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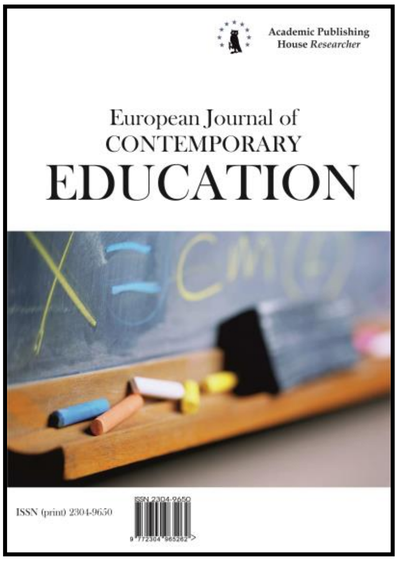

Factors that Explain the Attitude Towards Statistic in High-School Students: Empirical Evidence at Technological Study Center of the Sea in Veracruz, Mexico

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Abstract

The aim of this paper was to analyze attitude towards Statistics in high-school students using the SATS scale designed by Auzmendi (1992). The sample was 200 students from the sixth semester of the afternoon shift, who were enrolled in technical careers from the Technological Study Center of the Sea (Centro de Estudios Tecnológicos del Mar 07 CETMAR 07, for its acronym in Spanish) in Veracruz, México. The participants were selected using a non-random sampling by convenience. The procedure followed was the statistical exploratory factorial analysis by García-Santillán, Venegas-Martínez and Escalera-Chávez (2013), while the data analysis was made using the SPSS Statistics 19 software to analysis the information. The results provide significant evidence to ascertain that there is a component which explains the attitude towards Statistic of high-school students and it has three dimensions: liking, confidence and usefulness. The former leads us to think that there is a factor with an affective, a behavioral and a cognitive part. Hence, the affective component is present when they like working with Statistics; confidence is a behavioral component associated with the disposition and security a subject has when facing Statistic and finally, usefulness as a cognitive component involving beliefs, that is to say, the value a student places on the knowledge of Statistic.

Keywords: Student´s attitudes, high-school students, attitude towards Statistic.

1. Introduction

The phenomenon of academic performance in Mathematics has been a concern for governments and institutions around the world, as it has been the case in the Organization for Economic Cooperation and development (OECD), which has the Program for International Student Assessment (PISA), aimed to measure the performance in Mathematics, Reading and Sciences of 15 year old middle high-school students. In Mexico, the Secretary of Public Education (SEP for its

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acronym in Spanish) has implemented the program National Evaluation of Academic Performance in School Centers (ENLACE for its acronym in Spanish), which is a test applied in elementary and middle-school, measuring Reading comprehension and Mathematics of students enrolled in senior year.

Regarding Mathematics performance, the 2012 PISA test shows critical data, both in Mexico and in the state of Veracruz, since more than half of the surveyed students are below level 2 in a scale from 1 to 6. It is important to mention that men achieve higher scores than women and there are not differences between public and private schools; also, the scores of concern and anxiety are equally worrisome since Mexico reports the highest score among the OECD countries and women present higher anxiety than men (OCDE, 2013; INEE, 2013), as shown in Table 1.

Similarly, the results of the 2013 ENLACE tests applied to senior year students (see Table 2) show that more than half of the students are in the Elemental or Insufficient levels of Mathematics performance (SEP, 2013).

Considering the above, the results from the PISA and ENLACE tests are a reflection of a critical situation existing in the Mathematics education of Mexican students, despite the fact that performance scores in the subject showed an upwards tendency in 2012 and 2013 respectively.

Table 1. Pisa 2012 Results in Mexico

Indicators	**Data**	**Comparison**
Average performance	Mexico = 413 points	OCDE = 494 Latin America (LA) = 397
Placement	Mexico = Last place of the 34 OECD countries	Above LA average, Argentina, Brazil, Colombia and Peru. Underneath: Chile
High performance levels (4, 5 y 6)	Mexico = 4 % of the surveyed students	OECD = 31 % LA = 4%
Low performance levels (below 2)	Mexico = 55 % of the surveyed students	OCDE = 23 % LA = 63 %
High performance levels by federation entity	Veracruz = 3 % of the surveyed students	8 % = Aguascalientes, Nuevo Leon, Queretaro and Chihuahua
Low performance levels by federation entity	Veracruz = 61 % of the surveyed students	70 or more= Tabasco, Chiapas y Guerrero
Mathematics performance by Gender	Mexico = Men achieve highest scores than women	
Mathematics performance by school type	Mexico = students from private schools do not achieve a higher performance than the ones from public schools	
Concern for difficulties in Mathematics classes	Mexico = More than 75 % of students	Mexico has the highest score of anxiety among the OECD countries
Anxiety when facing Mathematics problems	Mexico = Approx. 50 % of students	Mexico has the highest score of anxiety among the OECD countries
Anxiety towards Mathematics by Gender	Mexico = Women report a higher anxiety level than men with the same performance	

