Anxiety towards Mathematics of Workers in the Production Area of a Sugar Mill in Veracruz, Mexico

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ABSTRACT
The aim of the study was to measure the level of anxiety towards mathematics among workers in the production area of a factory in the sugar industry. In order to carry out this study, the Muñoz y Mato-Vázquez scale was used (2007) and adapted to the working area. 283 workers from the three different shifts (morning, afternoon and night) were surveyed. For the data analysis and the Exploratory Factorial Analysis technique was used. The reliability of the instrument was acceptable (α = .804 and .945), according to Hair, Anderson, Tatham and Black (1991). The results suggest that the worker experiences anxiety during the evaluation process that they perform as part of the procedures in the production area where math calculations are constantly being used, meaning that the working environment causes anxiety toward math. This is related to the insecurity they feel, mainly due to the level of knowledge they have in mathematics, derived from their schooling level.

Keywords: math anxiety, sugar industry, evaluation

INTRODUCTION

The contribution of this study and where its originality lies is the analyzed context, since evidence was not found regarding existing literature about anxiety towards mathematics in sugar mills. This content focuses on a Mexican sugar mill located in the center area of the state of Veracruz. This industry is highly important in Mexican economy and tradition, where situations and facts that happened in this decade make it an interesting and current topic for analysis. Particularly, mills suffer with the shifts in prices, competition from sugar substitutes in the world market and demand from the producers for a higher guarantee price for the raw material.

Nowadays, Mexico is affected by different social conflicts, among the most common ones mentioned in the media are those related to education, which are linked to recent structural reforms, more specifically, the educational reform from the national development plan. This reform was the result of the low performance Mexican students achieved in different areas of knowledge as well as that of teachers who are responsible for educating Mexican future generations.

In this regard, there is the recent evaluation carried out in the Program for International Student Assessment, where a 28 point increase in math performance stands out between 2003 and 2012. Based on these data we can ask ourselves, how do social conflicts affect students’ performance?

Aliaga, Ponce, Gutierrez, Díaz, Reyes, and Pinto (2001) studied the psychological variables related to students’ performance in math and statistics in first and second year students from the Psychology School in San Marcos National University in Peru, based on the research by Hoffman (1996) and Mosquera (1999).
Likewise, it is possible to find in the Mexican context the paper “attitude towards mathematics and mathematics with technology: gender studies in middle-school students” by Sanchez-Ruiz and Ursini (2010), whose research includes four aspects: attitudes towards mathematics, the use of technology to teach math as well as gender and performance in math; the former using as basis the paper “Motivation and ability as factors in mathematics experience and achievement” by Schiefele and Csikzentmihalyi (1995).

In this manner, the topic of attitude and anxiety towards math has been studied in the Mexican context with several students' samples. For instance, a permanent research about attitude towards statistics has been developed in college students García-Santillán, Escalera-Chávez, Rojas-Kramer and Pozos-Texon, (2014); Escalera-Chávez, García-Santillán, and Venegas-Martínez, (2014a); Escalera-Chávez, García-Santillán and Venegas-Martínez, (2014b); García-Santillán, Escalera-Chávez, Rojas-Kramer, Córdova-Rangel and Pozos-Texon, (2016) and in elementary school level García-Santillán, Edwards Wurzinger and Tejada-Peña (2015).

Interesting findings have been reported in high school students about anxiety towards math, especially in anxiety towards evaluation and temporality (Escalera-Chávez, Moreno-García, García-Santillán, & Córdova-Rangel, 2016; García-Santillán, Moreno-García, & Hernández-Utrera, 2014; Moreno-García, García-Santillán, & Cristóbal-Hernández, 2014). Empirical studies about anxiety towards math have also been carried out at college level (García-Santillán, Escalera-Chávez, Moreno-García, & Santana-Villegas, 2016; García-Santillán, Flores-Serrano, López-Morales, & Ríos-Álvarez, 2014; Moreno-García, García-Santillán, Santana-Villegas, & Téllez-Mora, 2015).

Also, regarding anxiety towards math according to gender (Escalera-Chávez, Venegas-Martínez, & García-Santillán, 2016) and when a student starts math courses (Moreno-García, García-Santillán, Santana-Villegas, & Téllez-Mora, 2016). Additionally, about financial math (Rojas-Kramer, García-Santillán, Fuentes-Rosas, Benítez-Moreno, & Córdova-Rangel, 2015) and in the educational software design by college students as product evidence in the financial math teaching process (García-Santillán, Ríos-Álvarez, Portugal-Rincón, Zamora-Lobato, & Pozos-Texon, 2015).

