European Proceedings of
Social and Behavioural Sciences
EpSBS
www.europeanproceedings.com
e-ISSN: 2357-1330

DOI: 10.15405/epsbs.2021.06.7

CIPE 2020
III CONGRESO INTERNACIONAL "PSICOLOGOGIA EN LA EDUCACION"

ANXIETY TO MATHEMATICS AND ITS RELATIONSHIP WITH MATHEMATICAL LEARNING

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Abstract

Investigating anxiety to Mathematics and its relationship with mathematical learning is reaching greater depth and importance thanks to the findings obtained by Cognitive Neuroscience, contributions that guide us to understand how the brain works when it works with numbers, contributions that guide decision-making to improve the inter-learning of Mathematics and that of fractions, which is a content that presents difficulty for students to learn. The study investigated anxiety to mathematics and knowledge of fractions in 6th and 7th year students of basic education from a public educational institution in the province of Pichincha; it was a non-experimental, cross-sectional, descriptive correlational study, 330 male and female students participated, whose average age was 11 years 8 months. The proposed hypothesis was the existence of a correlation between anxiety to mathematics and learning fractions, as conclusions it was observed that of the 330 students, 207 presented anxiety to mathematics and 123 did not, these 207 participants were on the scales NAAR (Does not reach the required learning) and PAAR (close to reaching the required learning). In addition, it was evidenced that when students compared fractions with congruent common components, a greater number of students were located on the AAR (Achieve Required Learning) and DAR (Master the Required Learning) scales, in this research the male sex presented a higher number of students with anxiety to mathematics than female sex.

2357-1330 © 2021 Published by European Publisher.

Keywords: Anxiety to Mathematics, basic education, comparison of fractions, mathematical logical thinking

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https://doi.org/10.15405/epsbs.2021.06.7
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eISSN: 2357-1330

1. Introduction

Mathematics is often considered as a complicated subject of learning due to the complexity of its content that is progressive and systematic, scientific evidence reports that not all obstacles to inter-learning of this subject are caused by cognitive difficulties, since there is a large number of children and adults experience feelings of anxiety, anguish, restlessness or worry, when they carry out mathematical learning processes, an emotional state that develops a series of subjective reactions to an experience that in turn is related to physiological and behavioral changes , they have the capacity to feel or experience emotions, however, they differ in their frequency developing considerably negative attitudes, triggering a high level of anxiety in mathematics (Hembree, 1990; Papalia et al., 2005).

The researcher Tobias (1978) reported for the first time the presence of levels of anxiety to Mathematics in the students of this subject, based on this finding, the subject is of interest to scholars who reported that the effects of this subject can be considered as a serious inconvenience that affects the world in a similar way despite respecting the characteristics of each country (Ashcraft, 2002; Beilock et al., 2010; Maloney & Beilock, 2012). A report made by PISA in 2012 showed that 33% of the students from 65 countries who participated in the research and whose average age was 15 years, expressed that they felt helpless when solving mathematical problems (OECD, 2013).

Anxiety to Mathematics is considered a serious problem worldwide, research carried out in the USA reveals that the levels of anxiety to Mathematics range from moderate to high, the studies also allowed to determine that 25% of the students at the university level and 80% at the secondary education level presented anxiety to Mathematics, results that guided this First World Country to declare it as a serious problem for the educational field, which had to be solved urgently due to its importance that it has the inter-learning process for the progress of its country, more than for any other country in the world (Chang & Beilock, 2016).

1.1. Theoretical Framework

The researchers Ashcraft and Ridley (2005) is one of the most influential authors in this field, who explained how "the American culture abounds with attitudes that promote mathematical anxiety", the most outstanding American researchers on the subject of mathematical anxiety, emerged for the attempt to find solutions to this serious problem at the national and global level. Currently, there is an impulse at the global level to carry out scientific studies in this field of research in response to the growing problems of modern society in the interlearning of Mathematics (Ersozlu & Karakus, 2019).

One of the basic tasks in the inter-learning process of fractions is to compare two of them to decide which has a higher numerical value. Evidence indicates that students with a basic level of knowledge of fractions are predisposed to compare the components of separate fractions (numerator with numerator and denominator with denominator), instead of comparing the numerical values of both fractions; generating that the students could obtain correct answers when comparing 4/9 with 7/9 or 1/3 against 5/7, but they would develop incorrect answers when comparing 2/5 with 2/7 or 4/9 with 2/3, situation that occurs because they do not work with the fraction as a whole but only with its parts (Gómez et al., 2014; Gómez & Dartnell, 2015).