Source: elaborated with data from OECD (2013) and INEE (2013)

Table 2. ENLACE 2008-2013 Test Results

Indicators	National		State (Veracruz)	
	2008	2013	2008	2013
Performance levels Excellent and Good	15.6 %	36.3 %	14.2 %	37.8 %
Performance levels Elementary and Insufficient	84.4 %	63.7 %	85.8 %	62.2 %

Source: Elaborated with data from SEP (2013)

Consequently, considering that Statistic belongs to the Mathematics field, it can be stated that by association, its learning process faces the same problem that was stated before and gains relevance being a science that supports other knowledge areas such as Marketing, Accounting, Quality Control, Education, Politics, Medicine, Research and it is definitely of interest for decision making (Ruiz, 2004). Furthermore, this science is now known as "statistical literacy", that is, a statistical culture, understood as an inherent knowledge of the common citizen, regardless of his/her career, social class or educational level. The importance of Statistics is such that there are international organizations and initiatives focused on Statistical education, for instance, the International Association for Statistical Education (IASE) (Estrada, 2002).

The learning of Statistics goes beyond a mere knowledge; viewed from a systemic approach, this involves the integration of a student´s skills, disposition and competence, both as a data creator and interpreter (Gal y Garfield, 1997). In addition, there are other determinant factors such as previous experiences in class, notions acquired outside the classroom and the transference of attitudes from Mathematics to the field of Statistics (Ferreyra, n.d.). Hence, we must considerer that besides transmitting knowledge in the classroom, attitudes are also taught by teachers (Estrada, 2001).

Furthermore, research accounts for the influence of cognitive and non-cognitive factors, among which are attitudes, beliefs, feelings, emotions, interests and expectations (Gal y Ginsburg, 1994 quoted by Ferreyra, n.d.). Even though these terms are implied in each other, attitude stands out as the most encompassing one, being an object of study in Psychology and for which, there is not a consensus regarding its definition.

After reviewing the scientific literature on the subject, two seminal contributions quoted by Estrada (2001) were chosen in this work: on one hand, the broad definition of attitude by Rokeach (1968) as "an organization of several beliefs focused on a specific object or situation, predisposing one to respond in some preferential manner" (p. 371) and on the other hand, the definition by Auzmendi (1992), which is focused on Mathematics and Statistics, conceives attitudes as "aspects that are not directly observable but inferred, made up by beliefs and feelings as well as behavioral predispositions towards the directed object" (p. 372).

So, it can be stated that attitudes are determined by three components: cognitive, affective and behavioral (Darias, 2000) and three elements are identified in the measuring of attitudes: a) the relation subject-object, in this case, student-Statistic; b) the object evaluation by the subject in a cognitive and affective manner; and c) the predisposition of acting in a determined way as a result of the evaluation, involving a behavioral part (García, 2002).

The cognitive component involves the beliefs, that is to say, how objects, people and situations are conceived and perceived; the affective component refers to the feeling of liking and disliking that the object, person or situation causes; and the behavioral is the disposition of reacting in a determined way towards the object, person or situation, as a latent behavioral tendency (Méndez y Macía, 2007).

In the educational field, it is important to know the attitudes of the students towards Statistic, as well as their relationship with statistic performance (Stijn et al., 2006), even more when this subject is referred to as sadistic by the students of Anglo-Saxon universities (Rosenthal, 1992 quoted in Carmona, 2004); hence, Dillon (1982) "has even labeled those students´ feelings as statisticophobia" (Carmona, 2004: 6).