About how technology has influenced the math teaching processes, García-Santillán, Escalera-Chávez, Rojas-Kramer, Moreno-García, and Pozos-Texon, (2016) measured the interaction between math and the computer, the reliability towards the computer, the commitment, the motivation and the perception of technology in the learning process in college education and how a techno-pedagogical model has been adopted. Furthermore, the level of influence from the computer or any other technological device in the math teaching and learning processes has also been measured (García-Santillán, Escalera-Chávez, Rojas-Kramer, Moreno-García, & Santana-Villegas, 2015; García-Santillán, Moreno-García, Ortega-Ridaura, 2016; Rojas-Kramer, García-Santillán, Escalera-Chávez, 2015).

However, there has not been a study about the level of math anxiety or the attitude towards math in workers from a production area in a factory. The existent studies have only been focused in students at different academic levels, so it has become relevant to explore other samples where math is also used as part of people’s daily life activities.

The interest that currently encases the sugar industry – which has been a creator of culture for a long time and gave birth to the first agroindustry in America – is considered an inheritance from colonization by Hernan Cortes who brought in plants from Cuba in 1522 (Hernandez, Valencia, & Hernandez, 2013). Nowadays, sugar factories are the main center where populations grow surrounded by chacuacos and the steam whistling so typical in this kind of industry in Mexico.

The activities assigned for production personnel are related to the ability of using basic math applied to the operational level such as dosage, mixtures and extractions of the process, as well as in maintenance activities where the need of math is way more recurrent due to the different specialties such as measurements and accuracy typical of each activity. Therefore, the openness to math must be such that allows the right comprehension and correct use of it for every routine. Based on the arguments described previously, we have to pose the following question: which is the variables structure that best describes the level of anxiety towards math among the production area workers in a sugar factory production?

We intend to specifically answer the following questions:

Which are the dimensions or factors that better explain the level of anxiety among the workers in the sugar factory?

Considering that the Muñoz and Mato-Vazquez scale (2007) was designed to study the anxiety towards math phenomenon in students, the following concern arises:
Could it be possible to apply the Muñoz and Mato-Vazquez scale to sugar factory workers?

Can the level of anxiety towards math be explained with at least one factor?

From here, the following hypotheses are set:

- **H o1**: There is no group of latent variables to explain anxiety towards math.
- **H i1**: There is a group of latent variables to explain anxiety towards math.
- **H o2**: Anxiety towards math cannot be explained at least by just one factor.
- **H i2**: Anxiety towards math can be explained at least by just one factor.

In order to understand the variables involved from theory, an analysis and discussion about the theoretical and empirical fundaments that have explained anxiety towards math is carried out in the following pages.

**LITERATURE REVIEW**

In order to understand in detail how this theoretical structure about anxiety towards math has been designed for students who are at different academic levels and afterwards to be able to contextualize it to different populations, specifically workers in the production area in a sugar factory, seminal referents are analyzed and discussed next.

Among the seminal referents who have analyzed the topic of anxiety we have Dreger and Aiken (1957) who introduced the term “anxiety towards math” as a variable that allows to describe the difficulties and students’ attitude towards math. It is known that it has been difficult to explain this variable ever since, but at least the phenomenon began to be explained based on the opinions of those who wrote about the topic without even using statistical techniques back then to measure this anxiety to math variable (Wood, 1988).

Later on, studies focused on measuring attitude towards math began to be carried out. For these, surveys that included different factors of the variable were used and this made necessary the use of statistical procedures (Dutton & Blum, 1968). Then, the study of math is next and psychometric scales were designed that integrated dimensions related to beliefs, anxiety and student’s perception towards math.

About the scales developed to measure the phenomenon of anxiety towards math, there is evidence in literature ever since 1957 with Dreger and Aiken works, to whom one of the first instruments of numerical anxiety is attributed; after them in 1972 Richardson and Suinn designed the Mathematics Anxiety Rating Scale (MARS); then the Fennema-Sherman Mathematics Attitude Scale (1976) is developed. Following this same idea other scales were designed: the Mathematics Anxiety Scale by Sandman (1980) and the Math Anxiety Questionnaire by Wigfield and Meece (1988).