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This mathematical notion in fractions is called congruence and the pairs of fractions such as those listed above are known as congruent and incongruent respectively, the relevance of this variable in the interlearning of fractions is supported by studies in adult, adolescent, and child populations, investigations where it is observed that that respondents answer to congruent questions more accurately and quickly than to questions that contain incongruent fractions (Branje et al., 2018). Research indicates that one of the main causes of the variation in the level of learning and academic performance in Mathematics or in other areas of knowledge, are caused by emotional states; affirmation that is supported by the findings that show that most of the learning problems that develop in basic education have an emotional origin and if it is possible to balance the intellectual quotient with the emotional quotient, better results could be achieved in academic performance (Fernández & Sánchez, 2013).

School anxiety is defined as a set of cognitive, psychophysiological and motor responses that an individual emits in situations evaluated as threatening, dangerous or ambiguous, although objectively they are not, the negative consequences in the short and long term when an educator presents anxiety is that it affects school performance, an affective block that could arise due to the lack of an adequate method of inter-learning in Mathematics or the absence of adequate representations to solve problems (Auzmendi, 1992).

That is, at high levels of anxiety, it could possibly lead to making mistakes, since memory processes intervene, making concentration difficult and in general alters the psychological functioning of the student, affecting the performance of any activity that requires attention and concentration (Contreras et al., 2005). Findings guide that mathematics anxiety is a negative affective reaction-action process that a student experiences when performing exercises with numbers, develops mathematical calculation problems, processes that develop sensations of tension that hinder the development in learning arithmetic and hence Mathematics (Eden et al., 2013; Richardson & Suinn, 1972). The students who present anxiety to Mathematics show lower levels of confidence in their mathematical abilities, both constructs are negatively correlated (Ashcraft & Ridley, 2005; Bursal & Paznokas, 2006).

Studies show that there are differences between levels of anxiety according to sex, thus they investigated the presence of anxiety to Mathematics in primary and secondary school students, finding that girls presented higher visible symptoms of nerves, tension and discomfort than boys (Wigfield & Meece, 1988). Other research conducted on high school students reported that women have higher levels of anxiety than men (Eden et al., 2013; Fennema & Sherman, 1976). There is evidence that in teachers, adults and adolescents that anxiety to mathematics affects other cognitive abilities in a negative way, in addition, anxiety to mathematics generated by learning fractions negatively influences reading speed and comprehension, and in some cases it affects in the IC performance of the WAIS test (Hopko et al., 1998; Hopko et al., 2005; Venkatesh & Karimi, 2010).

Mathematics anxiety affects emotions and consequently Mathematics learning (Palacios, 2016) a study carried out by PISA in 2012, indicates that the countries where students had higher levels of anxiety, also their performance academic was less good. The report also indicates that one in three students becomes nervous when they have to solve a mathematical problem and in almost all the participating countries, women presented higher levels of anxiety to mathematics than men (OECD, 2013).

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Anxiety to Mathematics is directly related to the perceptions that the students have about their possibilities to solve exercises or mathematical problems and / or when taking an assessment, presenting anxiety reactions that develop low performance, despite the presence of anxiety decreases as feelings of self-efficacy, efficiency and effectiveness improve because it increases personal security, allowing the resolution of evaluations to present better scores improving their performance (Nortes & Nortes, 2014).

For Perina (2002) the claims made that the female sex presents higher levels of anxiety to mathematics than men, could be because women are more likely to feel anxiety and not because they are necessarily more anxious, the differences in levels of anxiety to Mathematics by sex were and are investigated trying to cover all educational levels (Ashcraft & Ridley, 2005). It should be considered that there are some findings in male and female secondary school students in which the works report differences in levels of anxiety to Mathematics according to sex, but in these findings, greater anxiety is characterized in men than in women (De la Torre et al., 2009; Eden et al., 2013; Valero, 1999).

For the researcher Maroto (2015) emotions, beliefs and attitudes are transcendental components to: a) Determine what could be the mathematical procedure that future teachers will use, b) Establish how these 3 components influence the Mathematical learning, c) Understand what is the maneuver of the 3 components when it works as a regulatory system, d) Be used as an indicator in the context of inter-learning, e) Influence as inertial forces or resistance to change and f) Function as a vehicle of knowledge. Research carried out confirms the importance of studying how affective control contributes to the interlearning of future teachers (Caballero, 2013; Gómez-Chacón, 2016; Marbán et al., 2016; Nortes & Martínez, 1996; Pérez-Tyteca, 2012; Pérez-Tyteca et al., 2013; Sánchez et al., 2011).