This is the context where a significant research line has been developed around attitude as an influential factor in student´s performance, as one of the two most important subjects in the educational research field, together with learning environment (Mvududu, 2003). Attitude has in McLeod (1992) a relevant author, since his work between 1988 and 1994 "largely contributed to recognize the importance of affective matters and explain the differential effects of attitude predispositions in teaching-learning processes of Mathematics, and therefore, Statistic" (Estrada, 2002: 50).

In scientific literature there are papers addressing the state of the art on research about students´ attitude towards Statistic and the studies that stand out are the works of Estrada (2001, 2002), who analyzes the characteristics of the studies made on the subject, such as population, variables and scales; Carmona (2004) focuses on the evidence of reliability and validity of several instruments and Blanco (2008) accounts the empirical research in Spain and Anglo-Saxon countries. It can be seen that, even though Statistic is as old as writing (Ruiz, 2004), the research on the education of this subject is considered emerging (Estrada, 2002) since it started in the United States in the decade of 1980 (Blanco, 2008) and in the case of Mexico, it was rated as limited by the Mexican Committee of Educational Research (COMIE for its acronym in Spanish) in the year 2002 (Ferreyra, n.d.).

To measure the attitudes toward Statistic, the most used technique has been the scale, for its advantage as an objective instrument to determine differences of liking and intensity regarding a subject and also, the Likert type scale is the most common because it focuses on the subjects (Estrada, 2001). Based on this assumption, there are several measuring instruments used in empirical research, from the seminal work by Roberts and Bilderback (1980) and Wise (1985), whose instruments are the most used, to Auzmendi (1992) and Velandrino and Parodi (1999) who designed instruments in the Spanish language (Carmona, 2004; Estrada, 2001).

Among the studies about attitude towards Statistic, Estrada (2002) mentions the work of Elmore and Vasu (1980, 1986); Garfield (1981); Harvey, Plake and Wise (1988); Schau and colab. (1995); Wilensky (1995, 1997); Silva and colab. (1999); Gil Flores (1999) and Mastracci (2000). On the other hand, Ferreyra (n.d.) identifies the research by Aparicio, Bazán and Abdounur (2004) in Peru; Méndez and Macía (2007) in Chile and Silva, Ferreira, Cazorla and Vendramini (2002) in Brazil.

In addition, there are the studies of Rodríguez (2011) in Argentina; Ferreyra and Organista (n.d.) in México; Vanhoof, Castro, Onghema, Verschaffel, Van Dooren and Van Den (2006) in Belgium; and Mondéjar, Vargas and Bayot (2008) in Spain.

This paper uses the Auzmendi (1992) scale called Scale of Attitudes toward Statistic (SATS) because it is the first instrument known to be designed in Spanish, it is also applicable to high-school students (Estrada, 2001) and it is the most commonly used instrument in Spanish (Carmona, 2004).

The former scales considers five dimensions: 1) usefulness, related to the value a student gives to Statistic; 2) anxiety or fear towards this subject; 3) confidence, as security the subject has when facing Statistic; 4) liking or enjoyment caused by working with Statistic and 5) motivation for the use and study of the subject (Carmona, 2004; Méndez y Macía, 2007).

The SATS scale by Auzmendi has been applied and validated by several researchers internationally, for instance, in Spain there is empirical evidence from Darias (2000) and Tejero and Castro (2011); in Chile from Méndez and Macía (2007) and in Mexico, applications were scarce barely six years ago (Méndez y Macía, 2007), however, interest has risen, as shown by the studies of García, Moreno, Carlos, Zamudio and Garduño (2012); Escalera, García and Venegas (2013); García, Venegas and Escalera (2013) and García, Venegas, Escalera and Córdova (2013). It should be noted that the studies hereby mentioned have targeted college students and no empirical research was found in Mexico regarding the application of attitude towards Statics scales in high-school students.

1.1. Research questions, objectives and hypothesis

Considering the object of study formerly described, it is necessary to know the students´ attitudes first so that performance can be measured, the following questions are posed:

1.- Which is the attitude toward statistic in high-school students of the "Centro de Estudios Tecnológicos del Mar No. 7 (Technological Study Center of the Sea #7) in Veracruz, México.

2.- Which are the dimensions that explain high-school students´ attitude towards Statistic?

In order to respond such questions, the present study aims to analyze the CETMAR 07 high-school students´ attitude towards Statistic based on the factorial structure of the SATS Auzmendi scale. Therefore, based on the hypothesis stated by García-Santillán et al (2013), this study seeks to prove if:

Null Hypothesis HO1: There are no factors that explain the students' attitude towards statistic in high school students in the CETMAR 07.