There is evidence in the consulted bibliography about the abbreviated version of the MARS scale, which was developed in other studies by Levitt and Hutton (1984); Rounds and Hendel (1980); Plake and Parker (1982); Alexander and Martray (1989). It was later used in Suinn and Winston works (2003) who created 30 items from Rounds and Hendel works (1980), Alexander and Cobb (1984), Alexander and Martray (1989). The 30 items gathered were measured through the analysis of principal components with crosswise rotation, from which two factors were obtained that represented 70.3% of variability of the total number of items of the MARS scale. The math anxiety test represented 59.2% of variance; meanwhile numerical anxiety represented 11.1% of variance.

In this specific case of the MARS scale and its psychometric properties, a wide research has been developed (Camp, 1992; Capraro, Capraro, & Henson, 2001; Drew, Galassi, & Galassi, 1984; Resnick, Viehe, & Segal, 1982; Richardson & Suinn, 1972; Rondas & Hendel, 1980; Strawderman, 1985; Suinn & Edwards, 1982). But further studies, which turned out to be really important, are about the deficiencies of the instrument and the underlying construct which turns out to be unidimensional (Richardson & Suinn, 1972; Suinn, Edie, Nicoletti, & Spinelli, 1972). Other studies revealed that there could have been more than one underlying construct of math anxiety (for instance, Alexander & Cobb, 1984; Alexander & Martray, 1989; Brush, 1981; Ferguson, 1986; Plake & Parker, 1982; Resnick et al., 1982; Rondas & Hendel, 1980; Satake & Amato, 1995).

Ling (1982) studied the validity of anxiety towards math as a multidimensional construct and his findings took him to obtain six factors (personal effectiveness; assertiveness; fear towards math; extroversion; success and dogmatism) which represent the 76% of the total variance. Besides, Bessant (1995) showed in his study that 43% of the variance in the MARS scores is explained by six factors: anxiety towards the general...
evaluation, daily numerical anxiety, anxiety towards passive observation, anxiety towards performance, anxiety towards math tests and anxiety to problem solving.

Kazelskis (1998) studied the factorial structure of the three scales on math anxiety that have been used the most: the RMARS (Alexander & Martray, 1989) the Mathematics Anxiety Questionnaire (MAQ; Wigfield & Mece, 1988) and the Mathematics Anxiety Scale (MAS; Fennema & Sherman, 1976). Applying the exploratory factorial analysis with principal components extraction and crosswise rotation, he got six dimensions of math anxiety that represented 61% of the total variance.

Bowl and Brady (2002) apply the principal components analysis with Varimax rotation to 357 high level education college students and found three factors that explained the 73% of variability in the RMARS scores, the three factors were named: anxiety towards the math test (11 items), anxiety towards the math course (8 items) and anxiety towards numerical homework (4 items).

Studies about math anxiety became particularly relevant to those researchers on the topic. For instance, to prove the recurrent validity of the RMARS instrument, the MAS Attitude Fennema-Sherma scale was used (1976) and its results showed there are no negative relations which means that students who had more favorable attitudes towards math experienced less math anxiety (Alexander & Martray, 1989). Besides, Moore, Alexander, Redfield and Martray (1988) found a moderate to high correlation between the RMARS and the MAS scale (Fennema & Sherman, 1976), the Anxiety State-Feature Inventory (Spielberg, Gorsuch, Lushene, Vagg, & Jacobs, 1983) and the Anxiety Test Inventory (Spielberg, 1980).

Moore et al. (1988) also found that the RMARS scores correlated significantly with the Mathematics American College Testing scores and the math course grades. On this same idea, Alexander and Martray (1989) also found that the factors of the RMARS scale discriminate between students from secondary school who took geometry and algebra courses and those who did not, and the results were: the students who took a geometry and algebra course at school experienced way less anxiety towards math compared to those who did not take those courses.

In another study, Sanchez-Ruiz and Ursini (2010) carried out a research with secondary students establishing as its main objective to know the attitudes towards math among Mexican students in middle-school and in different contexts. They assumed that the sociocultural and contextual factors are decisive in attitudes, which lead them to the conclusion that Mexican secondary school students’ attitude is modified gradually during their secondary education.

No relation between attitude and performance was found, however, self-confidence is linked to performance. Gender does not influence attitude and performance, but it does influence the referents used to justify them. They highlight the influence that attitude and performance in math encases the teacher and student's attitude.