The researchers Palacios et al. (2013) consider that anxiety to mathematics is a feeling of tension and / or fear that leads to presenting behaviors that are not well analyzed and assertive when operating with numbers, evidence that is supported by the study from a sample of 1064 students with a mean age of 13 years and 8 months (53% were male and 47% were female), it was also concluded that the higher the level of anxiety, the lower the mathematical performance of the learners and that the presence of anxiety is one of the indicators for the presence of school rejection.

Another investigation considered evaluating the levels of anxiety depending on the degree to which the situation of the evaluation (written test) is perceived as threatening for the learners, the results oriented that men face the evaluation processes as a challenge, implying that they do not perceive whether or not they are unable to operate mathematically, on the other hand, women face the evaluation situation as threatening, demonstrating behavior influenced by the presence of anxiety (Rosario et al., 2008).

Research indicates that a large number of people have extremely negative attitudes to mathematics, which may possibly lead to severe anxiety (Ashcraft, 2002; Hembree, 1990; Maloney & Beilock, 2012). Another investigation stated that parents who present high levels of anxiety to Mathematics influence that their children can also develop it (Maloney et al., 2015). On the contrary, there are other investigations that show that, if parents constantly support developing high expectations in their children, they would reduce their anxiety levels, increasing their achievement in mathematics (Vukovic et al., 2013).

Findings guide that, if teachers and parents increase the levels of motivation to mathematics of students who present levels of anxiety, supporting them in the analysis processes to decode the keys to

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solving the math exercises or problems, they could overcome the causes that generated the negative and affective cognitive antecedents of anxiety, managing to increase their performance (Wang et al., 2015). European Economic Organization for Development (OECD), promote first world countries to develop neurocognitive research to benefit the teaching-learning process, supporting research centers such as the Mind, Brain and Education program and the Max Planck Institute, to investigate how traditional teaching methods influence the learning process in the classroom and present educational proposals, based on the findings of Cognitive Neuroscience to improve inter-learning processes (Istance, 2008).

In the learning of Mathematics, one of the most difficult contents to understand is fractions, it is necessary to know that learning rational numbers is the first approach that students have to understand fractions (Gómez et al., 2014), despite since several alternatives are used to teach fractions, there are students who fail to understand their meaning and usefulness, causing students considered averages to not obtain a conceptual understanding when operating them (Fazio & Siegler, 2011); this problem is a challenge to overcome in the basic education curriculum, basing that the learning of fractions is a necessary tool for the development of multiplicative, quantitative thinking of the student (Thompson & Saldanha, 2003).

For this reason, in the field of Mathematics, teachers must have the responsibility of developing cognitive skills in students so that they can compare, value and order fractions, allowing the student to have a clear appropriation of the sense of magnitude and / or exact quantity of a fraction (Capilla, 2016), it is necessary to understand that the interlearning of fractions involves a succession of properties that are different from that of natural numbers and that in order to understand them it is necessary to differentiate that fractions and the numerousness of a rational number manages to be represented through other rational numbers. Understanding this activity would induce students to rethink their conceptual understanding of these numbers (Stelzer et al., 2016).

Research highlights that a large number of students at all educational levels experience difficulty learning rational numbers and within these fractions (Vamvakossi & Vosniadou, 2010). The confusion between the concept of integer and rational number originates when talking about magnitudes, to avoid this difficulty in learning fractions, the student must understand that the integer has its own value, that is, five is worth five (5) and it is not difficult to say five (5) is greater than four (4) and less than six (6), on the other hand in a rational number when saying 7/3 complicates recognizing if it is greater than 9/5 or if is less than 6/2, this bias develops because students often confuse concepts and procedures for operating whole numbers with those used for fractions (Ni & Zhou, 2005).

Currently, Cognitive Neuroscience provides a sustainable basis for understanding how the brain works in teaching-learning processes, for which some sciences dedicated to education incorporated these findings into curriculum design, didactics, and evaluation of learning (Puebla & Talma, 2011). Research shows that most of the mistakes when learning fractions do not arise from the incompatibility between the concept of fraction and the cognitive architecture of the student, but is due to current methods of inter-learning because they lack efficiency and because they miss the neurocognitive and perceptive skills of the students (Lewis et al., 2015).

In Ecuador, the evaluations carried out by INEVAL from 2013 to 2018 to students in the 4th, 7th, 10th, 11th years of basic education and the third year of high school, in public educational establishments,

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fiscal (Catholic educational establishments with the financial support of the state) and private, it was determined that achievement levels should be divided into 4 categories (Insufficient = 400 to 699; Elementary = 700 to 799; Satisfactory = 800 to 949 and Excellent = 950 to 1000).