Alternative Hypothesis HA1: There are factors that explain the students' attitude towards statistic in high school students in the CETMAR 07.

A particular way, the sub hypotheses are:

H1: Motivations is the factor that most explain the variance of model

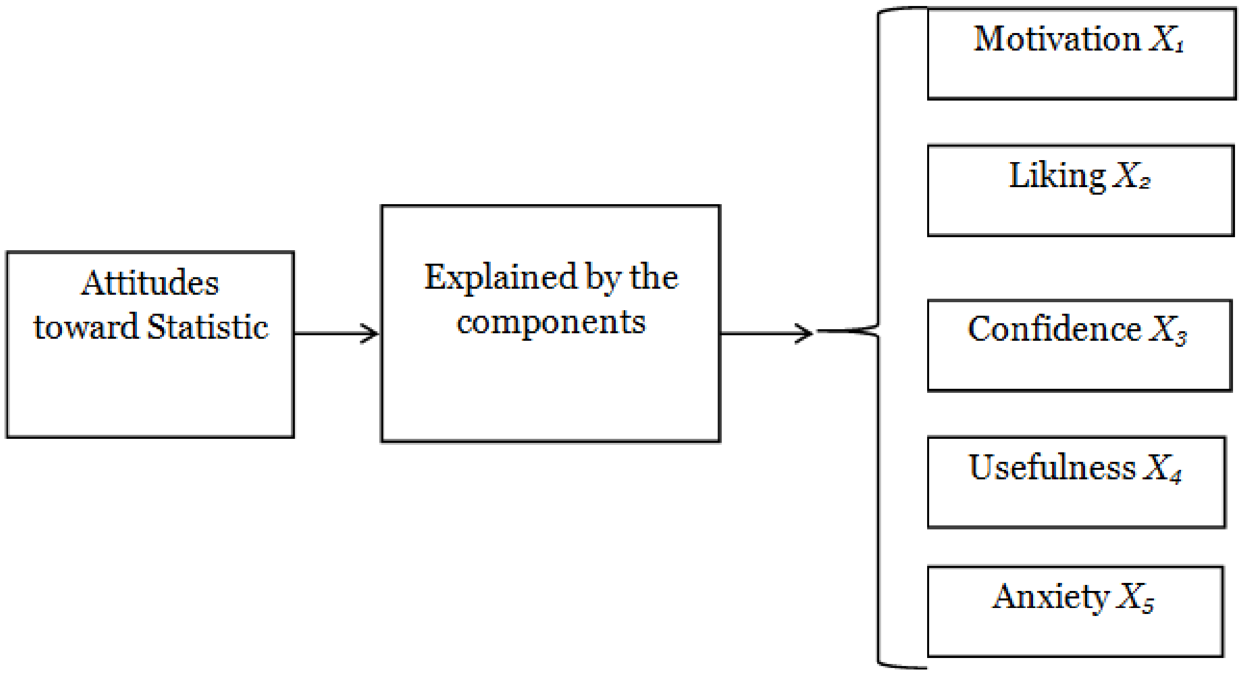
H2: Liking is the factor that most explain the variance of model

H3: Confidence is the factor that most explain the variance of model

H4: Usefulness is the factor that most explain the variance of model

H5: Anxiety is the factor that most explain the variance of model

1.2. Model of Analysis



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2. Methodology

2.1. Research design:

This study was non experimental, ex post facto and transversal cut. The instrument was applied in the classroom of the participants towards the end of the school cycle August-December, 2013 to ensure that the subjects were qualified to answer the questions. The questionnaire was anonymous and the instructions were previously explained. This was a transversal cut study considering it took place in a single time, both the recollection of data from the instrument application and the analysis and interpretation of the results. The study is also explicative since it aimed to measure the student´s attitude toward Statistic from the variables of the scale proposed by Auzmendi (1992).