In other recent studies, such as the one of Fernandez and Lahiguera (2015) in which they carry out a research among elementary school students in rural areas. They applied a learning method based on what they identify as “Matemagia” which changes the environment in the classroom and allows to improve the learning outcomes using magic tricks as resources, besides promoting curiosity, creativity and critical thinking. In their study, they stick to the hypothesis that math classes are scarcely motivating due to the traditional work routines. They are basically based on a text book and in mechanical execution of math operations, as well as the teacher’s explanation. In another hypothesis they show that the desire the student has for learning is promoting curiosity as well as motivating the students to get their attention. They conclude that the surroundings, being rural in this case, are not a learning factor as it would be the one related with teaching and the effects on the attitude of students and teachers towards math.

Later on, Garcia-Santillan, Escalera-Chavez, Moreno-Garcia and Santana-Villegas (2015) carried out a study to determine the factors that explain anxiety towards math. In order to do so, they use the scale designed by Muñoz and Mato-Vazquez (2007), which was applied to college students from different bachelor degrees. The questionnaire is made up of 24 items divided in five factors or dimensions: “anxiety towards evaluation” (11 items), “anxiety towards temporality” (4 items), “anxiety towards understanding of mathematical problems” (3 items), “anxiety towards numbers and operations” (3 items), and “anxiety towards mathematics in real life” (3 items). The component extracted picks a self-value that explains 74% of the variance from the scale scores.

Based on the arguments previously described it is possible to state that the environment in classrooms during the first years of education is a detonator for the comprehension of math fundamentals. As academic
advance in middle education level happens, self-confidence, anxiety and the referents used by students are the reason of academic progress. The student who reaches college level has conscience and auto regulation characteristics and authors coincide overall, that the teacher plays the most important role in the perception of math. With these fundamentals we describe the methodological design, analysis and results from this present research.

**METHODOLOGY**

It is a non-experimental, transactional and exploratory study originated from the need to know the level of anxiety towards math that thrives among the workers of the sugar factory and represents an empirical approximation to the phenomenon of anxiety towards math.

The sample selected was non-probabilistic sampling, we consider as population the total number of workers that make up the personnel being 600 workers who are the base of operation and maintenance in the production during the Zafra 2015-2016, out of which 82 belong to restricted areas departments. Therefore, we could identify a population of 518 elements available to be surveyed, as long as they comply with the inclusion criteria indicated below (see Table 1).

**Table 1.** Department distribution of personnel and minimum number for sampling

| Department             | Zafra workers | Shakes | 1 | 2 | 3 | 4 | Total | %       | Sample |
|------------------------|---------------|--------|---|---|---|---|-------|---------|--------|
| Batey                  | 32            | 8      | 8 | 8 | 8 | 32 | 6.18% | 14.0    |
| Mills                  | 57            | 19     | 19| 19| - | 57 | 11.00%| 25.0    |
| Clarification          | 36            | 12     | 12| 12| - | 36 | 6.95% | 16.0    |
| Evaporation            | 24            | 8      | 8 | 8 | - | 24 | 4.83% | 11.0    |
| Crystallization        | 58            | 18     | 18| 18| 4 | 58 | 11.20%| 26.0    |
| Centrifugation         | 37            | 11     | 11| 11| 4 | 37 | 7.14% | 16.0    |

Drying and packaging

| Sugar handled          | Restricted access |
|------------------------|--------------------|
| Laboratories           |                    |
| Boilers                | 89                 |
| Power plant            | 34                 |
| Environmental sanitation| 5                 |
| General services       | 13                 |
| Internal workshop      | 11                 |
| Buildings maintenance  | 20                 |
| Stock materials        | 20                 |
| Mechanical maintenance | 70                 |
| Industrial security    | 7                  |
| Instrumentation        | 14                 |
| Total                  | 518                |

Source: elaborated based on daily working attendance data

The sample calculation for finite populations gave us 230 workers to survey (Table 1). To secure the sample against a possible bias due to the rejection of some instruments badly edited or answered, we applied the instrument to 302 people from the different shifts in the sugar factory La Gloria, S.A. Of all the cases, only 283 were valid since 19 questionnaires (3.71%) were invalided for not having completed all the answers. Of all the cases we could learn that 264 were male (93.29%) and 19 female (6.71) all with an academic average of 10.3 years equivalent to the first year of high school and only 2 people (0.66%) with illiteracy. The research was carried out on the first 13 days of January, 2016.

