ISSN: 0798-1015

REVISTA ESPACIOS

Educación • Education • Educação • Vol. 41 (35) 2020 • Art. 16

Recibido/Received: 15/06/2020 • **Aprobado**/Approved: 24/08/2020 • **Publicado**/Published: 17/09/2020

Belief system towards mathematics present in future teachers. A comparative study

Sistema de creencias hacia las matemáticas presente en futuros docentes. Un estudio comparativo

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Abstract
This comparative study focuses on the analysis of present beliefs in future mathematics teachers in three different educational institutions. It applies an instrument that analyzes the beliefs he or she holds about the nature of mathematics, about himself or herself as a mathematics learner, about the mathematics teacher, and those raised by his or her family context. It is identified as the main finding that the like for the subject influences the choice of the professional program to be studied, but with the passage of time his understanding, his competences and his vocation for teaching increases.
key words: affective domain, beliefs towards mathematics, teachers in training

Resumen
Este estudio comparativo centra su interés en el análisis de las creencias presentes en los futuros docentes de matemáticas en tres instituciones educativas diferentes. Se aplica un instrumento que analiza las creencias que posee sobre la naturaleza de las matemáticas, acerca de sí mismo como aprendiza de matemáticas, acerca del profesor de matemáticas y las suscitadas por su contexto familiar. Se identifica como principal hallazgo que el gusto por la asignatura influye en la elección del programa profesional a estudiar, asimismo, que con el paso del tiempo aumenta su entendimiento, el desarrollo de las competencias asociadas y su vocación por la enseñanza.
Palabras clave: dominio afectivo, creencias hacia las matemáticas, docentes en formación.

1. Introduction

Without being exhaustive, the works of McLeod (1988, 1992, 1994) open the discussion on the effect of affects on the processes of teaching and learning mathematics, reaching the conclusion that some of them are difficult to displace because of their level of rootedness in the person. At the same time, the works of D'Ambrosio (1985), Bishop (1999), Mellin-Olsen (1987) and Lerman (1996) ratify the importance of affects in the learning of mathematics, but recognize as an additional element the importance of the socio-cultural context in the learning of the subject. Therefore, the question arises: what is the affective dimension in mathematics?

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Then the need arises to identify which feelings are part of that emotional dimension. For example, as time has passed, it can be said that the interest of researchers in mathematical education in the influence of emotions on the learning process of various mathematical concepts has grown (Di Martino & Zan, 2011¸McLeod & Adams, 2012;Polly et al. 2013; Gómez Chacón, 2017; Unlu, Ertekin & Dilmac, 2017; León-Mantero, Solano Pinto, Gémezescobar-Camino and Fernández-Cézar, 2020). Mathematics has historically been recognized as the problem subject or the obstacle in the academic progress of students regardless of their level of schooling (Riviere, 1990; García-Moya, Gómez-Escobar, Solano-Pinto and Fernández-Cézar, 2020), while in many cases their teachers have earned the image of rigid and insensitive people who are unaware of the effort that the student makes to achieve the achievements or competencies suggested for the subject. The following is a brief discussion of some theoretical aspects associated with the affective dimension around the study of mathematics.

1.1. Affective domain

The problem that has arisen is to have a clear definition of what is affection or what is understood by affective domain. A review of the literature shows that the most common definition corresponds to that proposed by Krathwohl, Bloom and Masia (1973), who propose a definition of the affective domain in which attitudes, beliefs, perceptions, likes and preferences, along with emotions, feelings and values, are found.

Later McLeod (1987) uses the term affective domain to refer to "a wide range of feelings and moods (states of mind) that are generally considered to be something other than pure cognition" (p. 245) and includes attitudes, beliefs and emotions as specific descriptors of this domain (Gómez Chacón, 2017).

The research generated by this article adopts the term affective domain as defined by McLeod (1987) which defines beliefs, attitudes and emotions as basic descriptors.