2.2. Study Population:

The sample size included 200 students, 48 % male and 52 % female from the sixth semester of the afternoon shift (see Table 3) of the Technological Study Center of the Sea (CETMAR 07) in Veracruz, Mexico. The students were enrolled in the following technical careers:

- Port Operation
- Food and Beverage Preparation
- Maritime Water Aquiculture
- Naval Construction and Repair
- Refrigeration and Air-Conditioning

They were selected by a non-random sampling by convenient, based on two inclusion criteria: Access availability and taking the subject Statistic. From a quantitative approach and for a set design, the usefulness of a non-probabilistic sample resides not in the "representativeness" of elements, but in a careful and controlled choosing of the subjects with certain characteristics that were previously defined in the problem statement. It is important to note that the study was carried out at the request of the campus authorities in certain groups of students. Hence, the sample was for convenience. As a result, 200 students were surveyed, 96 women (48 %) and 104 men (52 %) and the data was later collected and analyzed with the SPSS (Statistical Package for Social Science) v.16 software.

2.3. Instrument

The SATS scale of Auzmendi considers five dimensions which comprise five items each one (25 items), as shown in Table 3. The scale it's a Likert type with five response options (Darias, 2000):

Table 3. Dimensions of the Attitude towards Statistics Scale

Dimension	Item
Usefulness	1, 6, 11, 16, 21
Anxiety	2, 7, 12, 17, 22
Confidence	3, 8, 13, 18, 23
Liking	4, 9, 14, 19, 24
Motivation	5, 10, 15, 20, 25

Source: elaborated based on the Auzmendi (1992) scale

Response options: Strongly disagree (1), Disagree (2), Neutral (3), Agree (4) and strongly agree (5).

Regarding the reliability, several studies report high internal consistency scores in terms of Cronbrach´s alpha coefficient, for example 0.90 in Darias (2000); 0.85 in Méndez & Macía (2007); 0.87 in Tejero & Castro (2011); all above 0.80, a recommended value as the minimum acceptable (Hair, 1998). The author reports that the instrument can explain a 60.7 % of the total variance, extracting the dimensions by means of a main components factorial analysis with varimax rotation (Carmona, 2004; Tejero y Castro, 2011).

In order to validate the Auzmendi (1992) scale, Carmona (2004) correlated the instrument with the Statistics Attitude Survey (SAS) of Roberts and Bilderback (1980) and got a value of 0.86 among both instruments, "which shows that it effectively measures the construct of attitudes toward Statistic. With the analog procedure it confirms the multidimensional validity of the different subscales" (Estrada, 2001: 380).

2.4. Statistic procedure

For the evaluation and interpretation of the data collected by the instrument, we follow the procedure by García-Santillán, Venegas-Martínez and Escalera-Chávez (2013), García-Santillán, Rojas-Kramer, Moreno-García, and Ramos-Hernández (2017), Navarro-Ibarra, García-Santillán, Cuevas-Salazar, Ansaldo-Leyva (2017), García-Santillán (2017). Who carried out the statistic procedure Multivariate Exploratory Factorial Analysis to measure the attitude toward Mathematics by replicating the Auzmendi (1992) scale, as well, other scales that measure similar phenomenon of study, such as, RMARS scale of Richardson and Suinn (cited in Navarro-Ibarra et al., 2017).

Therefore, to prove the hypothesis, the following criterion is established: Ho: ρ=0 there is no correlation and Hi: ρ≠0 there is correlation. Hence, the test statistics are: $\chi 2$ and the Bartlett´s test of Sphericity KMO (*Kaiser-Meyer_Olkin*) and the value of the Measure of sample adequacy (MSA) for each variable. Under the null hypothesis, this test statistic is asymptotically distributed by an $\chi 2$ distribution with *p(p-1)/2* degrees of freedom, with a significance level: α= p<0.01 or <0.05, the practical significance of the factorial loading of 0.70 and the statistic establishes loadings higher than 0.55.

Hence, if Ho is true, the own values are one and its logarithm is null, so the test statistic is zero and on the contrary, Bartlett´s test with high values of $\chi 2$ and a low determinant would suggest that there is a high correlation. Considering this, if the critical value: computed $\chi 2$ > tables $\chi 2$, there is evidence for the rejection *Ho* and the decision rule is: Reject Ho if computed $\chi 2$ > tables $\chi 2$, otherwise do not reject.

3. Data analysis and discussion

3.1. Test validation

Before the discussion of the results obtained by means of the SPSS Statistics 19 software, we proceed to analyze the reliability of the applied instrument and its responses with the Cronbach´s alpha coefficient, which measures the internal consistency of the scale and its reliability, that is to say, the homogeneity of the questions, by getting the average of the correlations between all items, from where we can determine the degree in which equal results are obtained by repeatedly applying the instrument to the same subject.