Although it is true that there is vast information on the relationship between anxiety to Mathematics and Mathematical learning, it is still an unresolved field in this line of research, therefore this research contributes from the point of view that was evaluated a Mathematics content that was the knowledge of fractions through a standardized test (Ministry of Education) and a computerized questionnaire for comparing fractions, for which two different evaluation systems were applied (one written and the other computerized), correlating them with the Mathematics anxiety questionnaire.

Table 1. Evaluation at the national level in the area of Mathematics in percentage of the years 2013-2018

	Years of basic education evaluated															
	Fourth year of basic				Seventh year of basic				Tenth year of basic				Third year of high school			
Evaluated period	NAAR	PAAR	AAR	DAR	NAAR	PAAR	AAR	DAR	NAAR	PAAR	AAR	DAR	NAAR	PAAR	AAR	DAR
2013-2014	28	46	22,2	3,8	51,3	40,8	6,8	1,1	66,2	30,1	3,3	0.4	25	31,5	28,5	15
2014-2015	19.8	45	30,3	4,9	39	45	13,7	2,3	49,6	43,9	6,1	0,4	39	31,5	19,5	10
2015-2016	20,2	41,6	28,9	9,3	35	48	15,6	1,4	57,9	35,6	6,2	0.3	41	28,5	16,5	14
2016-2017	50,6	27,6	20,1	1,7	55,7	26	13,6	4,7	58,6	25,6	10,7	5,1	34	43	21,5	1,5
2017-2018	49,7	29,4	20,6	0,3	52,6	28,4	15,6	3,4	57,6	27	11,5	3,9	27	45,5	25	2.5

Prepared by: Researchers
Source: INEVAL "Being a Student"
Cut-off date: 12-07-2019

In table 1 it can be seen that in 5 years of evaluation the results of the performance of the students in the area of Mathematics are worrisome since when performing the arithmetic mean of the first two categories (Insufficient and elementary) they exceed 70% (Ineval, 2016; Ineval, 2017a; Ineval, 2017b; Ineval, 2018; Ineval, 2019; Ministerio de Educación del Ecuador, 2014). According to the results obtained in the official measurements, some elementary assumptions of inter-learning that guide the process of curricular design and strategies in the teaching of Mathematics should be reviewed and within this, that of the fractions since this theme is which reports the lowest level of performance, which is used by the teacher in Ecuador; considering that the learning of fractions is a basic tool for the development of multiplicative, quantitative and mathematical thinking of the student (Lamón, 2007; Thompson et al., 1992). For this reason, it is necessary for teachers to develop cognitive skills in the students so that they can compare, value and order fractions, since these skills allow the student a clear appropriation of the sense of magnitude and / or exact quantity that a fraction represents, knowledge that develops an understanding of the correct meaning that mathematics assigns to fraction (Capilla, 2016).

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2. Problem Statement

- The students of the school level present a low academic performance in the area of Mathematics and within this in the knowledge of fractions, which affects their academic development

3. Research Questions

- Will the academic performance in the knowledge of fractions be required to anxiety processes to Mathematics?
- Will the presence of math anxiety affect the knowledge of fractions vary according to sex?

4. Purpose of the Study

Evaluate the correlation between anxiety to mathematics and the academic performance of students in knowing fractions

5. Research Methods

It is a non-experimental cross-sectional study of a correlational descriptive nature, with a methodological design aimed at seeking the existence of a correlation between anxiety to mathematics, and the computerized questionnaire for comparing fractions, the sample was of an intentional nature, in the 330 participants participated in the sixth and seventh year of basic education (n = 172 boys and n = 158) from a state educational institution in the province of Pichincha, the age of the participants was in a range of 10 years 6 months to 12 year old. The educational institution, being of a state nature, is subject to the planning provided by the Ministry of Education of Ecuador (texts for the teacher, hourly load, workbooks for the learners, snacks, break time, evaluations and pedagogical planning) therefore it can be said that they use the same common study program.

The authorities of the Institution, the teachers who participated in the research, the parents and / or student representatives signed the informed consent, and then proceeded to sign the informed assents by the 330 participating students.

5.1. Homework

5.2. Anxiety to Mathematics MASC

The MASC test developed by Chiu & Henry (1990) stated that the students had to answer the questionnaire in writing, which had 22 questions, evaluating each according to a 4-point scale in terms of how much anxiety they feel: 4 represents very very nervous, 3 represents very nervous, 2 represents a little nervous, and 1 represents not nervous at all; this test is applicable from the fourth grade of primary (Fifth year of basic education in Ecuador), the students had a time of 30 minutes to answer it, after the

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delivery they were coded to save the identity of the evaluated student, Cronbach's Alpha was calculated to determine its reliability, which was 0.93.