Inclusion criteria

- Must be working personnel from the sugar factory mentioned.
- Must answer the questionnaires entirely on the different scales.
- Must be working in the manufacturing departments on the dates the surveys are applied.
- Written acceptance by the survey respondent, to answer all the questionnaires.
- Must work in an area of non-restricted access.

Source: elaborated based on daily working attendance data

[Table 1]: 230

http://www.iejme.com
The instrument used was the anxiety towards math scale proposed by Muñoz and Mato-Vazquez (2007), which previously explained in the literature review, and it is made up of 24 items integrated in five dimensions. The dimensions are represented the following way: Anxiety towards evaluation (X1ANSIEVAL), anxiety towards temporality (X2ANSIETEM), anxiety towards the understanding of mathematical problems (X3ANSPROBM), anxiety towards numbers and operations (X4ANSINUOP), and anxiety towards mathematics in real life (X5AMSIMATV). The scale is a Likert kind, with values ranging from: SN= never (1), PV= rarely (2), N= neutral (3), MV= usually (4), SM= always (5). Each dimension incorporates the items shown on Table 2:

Table 2. Anxiety towards math scale

| Codes       | Dimensions                               | Items                        |
|-------------|------------------------------------------|------------------------------|
| X1ANSIEVAL  | Anxiety towards evaluation               | 1,2,8,10,11,14,15,18,20,22,23|
| X2ANSIETEM  | Anxiety towards temporality               | 4,6,7,12                    |
| X3ANSPROBM  | Anxiety towards the understanding of math problems | 5,17,19                  |
| X4ANSINUOP  | Anxiety towards numbers and math operations | 3,13,16                  |
| X5AMSIMATV  | Anxiety towards math in real life         | 9,21,24                     |

Source: from Muñoz and Mato-Vazquez (2007)

The rejection and/or acceptance of null hypothesis criterion (Ho) establishes: rejecting the null hypothesis (Ho) if the calculated $x^2$ is larger than the theoretical $x^2$. Besides, the propriety of the factorial technique is justified based on the values of the Bartlett sphericity test $KMO>0.7$; $x^2$ with $n$ (df), values $MSA>0.5$; $\sigma <0.01$.

Results Analysis

The data obtained in the field were processed in the SPSS v. 19 software, where the results obtained are as follows:

**Instrument validation**

The value obtained from the Alfa Cronbach was 0.945 (individual items) and 0.804 (items grouped by dimension), which detonates an acceptable internal consistency. This coefficient measures the correlations among the items from the instrument, the minimum acceptable value is 0.70 (Oviedo and Campo-Arias, 2005).

**Properties of the factorial technique**

To validate the statistical technique used, the first criterion was the Bartlett and Kaiser sphericity test, the value of $x^2$ with $n$ df and sig. <0.05 (Hair et al., 1998). The values obtained are shown on Table 3.

Table 3. Bartlett test of sphericity with KMO

| Kaiser-Meyer-Olkin Measure of Sampling Adequacy | 0.872 |
|------------------------------------------------|-------|
| Approx. Chi-Square                              | 1066.284 |
| df                                              | 10 |
| Sig.                                            | 0.000 |

Source: own with sample data

The $KMO$ value obtained of 0.872, the $x^2$ value 1066.284 with 10 degrees of freedom and the statistical significance 0.000 exceed the theoretical values threshold, so it can be concluded to this point that the statistical technique for the data analysis is right and besides there is evidence of the $Ho$ rejection. Besides Table 4 shows the correlations matrix where you can see the determining value (0.022) that is close to zero, which indicates the correlations presence is high, characteristic of the use of this technique.

Table 4. Correlations matrix

| Variables | X1 ANSIEVAL | X2 ANSIETEM | X3 ANSPROBM | X4 ANSINUOP | X5 AMSIMATV |
|-----------|-------------|-------------|-------------|-------------|-------------|
| X1ANSIEVAL| 1.000       |             |             |             |             |
| X2ANSIETEM| .838        | 1.000       |             |             |             |
| X3ANSPROBM| .759        | .716        | 1.000       |             |             |
| X4ANSINUOP| .794        | .806        | .667        | 1.000       |             |
| X5AMSIMATV| .578        | .532        | .578        | .443        | 1.000       |

a. Determinant = 0.022

Source: own with sample data
The values of Measure Sampling Adequacy per variable (MSA) observed in the anti-image matrix of table 5 tend to be 1 with its lowest value at 0.841 and the highest at 0.909, being these values pretty acceptable in theoretical terms, confirming that factorial analysis is adequate for the explanation of the studied phenomenon.

