)\right|$

Where: Fn (x) corresponds to the sampling distribution and Fo (x) is the theoretical function that corresponds to the normal population on which the null hypothesis is based.

Table 6. Kolmogorov-Smirnov test for a sample

		1	2	3	4	5
N		201	201	201	201	201
parameters normal[a,b]	Medium	33.0547	11.3234	7.3333	8.2189	5.0597
	Deviation Standard	10.26655	4.43508	3.07625	3.18620	2.44876
Maximum differences extreme	Absolute	0.067	0.092	0.125	0.125	0.203
	Positive	0.067	0.092	0.125	0.125	0.203
	Negative	-0.062	-0.053	-0.079	-0.086	-0.200
Test statistic		0.067	0.092	0.125	0.125	0.203
Sig. Asymptotic (bilateral)		0.029[c]	0.000[c]	0.000[c]	0.000[c]	0.000[c]

a. The test distribution is normal. b. It is calculated from data. c. Correction of significance of Lilliefors. Where (1) ANSIEV; (2) ANSITEM; (3) ANSICOPM; (4) ANSINOM and (5) ANSISIT.

As shown in Table 6, the asymptotic significance of the five variables have values a < 0.05, which evidently shows the non-normality of the data. However, there are some theoretical foundations that suggest that if it were the case, some tests should be performed to support the exploratory analysis of the data (Gorsuch, 1983; Pett et al., 2003, Hair et al., 2009, García-Santillán, 2017).

In this way, Table 7 shows the matrix of correlations between the variables of the empirical model that is analyzed.

Table 7. Correlation matrix[a]

Correlation	ASIEV	ANSITEM	ANSICOPM	ANSINOM	ANSISIT
ASIEV	1.000	0.804	0.693	0.779	0.330
ANSITEM		1.000	0.700	0.801	0.352
ANSICOPM			1.000	0.706	0.472
ANSINOM				1.000	0.348
ANSISIT					1.000

a. Determinants = .036

From the visual revision to the correlations, these present very acceptable values, considering that it is suggested that these are greater than 0.30, so it is considered that the data matrix presents good correlation, in addition the value of the determinant (dr = 0.036) is very close to zero, which supports this test and to a large extent to the completion of the exploratory factor analysis (Pett et al., 2003; Hair et al., 2009).

Therefore, it is necessary to evaluate these correlations by means of the Bartlettt sphericity test, with the idea of evaluating the null hypothesis that indicates that there is no correlation between the variables and that it is an identity matrix. From its result we could know if the data matrix presents a degree of correlation that is statistically significant (Hair et al., 2009; Barttlet, 1950).

Table 8. KMO Test and Bartlett's Sphericity Test

Kaiser-Meyer-Olkin measure of sampling adequacy		0.857
Bartlett's sphericity test	Aprox. Chi-squared	654.190
	gl	10
	Sig.	0.000

The result described in Table 8 gives evidence of the good correlation of the variables with the value obtained from Chi2 of 654.19 with 10 degrees of freedom, which is greater than the table Chi2 of 18307 with 10 gl. In addition, the value of the KMO index> 0.8 is very acceptable. Similarly, the MSA index is calculated to assess the suitability of the sample for each variable, whose values are interpreted very similarly to the KMO (Table 9).

Table 9. Anti-image matrices

Anti-image correlation	ASIEV	ANSITEM	ANSICOPM	ANSINOM	ANSISIT
ASIEV	0.855[a]				
ANSITEM		0.840[a]			
ANSICOPM			0.881[a]		
ANSINOM				0.859[a]	
ANSISIT					0.849[a]

a. Measures of sampling adequacy (MSA)

As observed in Table 9, the MSA values obtained in all cases are greater than 0.8, which exceeds the suggested theoretical threshold of > 0.5, giving statistical evidence of a matrix that presents a good correlation between the variables under study. After that, the component and commonality matrix is now presented, as well as the total variance explained. The criterion followed is that of self-value> a 1, since it is a technique that allows us to obtain the total variance explained by those factors that are obtained and that are greater than 1 (Hair et al., 2009; Pett et al., 2003).

Table 10. Component matrix[a]

Dimensions	**Component 1**	**Communalities**
ASIEV	0.893	0.798
ANSITEM	0.905	0.819
ANSICOPM	0.867	0.752
ANSINOM	0.899	0.808
ANSISIT	0.540	0.292

Extraction method: analysis of main components. to. 1 extracted components.

Table 11. Total variance explained

	Inicial Eingenvalues			∑ extraction of loads squared		
Component	Total	% variance	of% accumulated	Total	% variance	de % accumulated
1	3.470	69.405	69.405	3.470	69.405	69.405
2	0.809	16.182	85.588			
3	0.312	6.219	91.806			
4	0.220	4.403	96.209			
5	0.190	3.791	100.000			

Extraction method: analysis of main components.