5.3. Proof of knowledge of fractions

The students were evaluated by applying a test containing 10 questions which had 71 sub-items; for the preparation of the test, the researchers collected the questions from the teacher's book delivered by the Ecuadorian Ministry of Education, which at the end of each unit has evaluation questions, the test was carried out in writing, for which the students had 80 minutes to solve it, before starting the evaluation it was explained to them that it should be done individually and that if they had any doubts, they should raise their hand and an evaluator would come to solve the concern, after delivery they were coded to save the identity of the evaluated student.

5.4. Computerized fraction comparison questionnaire

The computerized fraction comparison questionnaire was applied, which consisted of 48 exercises, classified with common components (congruent and incongruent) and without common components (congruent, incongruent and neutral), the program used to evaluate was Python and PyGame. Each student was asked to verify that their computer was working properly and the students were explained what the evaluation consists of, after the general indications they were asked to write the data requested by the computer program, indicating them to read carefully what came out on the screen.

It was highlighted that to choose the answer that they considered correct, they should press the Q or P key to select the largest fraction, if they considered that the fraction on the left was greater, press the Q key and if they considered that the largest fraction was that of the Right press the P key, they were also told that they had seconds to give an answer and that after the answer was issued, they could not rectify, the data was stored in a pen drive, and then they coded it with the aim of saving the identity of the evaluated student.

6. Findings

6.1. Descriptive Analysis

The descriptive data of the sample in relation to the year of basic education and the sex of the participants is presented below.

Table 2. Descriptive statistics

Year of study	Sex	Frequency	Total	Percentage
SIXTH	Male	93	178	53,9%
	Female	85		
SEVENTH	Male	79	152	46,1%
	Female	73		
TOTAL			330	100%

Taken from: Data record
Done by: Researchers

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In the table 2, it was observed that, of the 330 participants, 178 belonged to the sixth and 152 to the seventh year; 172 were male, of which 93 belonged to the sixth year and 79 to the seventh year and the remaining 158 were female, classified in 85 belonging to sixth and 73 of seventh.

6.2. Fraction Knowledge Test

Next, the descriptive analysis of the Mathematics anxiety questionnaire and the Knowledge test of fractions were carried out and the level of hits that they had in each of them related to the evaluative scale of the learning results used in Ecuador

Table 3. Anxiety and Knowledge Test

			Year of basic education Rating scale Ministerio de Educación of Ecuador			
			NAAR	PAAR	AAR	TOTAL
SIXTH	Anxiety scale		69	51	1	121
		Anxiety	31	26	0	57
		No Anxiety				
	Total		100	77	1	178
SEVENTH	Anxiety scale		32	53	1	86
		Anxiety	30	35	1	66
		No Anxiety				
	Total		62	88	2	152
TOTAL	Anxiety scale		101	104	2	207
		Anxiety	61	61	1	123
		No Anxiety				
	Total		162	165	3	330

Taken from: Data record
Done by: Researchers

Table 3 shows that of the 330 students, 207 presented anxiety to mathematics and 123 did not, of the 207 students who presented anxiety, 121 belonged to the sixth and 86 to the seventh year, and of the 123 students who did not present anxiety, 57 belonged to sixth and 66 to seventh year of basic education, in relation to performance and anxiety there were 106 of the 207 students who were on the scales (PAAR and AAR), as for the 123 students who did not present anxiety to Mathematics, 62 were on the scales (PAAR and AAR). In addition, it was evident that 205 students did not achieve the required learning (NAAR and PAAR) and only 2 achieved the required learning.

When calculating the value of chi2 we had the value of $p = .036$ but two cells had a value less than 5, so we proceeded to calculate the value of the contingency coefficient that had a value of $p = .982$, that was, the value of the correlation is 98.2%.

6.3. Computerized fraction comparison questionnaire

The following table performs the descriptive analysis of the computerized fraction comparison questionnaire, which characterizes the percentage of the hit rate according to the type of fraction (Congruent with common components and Incongruent with common components) and the level of hits

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that they had in each of them related to the evaluative scale of the learning results that was used in Ecuador.

Table 4. Computerized Questionnaire for Comparing Fractions with Congruent and Incongruent Common Components

Congruent Common Components	Scale	Frequency	Percentage	Incongruous Common Components	Frequency	Percentage
	DAR	20	6%		8	2.4%
	ARR	63	19.1%		38	11.6%
	PAAR	120	36.4%		140	42.4%
	NAAR	127	38.5%		144	43.6%
TOTAL		330	100%		330	100%

Taken from: Data record
Done by: Researchers

Table 4 shows that of the 330 students who compared fractions with congruent common components, 247 were on the scales (NAAR and PAAR) and the remaining 83 were on the scales (AAR and DAR) and that when they compared fractions with incongruent common components 284 students were on the scales (NAAR and PAAR) and the remaining 46 were on the scales (AAR and DAR).