**Table 5.** Anti-image matrix

| Anti-image Covariance | X1 ANSIEVAL | X2 ANSIETEM | X3 ANSPROBM | X4 ANSINUOP | X5 AMSIMATV |
|-----------------------|-------------|------------|-------------|-------------|-------------|
| X1ANSIEVAL            | .213        |            |             |             |             |
| X2ANSIETEM            | -.092       | .235       |             |             |             |
| X3ANSPROBM            | -.086       | -.043      | .374        |             |             |
| X4ANSINUOP            | -.082       | -.108      | -.033       | .298        |             |
| X5AMSIMATV            | -.071       | -.034      | -.121       | .046        | .611        |

| Anti-image Correlation | .847a | .855a | .909a | .867a | .903a |
|------------------------|-------|-------|-------|-------|-------|
| X1ANSIEVAL             |       |       |       |       |       |
| X2ANSIETEM             | -.410 |       |       |       |       |
| X3ANSPROBM             | -.304 | -.145 |       |       |       |
| X4ANSINUOP             | -.326 | -.408 | -.099 |       |       |
| X5AMSIMATV             | -.196 | -.091 | -.254 | .109 |       |

Measures of Sampling Adequacy (MSA)

Source: own with sample data

With the values obtained previously (Tables 3, 4 and 5) and once validated the factorial technique there is evidence that a group of variables exists that acknowledge and explain the level of anxiety in the studied participants, from here, these are rotated with Varimax and the obtained components are extracted, which will tell the total of the variance that explains the studied phenomenon.

On Table 6 the obtained factorial weights are shown for each one of the dimensions in the scale used, as well as the variance proportion for each factor represented for their communalities and whose sum represents the self-value and the total percentage of the variance explained. Besides we can see that the only component extracted has factorial weights of > a 0.5 of each one of the five factors.

**Table 6.** Component matrix, communalities and variance

| Factors               | Component 1 | Communalities |
|-----------------------|-------------|---------------|
| X1ANSIEVAL            | 0.931       | 0.867         |
| X2ANSIETEM            | 0.914       | 0.836         |
| X3ANSPROBM            | 0.867       | 0.751         |
| X4ANSINUOP            | 0.872       | 0.761         |
| X5AMSIMATV            | 0.705       | 0.497         |

Eigenvalue | 3.711255
Total variance | 74.240 %
Source: own with sample data

As you can see on Table 6 and 7, the eigenvalue of 3.711255 corresponds to the sum of the communalities of each of the factors X1ANSIEVAL, X2ANSIETEM, X3ANSPROBM, X4ANSINUOP and X5AMSIMATV, same self-value that shows 74% of variability of the anxiety phenomenon present in the production area workers of the sugar factory who are being studied.

**Table 7.** Explained variance matrix

| Component | Initial self-value | Extraction Sums of Squared Loadings |
|-----------|--------------------|-------------------------------------|
|           | Total | Variance % | Cumulative % | Total | % de variance | % acumulado |
| 1         | 3.712 | 74.240     | 74.240       | 3.712 | 74.240        | 74.240       |
| 2         | 0.622 | 12.445     | 86.685       |       |               |             |
| 3         | 0.317 | 6.333      | 93.018       |       |               |             |
| 4         | 0.193 | 3.856      | 96.875       |       |               |             |
| 5         | 0.156 | 3.125      | 100.000      |       |               |             |

Source: own method: Main Component Analysis

Source: own with sample data
As it can be observed, the extracted component composition detonates in its values the presence of factorial weights over 0.5 in each of the dimensions, being X1ANSIEVAL (anxiety towards evaluation) the one with the highest weight (0.931), X2ANSIETEM (anxiety towards temporality) with a factorial weight slightly below (0.914), in a second group with lower values but important as well, we can find X4ANSINUOP (anxiety towards numbers and operations) with (0.872), and X3ANSPROBM (anxiety towards the understanding of mathematical problems) with (0.867), finally the component with the less factorial weight is represented by X5AMSIMATV (anxiety towards mathematics in real life) with (0.705).

**Importance of the Study**

It is possible to derive some collateral research paths from this study, which could respond to the following questions:

Empirical works that deal with the topic of anxiety towards math in different kinds of populations other than academic were not identified in the literature, this is, workers in a given company or factory, neither public nor private.