Consequently, said coefficient verifies the quality of the collected data and ensures that the discussion of the results is based in stable and consistent measurements. The more abundant, the reliability analysis is a square correlation coefficient that considers values between 0 and 1, so that the more the value is closer to 1, the higher the reliability; in that sense, Hair (1998) states that a value >0.6 can be accepted even when a respectable reliability is considered from 0.80. Therefore, for the calculation the following formula is applied:

$$\alpha = \frac{N * \overline{r}}{1 + (N - 1) * \overline{r}}$$

Where:

N = Number of items (or latent variables), $\overline{r}$ = is the medium correlation between the items.

The following table shows the results of the 200 studied cases:

Table 4. Cronbach´s alpha reliability statistic tests

Cronbach´s alpha	N of cases	%	Alpha
Valid cases	200	100.0	α= 0.621
Excluded(a)	0	.0	
Total	200	100.0	25 elements
	Usefulness		
	Anxiety		α= 0.218
	Confidence		
Grouped	Liking		5 elements
	Motivation		

a. Elimination based on all the variables of the procedure.
Source: own

As it can be seen in Table 5, the obtained alpha of 0.621 (extended) is acceptable, even when it barely surpasses the theoretical value suggested by the >0.6 criterion (Hair, 1998); thus, it can be stated that the test is valid regarding the consistency and reliability of the instrument.

In order to achieve a higher confidence about the reliability of the applied instrument, Guttman test was applied and the results are shown on Table 5.

Table 5. Guttman reliability

Lambda	1	.596
	2	.692
	3	.621
	4	.682
	5	.642
	6	.764
Number of elements		25

Source: own

Reading the former table, the reliability of the instrument is reasserted because for the 25 analyzed elements, the statistic reports Lambda values between 0.596 y 0.764, meaning that all are above.5

3.2. Data analysis

First, some parameters are evaluated to see if it is considered convenient or not to make this kind of test; for that, the correlation matrix of Pearson, the Kaiser-Meyer-Olkin test and the Bartlett´s test of Sphericity are valued. Table 6 shows the matrix of correlations between variables, where a representative group of variables has a correlation higher than 0.25 (70 %). It can be seen that there is a positive relation between usefulness and liking (*r*=.542), while there is a negative relation between anxiety and confidence (*r* =. 486), that is to say, the lower the confidence, the higher the anxiety.

Table 6. Correlation matrix

Variables	Usefulness	Anxiety	Confidence	Liking	Motivation
Usefulness	1.000	-.118	.428	**.542**	.079
Anxiety		1.000	**-.486**	-.232	.264
Confidence			1.000	.359	-.032
Liking				1.000	-.115
Motivation					1.000

Source: own

Table 7 shows Bartlett´s statistic and the MSA (Measure of Sample Adequacy) values, which corroborate the correlation pattern. It can be seen that the KMO value is an accepted one (0.586) since it is higher than 0.500, as recommended by Hair (1998) and the Bartlett´s test of Sphericity value (α =0.00) is lower than 0.05.

Table 7. KMO values and Bartlett´s test of Sphericity

Kaiser-Meyer-Olkin measure of sample adequacy.		.586
Bartlett´s test of Sphericity	Chi-square	195.33
	approximate	6
	df	10
	Sig.	.000

Source: own

The Measure of Sample Adequacy values are shown on Table 8 and it is possible to see that of the five constructs, one presents values under 0.5, so the variable with lower value is removed and the analysis is run again since all the constructs must have values above 0.5.

Table 8. Anti-image matrix

Variables	Usefulness	Anxiety	Confidence	Liking	Motivation
Usefulness	**.573[a]**	-.124	-.322	-.483	-.135
Anxiety		**.543[a]**	.472	.096	-.258
Confidence			**.616[a]**	-.092	-.085
Liking				**.642[a]**	.148
Motivation				.	**.443[a]**

Source: own

Table 9 shows the correlation matrix once the motivation construct is removed and the variables with more correlation are still usefulness and liking (*r* =.542). The set of variables reaches an acceptable value for the Measure of Sample Adequacy (0.599), the sphericity test is significant and the anti-image matrix values are all above 0.500 (Table 9).