Below, the descriptive analysis of the computerized questionnaire for comparing fractions in reference to fractions with no common components (congruent, incongruent and neutral) can be found and the level of hits they had in each of them related to the evaluative scale of the results of learning that was used in Ecuador.

Table 5. Computerized Questionnaire for Comparing Fractions without Congruent, Incongruent and Neutral Common Components

Scale	No Congruent Common Components	Frequency	Percentage	No Congruent Common Incongruous	Frequency	Percentage	No Congruent Common Incongruous	Frequency	Percentage
DAR		47	14,2%		7	2,1%		3	0,9%
AAR		36	10,9%		72	21,8%		69	20,9%
PAAR		182	55,2%		161	48,8%		148	44,8%
NAAR		65	19,7%		90	27,3%		110	33,3%
	TOTAL	**330**	**100%**		**330**	**100%**		**330**	**100%**

Taken from: Data record
Done by: Researchers

Table 5 shows that of 330 students who compared fractions, 247 who compared Congruent Common Non-Components fractions were found on the scales (PAAR and NAAR) and 83 were on the scales (DAR and AAR) but when the same number of students investigated compared Incongruent Non-Common Components fractions, 251 were on the scales (PAAR and NAAR) and 79 on the scales (DAR and AAR); It was also evident that when those 330 students compared Neutral Non-Common Components fractions, 258 were found on the scales (PAAR and NAAR) and 72 learners on the scales (DAR and AAR).

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The following table presents the descriptive analysis of the computerized questionnaire for comparing fractions, the level of success they had when comparing fractions with common components (congruent and incongruent) related to the evaluative scale of learning results used in Ecuador and according to sex and the presence or not of anxiety to Mathematics.

Table 6. Computerized Questionnaire Comparing Fractions with Congruent and Incongruent Common Components and Their Relationship to Anxiety and Sex

SEX	Fraction Type	Scale	Anxiety	No Anxiety	Total	Fraction Type	Scale	Anxiety	No Anxiety	Total
M	CC. Congruent	DAR	7	5	12	CC. Incongruous	DAR	3	4	7
		AAR	22	15	37		AAR	10	11	21
		PAAR	37	27	64		PAAR	48	17	65
		NAAR	40	19	59		NAAR	45	34	79
	TOTAL		106	66	172			106	66	172
F	CC. Congruent	DAR	6	2	8	CC. Incongruous	DAR	1	0	1
		AAR	15	11	26		AAR	13	4	17
		PAAR	36	20	56		PAAR	42	33	75
		NAAR	44	24	68		NAAR	45	20	65
	TOTAL		101	57	158			101	57	158
TOTAL										
	CC. Congruent	DAR	13	7	20	CC. Incongruous	DAR	4	4	8
		AAR	37	26	63		AAR	23	15	38
		PAAR	73	47	120		PAAR	90	50	140
		NAAR	84	43	127		NAAR	90	54	144
	TOTAL		207	123	330			207	123	330

Taken from: Data record

Done by: Researchers

Table 6 shows that the male sex showed 106 students who presented anxiety to Mathematics, of which 29 students were on the learning scales (AAR and DAR) and 77 were on the scales (NAAR and PAAR), on the other hand, there were 66 students who did not present anxiety, of which 20 were on the scales (AAR and DAR) and 46 were on the scales (NAAR and PAAR); Instead, when they compared fractions with Incongruent Common Components, 13 children presented anxiety to Mathematics and were found on the scales of (AAR and DAR) and 93 were found on the scales (NAAR and PAAR), in addition it was observed that 15 children who did not present anxiety were found on the scales (AAR and DAR) and 51 were found on the scales (NAAR and PAAR).

In contrast, in the female sex, 21 girls presented anxiety to Mathematics and were on the learning scales (AAR and DAR) and 13 who did not present anxiety were on the same scale when comparing fractions with Congruent Common Components; in contrast, the same sex when comparing fractions with incongruent Common Components, 14 girls presented anxiety and were on the scales of (AAR and DAR) and there were 4 girls who did not present anxiety and were on the same learning scales.

The following table presents the descriptive analysis of the computerized questionnaire for comparing fractions, the level of hits they had when comparing non-common components fractions

https://doi.org/10.15405/epsbs.2021.06.7
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eISSN: 2357-1330

(congruent, incongruent and neutral), related to the assessment scale of the learning results used in the Ecuador and according to sex and the presence or not of anxiety to Mathematics.