To test the null hypothesis that establishes that the sample is random, the analysis of runs is carried out. This test gives us evidence about the existence or not of randomness, considering that a reduced number of runs would be a sample that the data were not extracted at random (Table 10)

Table 10. Runs Test

	ASIEV	ANSITEM	ANSICOPM	ANSINOM	ANSISIT
Test Value[a]	33.0547	11.3234	7.3333	8.2189	5.0597
Cases < Test Value	108	107	113	111	134
Cases > Test Value	93	94	88	90	67
Total Cases	201	201	201	201	201
Number of runs	93	93	104	99	89
Z	-1.129	-1.147	0.582	-0.201	-0.212
Sig. Asymptotic (bilateral)	0.259	0.251	0.560	0.841	0.832

a. Medium

As shown in Table 10, the value of the critical level of bilateral asymptotic significance exceeds 0.05 in the five analyzed variables, so we cannot reject the independence hypothesis, that is, the cases studied are random

Data discussion and conclusions

The core part of this study was to focus on analyzing the attitude that students show towards mathematics, based on the hypothetical assumption that there is a structure that underlies the explanation of the phenomenon of anxiety in student populations, and for this specific case, in students of a Telebachillerato within the rural context.

In the data analysis, the procedure to test the basic assumptions of normality and randomness was followed, and in a very special way, the internal consistency of the instrument.

Given the apparent absence of normality of the data matrix, the use of the factor analysis technique was based on the correlation matrix, which showed a high correlation and a really low determinant close to zero (Gorsuch, 1983; Pett et al., 2003; Hair et al., 2009).

With this data supporting the decision of the use of EFA, we proceeded to calculate the Bartlett sphericity test and the Chi2, as well as the MSA values to provide new statistical elements in support for the use of factor analysis (Hair et al., 2009; Barttlet, 1950).

In this way we proceed to the discussion of the result, being the most significant finding the obtaining of a single component whose factorial loads and the proportion of the variance reflected in their commonality (Ψ), explain the 69.4 % of the assimilable variance of the phenomenon that it is studied, that in this case it is the anxiety that students of a Telebachillerato show towards mathematics.

As we can see in table 10, the greater factorial load and consequently the greater proportion of the variance reflected in their commonality (Ψ) is presented in the dimension of anxiety towards the temporality of the exams (ANSITEM, 0.905), followed by anxiety towards numbers and mathematical operations (ANSINOM, 0.899) and anxiety towards evaluation (ANSIEV, 0.893).

This trilogy that makes up the extracted component (to call it so) leads us to think that anxiety is generated within the institution where they are studying, since evaluations and its temporality are present precisely in the classrooms, and in the contents of the mathematics curricula, it is precisely in that context that numbers and mathematical operations are seen.

Likewise, we can point out another data that seem significant to us, and this refers to the lowest of the factorial loads and proportion of variance, represented by the anxiety dimension towards real-life mathematical situations (ANSISIT, 0.540). Apparently that generates less anxiety, that is, they probably do not feel pressure to develop calculation operations in front of their teachers or classmates within their courses. This leads us to think that it is very likely that when the student carries out every-day activities where they interact in some way with numbers, these give them a little more security and independence, or maybe confidence.

However, in the academic discussion aspect, García-Santillán, Mato-Vázquez, Muñoz-Cantero and Rodríguez-Ortega (2016) carry out a comparative study in the morning and evening shift students of the National College of Professional Technical Education (CONALEP) which is also high school level. In their study they identified a component in each of the surveyed populations, which explained 66.74 % in the morning shift and 67.28 % in the afternoon shift, which is considered very acceptable.

In their findings they found that anxiety is more present in the variable ANSIEV and ANSINOM (in both populations) and in the remaining three factors they differ, since the morning shift presents greater anxiety in ANSICOPM, followed by ANSITEM and ANSISIT while the evening shift presents greater anxiety in ANSITEM, ANSISIT and ANSICOPM.

These results are concordant with those of this study, in two of the variables that presented the highest factorial loadings, being these: anxiety towards numbers and mathematical operations (ANSINOM, 0.899) and anxiety towards evaluation (ANSIEV, 0.893). However, in the anxiety variable of real life mathematical situations (ANSISIT), CONALEP students showed a greater degree of importance, which differs from that of this study, where it was the lowest factorial load.

A similar study was carried out by García-Santillán, Edwards-Wurzinger and Tejada-Peña, (2015) who evaluated high school students. In the same way, they obtain a component that explains 76.76 % of the assimilable variance with loads > to 0.8 in each one of the factors.

Finally we can say that, the most significant finding that we could highlight is the validation of the Muñoz and Mato test, used for the study: Although it is an instrument that has shown a high reliability and internal consistency from its design, however the data matrix in this study does not show normal distribution. About this, several studies that has been used with similar results about its internal consistency (García-Santillán et al., 2016, García-Santillán et al., 2016, García-Santillán et al., 2018)

However, in this empirical study it was possible to validate the instrument used with an acceptable internal consistency, but the problem that we face for data analysis was presented at the normality of the database, i.e. the data matrix does not came from a normal distribution.

This fact could prevent to carry out the factorization; however the data matrix was presenting acceptable values in each of the required steps of the exploratory factor analysis, following the recommendations suggested by Méndez and Rondón (2012).

Future lines of research

Finally it is suggested to extend the study by integrating other variables that may be present within the context in which the student develops. For example, the performance they had in the previous grade, that is, an analysis where the academic performance obtained in junior high school and its relationship to the degree of anxiety towards mathematics now that they study high school can be integrated. Another line of research that has been suggested in other studies is the measurement of variables such as the profession and activity of parents; this could explain some behaviors in children.

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