Table 9. Correlation matrix and anti-image matrix values

Correlation matrix				
Variables	Usefulness	Anxiety	Confidence	Liking
Usefulness	1.000			
Anxiety	-.118	1.000		
Confidence	.428	-.486	1.000	
Liking	.542	-.232	.359	1.000
Anti-image matrix values				
	.573[a]	.533[a]	.618[a]	.656[a]
Kaiser-Meyer-Olkin measure of sample adequacy.				0.599
Bartlett´s test of sphericity				173.405
Significance				0.000

Source: own

All the measures indicate that factorial analysis is suiting, for that reason, the component matrix is valued and applying the latent root criterion. As we can see in Table 5 there is only one component, which represents 52.58 % of the total variance of the four constructs.

Also, Table 10 shows that three of the constructs: usefulness, confidence and liking have positive charges and one of them, anxiety, has a negative charge (-0.590). The value of the Communalities demonstrates that the construct with higher variance is confidence (.633).

Table 10. Component and extraction of component factor matrix

Component matrix		
Variables	Component 1	Communalities
Usefulness	.744	.553
Anxiety	-.590	.348
Confidence	.796	.633
Liking	.751	.564

Component extraction		
Eigenvalue	% variance	% accumulated variance
2.099	52.480	52.480

Source: own

4. Conclusions

The results of this research provide significant evidence to ascertain that there is a tridimensional component that explains attitude of high-school students towards Statistic: usefulness, liking and confidence with a factorial loading of 0.744, 0.751 and 0.796 respectively.

However anxiety shows negative charge (-0.590), which leads us to believe that anxiety decreases when the student feels liking, usefulness and confidence toward statistic.

The dimension *liking* is an affective component related to the feeling of liking and disliking, which is understood as the enjoyment of working in Statistics; the dimension confidence is a behavioral component regarding the disposition of reacting in a certain way, and in general terms it is the confidence the subject has when facing Statistics; finally, the usefulness dimension is a cognitive component involving beliefs, understood as the value the student places on the knowledge of Statistics.

The liking and confidence dimensions concur with the results found in the studies of Méndez & Macía (2007); Tejero & Castro (2011); Darias (2000); García-Santillán, Moreno-García, Carlos, Zamudio & Garduño (2012); García-Santillán, Venegas-Martínez & Escalera-Chávez (2013); García-Santillán, Venegas-Martínez, Escalera-Chávez & Córdova-Rangel (2013).

Besides the former studies, the usefulness dimension coincides with the findings of Mondéjar, Vargas y Bayot (2008).

As it can be seen in the findings of this study, the three components of attitude, which have an impact on learning, are present: the cognitive, affective and behavioral, related to usefulness, liking and confidence, respectively. The former, allows to suggest that when high-school students of *Centro de Estudios Tecnológicos del Mar* (Technological Study Center of the Sea) in Veracruz, México. CETMAR 07 perceive the usefulness of the Statistics applications, the liking for the subject increases and when self-confidence decreases when facing Statistics, then anxiety increases.

Hence, it is important that academic authorities of said institution promote learning strategies that involve the approach of students to real cases and experiences of professionals, where they can appreciate the application of Statistics and its positive impact in decision making. Also, we recommend the implementation of simulation practices where the student can face situations that can be analyzed and/or resolved by using Statistics and so, he/she can gain confidence regarding this subject.

Finally we can see that the null hypothesis HO1 it's rejected in terms of $\chi2_c > \chi2_t$, accepting the alternative hypothesis HA1, since it was shown that there are factors that explain students' attitude towards statistic in high school students in the CETMAR 07.

Also, we can see a particular way, that the sub hypotheses:

H1: Motivations is the factor that most explain the variance of model
H2: Liking is the factor that most explain the variance of model
H3: Confidence is the factor that most explain the variance of model
H4: Usefulness is the factor that most explain the variance of model
H5: Anxiety is the factor that most explain the variance of model

The result shows evidence that confidence is the factor that most explain the variance of the model, following of liking and usefulness, therefore the sub-hypothesis H3, H2 and H4 are accepted.

One of the frequent limitations of this type of study is the sample size; hence we suggested continuing the study, integrating as many cases as possible. With this action, more empirical evidence could be obtained to identify the factor or factors that most explain the scale used.

As a future line of research, we suggest extending the study to other universities, especially in those majoring that include mathematics in their curriculum.

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