Table 7. Computerized questionnaire for comparing fractions Non-common components Congruent, Incongruent and Neutral and its relationship with anxiety and sex

SEX	**Fraction type**					**Fraction type**					**Fraction type**				
M	**No CC. Cong.**	Scale	Anxiety	No Anxiety	Total	**No CC. Incong.**	Scale	Anxiety	No Anxiety	Total	**No CC. Neutral**	Scale	Anxiety	No Anxiety	Total
		DAR	18	10	28		DAR	4	1	5		DAR	1	1	2
		AAR	12	8	20		AAR	19	12	31		AAR	27	16	43
		PAAR	52	36	88		PAAR	48	35	83		PAAR	50	27	77
		NAAR	24	12	36		NAAR	35	18	53		NAAR	28	22	50
	Total		**106**	**66**	**172**	**Total**		**106**	**66**	**172**	**Total**		**106**	**66**	**172**
F															
		DAR	15	4	19		DAR	1	1	2		DAR	1	0	1
		AAR	10	6	16		AAR	28	13	41		AAR	14	12	26
		PAAR	57	37	94		PAAR	47	31	78		PAAR	49	22	71
		NAAR	19	10	29		NAAR	25	12	37		NAAR	37	23	60
	Total		**101**	**57**	**158**	**Total**		**101**	**57**	**158**	**Total**		**101**	**57**	**158**
T		DAR	33	14	47		DAR	5	2	7		DAR	2	1	3
		AAR	22	14	36		AAR	47	25	72		AAR	41	28	69
		PAAR	109	73	182		PAAR	95	66	161		PAAR	99	49	148
		NAAR	43	22	65		NAAR	60	30	90		NAAR	65	45	110
	Total		**207**	**123**	**330**			**207**	**123**	**330**			**207**	**123**	**330**

Taken from: Data record

Done by: Researchers

Table 7 shows that of the 330 students who compared Non- Common Component fractions (Congruent, Incongruent and Neutral), 172 belonged to the male sex and 158 to the female; when children compared Congruent Non-Common Components fractions 30 were found on the scales (AAR and DAR) and 76 on the scales (PAAR and NAAR) instead of the 66 children who did not present anxiety 18 were found on the scales (AAR and DAR) and the remaining 48 were on the scales (PAAR and NAAR); on the other hand, when the same group of children (172) compared Incongruent Non-Common Components fractions, 23 presented anxiety to Mathematics and were found on the scales (AAR and DAR) and 83

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eISSN: 2357-1330

were on the scales (PAAR and NAAR), instead the 66 who did not present anxiety 13 were on the scales (AAR and DAR) and the remaining 53 were on the scales (PAAR and NAAR) and when this group of children compared Neutral Non- Common Components fractions, 28 children who presented anxiety were on the scales (AAR and DAR) and the 78 on the scales (PAAR and NAAR) instead of the same group that did not present anxiety to Mathematics 17 were on the scales (AAR and DAR) and the remaining 49 were on the scales (PAAR and NAAR). In relation to the same group, when they compared Neutral Non-Common Components fractions, it was found that 28 children were on the AAR and DAR scales and 78 were located on the scales (PAAR and NAAR), instead of the 66 children who did not present anxiety to Mathematics, 17 were located on the scales (AAR and DAR) and 49 on the scales (PAAR and NAAR).

Instead of the 158 girls, 101 presented anxiety to Mathematics and 57 did not, and when they compared Congruent Non- Common Components fractions, 25 were found on the scales (AAR and DAR) and 76 on the scales (PAAR and NAAR) instead of the 57 girls who did not present anxiety 10 were placed on the scales (AAR and DAR) and the remaining 47 were on the scales (PAAR and NAAR); on the other hand, when the same group of girls (158) compared Incongruent Non- Common Components fractions, 29 presented anxiety to Mathematics and were located on the scales (AAR and DAR) and 72 were on the scales (PAAR and NAAR), whereas the 57 who did not present anxiety 14 corresponded to the scales (AAR and DAR) and the remaining 43 were on the scales (PAAR and NAAR) and when this group of girls compared Neutral Non- Common Components fractions, 15 girls who presented anxiety were found on the scales (AAR and DAR) and the 86 on the scales (PAAR and NAAR,) instead the same group that does not present anxiety to Mathematics 12 were on the scale (AAR) and the remaining 45 were located on the scales (PAAR and NAAR).

7. Conclusion

It was observed that, in the research of the 330 participants, 207 presented anxiety to Mathematics, which coincided with the reports made by Ashcraft (2002); Beilock et al. (2010); Maloney & Beilock (2012). Those who expressed that the presence of anxiety to Mathematics was a serious inconvenience that affected the world in a similar way. Of the 207 participants who presented anxiety to Mathematics, 121 corresponded to the sixth year of basic education and 86 to the seventh, when relating them to the learning process valued according to the scale of the Ministry of Education of Ecuador, were found on the scales (NAAR and PAAR), which meant that the students did not achieve the required learning.