The importance of developing empirical studies in this kind of populations different from academic ones contributed to the study of this phenomenon and provides evidence that enriches the empirical and theoretical body that explains this symptom of anxiety towards math. One of the dimensions even refers specifically to anxiety towards real life situations where the use of math is present.

Mexican blue-collar workers usually have an elementary or secondary education level, they occasionally have a high school diploma and very few have a bachelor degree diploma. The blue-collar employee who needs to work a daily basis for his survival, will likely have no time to keep on studying a technical career, given the fact that work shifts are really exhausting. Hence, the result of this work will be of great interest for discussion as well as in comparison with other documented findings from other empirical studies carried out in different populations.

This work could be easily related with the research that was the basis for this study, since the population surveyed have had the chance to finish their middle basic education (secondary), therefore they were exposed to environments that could have influenced their academic progress in math as García-Santillán et al. mentions (2015) when showing that anxiety is a factor that prevents students from having a good performance during the learning process.

**CONCLUSIONS**

Based on the results obtained after the information analysis in the study carried out with operational personnel from the production area of the sugar factory, we got enough evidence to conclude that there is a group of variables that allows us to explain math anxiety among the operational personnel of the sugar factory.

On the contrary, with the values obtained from calculated X2 with n degrees of freedom, higher than theoretic X2, as well as the value of Bartlett’s test of sphericity (> 0.8) and statistical significance < 0.000 provide support for this rejection, which leads us to thing that there is in fact a set of variables that can explain anxiety towards math in the operation personnel of the sugar factory.

As a summary, we can answer all the questions with the following information:

To the question, which are the dimensions or factors that better explain the level of anxiety among the workers in the sugar factory? The result indicates that the five dimensions in the Muñoz and Mato-Vazquez scale (X1ANSIEVAL, X2ANSIETEM, X3ANSPROBM, X4ANSINUOP and X5AMSIMATV) gives us an eigenvalue of 3.711, equivalent to 74% of the variance of the phenomenon studied. Regarding the question, would it be possible to apply the Muñoz and Mato-Vazquez scale to a population of workers in a sugar factory? We can also point out that the afore-mentioned scale gives us a high reliability index in the data collected with such instrument. (Cronbach’s alpha is 0.945 in the individual items and 0.804 in the grouped factors per dimension).

In the Varimax rotation and components extraction, we got a factor that collects the factorial weights of the five dimensions (X1ANSIEVAL 0.931; X2ANSIETEM 0.914; X4ANSINUOP 0.872; X3ANSPROBM 0.867; X5AMSIMATV 0.705) which answers the question about how the level of anxiety towards math can be explained with at least one factor. We can point out convincingly that it can be explained by just one component factor as it is described in Tables 6 and 7.
Consequently, we could reject the null hypothesis Ho1 that points out the non-existence of a group of variables that allows to explain the anxiety towards math among the workers in the production area and in the same manner, the Ho2, which denies that anxiety can be explained with at least one factor, is rejected as well. In both cases, the alternative hypothesis could be proved since the dimensions of the anxiety variable in the Muñoz and Mato-Vazquez scale structure do constitute a group of variables that explain the variability of the factorial scores of anxiety towards math among the workers in the sugar factory; also, one component with factorial weights over > 0.5 was made.

The goal set in the research is achieved by identifying the structures of the variables; moreover, the factors that better explain the level of anxiety among workers in the sugar factory correspond to the anxiety towards the evaluation with a factorial weight of 0.931 and anxiety towards temporality with a factorial weight slightly below 0.914.

We can say that the scale indicators are related with the results obtained in the tasks the worker performs in the production area with a permanent supervision from an observer, which is part of the evaluation process of the procedures carried out; added to this lack of confidence from the worker in relation to the knowledge he has about the necessary math calculations for the evaluation, and complemented with the temporality that involves the moment of making the necessary calculations to perform a task and possible future responsibilities, this allows us to deduce that the working environment influenced by the applied leadership style could be held accountable for the current anxiety that the production are worker in the sugar factory presents.

**Other Possible Research Paths**

It is possible to derive some collateral research paths from this study, which could respond to the following questions:

- How is working productivity affected by the remnants that math has left in the worker based on their highest academic level reached?
- Do trust and the kind of leadership applied have a direct relationship with the anxiety towards evaluation and temporality levels?
- How has school environment influenced workers in determining the kind of activity done inside the factory?

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No potential conflict of interest was reported by the authors.

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