When the students of these 2 years of basic education compared fractions with Common Components (Congruent and Incongruent) and Non-Common Component fractions (Congruent, Incongruent and Neutral), it was evident that the fractions with Congruent Common Components were the ones with the highest number of students presented on the scales (AAR and DAR) corroborating the results of other investigations that indicated that students with a basic level of knowledge of fractions were predisposed to compare the components of the fractions separately (numerator with numerator and denominator with denominator), coinciding with what was expressed by Gómez et al. (2014) instead of comparing the numerical values of both fractions; generating that the students could obtain correct

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eISSN: 2357-1330

answers when comparing 4/9 with 7/9 or 1/3 against 5/7, but they would develop incorrect answers when comparing 2/5 with 2/7 or 4/9 with 2/3, results similar to those obtained by Gómez & Dartnell (2015).

When they compared Congruent Non-Common Component fractions, 247 students were in the (NAAR and PAAR), and when they compared Incongruent Non-Common Component Fractions, 251 students were on the scales (NAAR and PAAR) and that when they compared Neutral Non- Common Component fractions, 258 students were on the scale (NAAR and PAAR), corroborating the findings of Richardson & Suinn (1972), that guided that Math anxiety was a process of negative affective reaction-action that a student experienced when doing exercises with numbers and /or developed mathematical calculation problems, processes that produced sensations of tension that hinder the learning of arithmetic and therefore of mathematics, as expressed by Eden et al. (2013).

Male students, despite presenting anxiety to mathematics, presented a greater number of students on the scales (AAR and DAR) than the female gender when they compared fractions with congruent common components; and the same relationship was observed when there was not anxiety to Mathematics. In this research, the male sex presented a greater number of students with anxiety to Mathematics, clarifying that the difference was minimal (5 students), a result that went against position with other research that indicated that girls presented higher visible symptoms of nerves, tension and discomfort than children, as reported by Ashcraft & Ridley (2005); Wigfield & Meece (1988).

When students compared Congruent Non- Common Component fractions in the male sex and with the presence of anxiety, they presented a greater number of students than the female gender, and the same happened when they did not present anxiety, when they compared Incongruent Non- Common Component fractions, the male sex presented less number of students on the scales (AAR and PAR) than the female gender when they had the presence of anxiety, but when there was anxiety, the number of students who were on the scales (AAR and DAR), only with a student in favor of sex female; when they compared Neutral Non- Common Components fractions, the male sex presented a greater number of students than the female sex and the same happened when there was no presence of anxiety in both sexes, these results corroborated with what was expressed by Gómez et al. (2014), researchers who mentioned that the most difficult learning to understand were fractions, despite the fact that several alternatives were used to teach them, and also, as Fazio & Siegler (2011) pointed out, there were students who could not understand their meaning and usefulness, causing the students considered averages to fail to obtain an understanding, which was reflected in their grades.

The main contribution of this research was the use of technology to evaluate mathematical knowledge (in this case comparison of fractions with common components or not with common components) and the written evaluation, this process allowed to demonstrate that the presence of Anxiety to Mathematics did not vary in either of the two forms of evaluation. As future research processes, the use of these questionnaires is scheduled in a study in which a neurocognitive methodology will be applied for the inter-learning process of the fractions, where a pre and post-test will be assessed and thus determine if the process of inter-learning will improve.

7.1. Limitations and advantages of the study

In the present investigation, it was not considered to control other variables that could possibly influence the results, such as academic performance in other subjects, reports of the presence of specific learning disorders that the results obtained respond to a single educational institution.

7.2. Research contribution

The contribution of this research is the application of two different types of evaluations on the content of fractions, the first evaluation shows the level of general knowledge of fractions that a student has, in which the student can perform calculations in a paper and repeat mechanical and memory processes to give an answer to a question posed, compared to the second evaluation that consisted of comparing the value of a fraction in relation to another fraction in a computerized program, an activity that makes it possible to use basic intuitive processes of the student to indicate the answer that he considers correct. These two forms of evaluation could guide teachers to understand which are the biggest problems that students present when comparing fractions.

7.3. Declaration of conflict of interest

The researchers who carried out this study declare that they have no conflict of interest or with public and / or private institutions, as well as with natural and / or legal persons.

Acknowledgments

The researchers thank the authorities, students and teachers who participated in the research, since their collaboration was total, which they managed to carry out without any problem in the study.

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