1.2. Basic affective domain descriptors

Mathematical *beliefs* are "one of the components of the individual's implicit subjective knowledge about mathematics and its teaching and learning, which is based on experience" (Gómez Chacón, 2017, p. 23). For the purposes of this publication, the beliefs of the subjectivity of students and teachers are considered, that is, based on their experiences and knowledge. Gómez Chacón (2017) states that the beliefs observed in students are classified in terms of the object of the belief: beliefs about the nature of mathematics (being the object of study or discipline that students develop), about oneself as a learner (self-image that the student has of him/herself and his/her relationship with the discipline), about the teaching of mathematics (aspects related to the teacher and his/her relationship with the discipline) and about the context in which mathematics takes place (influence of the social context) (McLeod, 1992).

Attitudes are defined by Gómez Chacón (2017) as "the evaluative predisposition (positive or negative) that determines personal intentions and influences behavior" (p. 23). For Callejo (1994) if the object of study is mathematics, two categories can be distinguished: a) attitudes toward mathematics, to refer to the valuation and appreciation that the person possesses toward the discipline and its learning, that is, it corresponds to the affective component; b) mathematical attitudes, associated with the cognitive component and corresponds to the way of using general abilities such as flexibility, objectivity, logical sense, among others.

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Finally, for Gómez Chacón (2017) *emotions* are "organized responses that arise in response to an internal or external event, which has a charge of positive or negative meaning for the individual" (p. 25).

1.3. The context of implementation

For Vaillant (2010) the concept of "social change is the central element in understanding the identity issues affecting teachers and the challenges they face" (p. 2). Social change has led to major transformations in the work of teachers, their image and the value that society places on this work of academic training (Gamboa-Suárez, 2016). Esteve (2006) outlines that the processes of social change that have taken place in recent decades have required the transformation of education systems by proposing new challenges that have been difficult to assimilate, such as making effective use of technological resources in the classroom in favour of an adequate process of efficient teaching (Prada Núñez, Hernández Suárez and Gamboa, 2019) or the inclusion of students with special educational needs in regular institutions, among many others. These new challenges have generated feelings of disconcert among teachers who demand training from the system in order to adequately face these challenges. In the face of these needs, another aspect emerges that corresponds to this constant intention of teachers to maintain work routines that at times make them reluctant to change. All of this situation leads many teachers to do their work poorly, constantly facing a cascade of criticism since they are the ones who socially turn out to be responsible for all of the difficulties and frustrations of the education system.

Vaillant (2010) states that "teacher identity refers to how teachers subjectively experience their work and what the factors of satisfaction and dissatisfaction are" (p. 4). It also relates to the perception of the profession by teachers themselves and by society. The identity of teachers is both their personal experience and the role that is recognized for them in a society. In summary, the teaching identity is a dynamic and continuous construction, both social and individual, resulting from various socialization processes understood as biographical and relational processes, linked to a particular context (socio-historical and professional) in which these processes are inscribed (Vaillant, 2010, p. 5).

For all the above mentioned is that it is important to study the belief system observed in students enrolled in the academic program of Bachelor of Mathematics because if they do not have a clear vocation for teaching and even more, a like for mathematics, they will end up promoting in their students consciously or unconsciously misleading beliefs that go in disregard of the subject and their teaching profession.

2. Methodology

This research report presents a number of characteristics that are consistent with the purpose of the research.

2.1. Methodological approach

A quantitative proposal at a descriptive correlational level was adopted for the development of this research, since the data are collected directly from the primary source (field) without the manipulation of variables, they are subsequently processed and the data are given a descriptive treatment in order to obtain statistics and some indicators, which allow to validate the existence of similarities or differences between the different contexts analyzed.

2.2. Participants

The key informants in this research correspond to a group of students from the Mathematics degree academic program of three public institutions of higher education located geographically in different places, two of which are located in Colombia in the capital cities of the departments of Nariño (Universidad de Nariño - UDENAR) and Norte de Santander (Universidad Francisco de Paula Santander - UFPS), characterized by being border cities with similar economic and social dynamics; in each of these cities, the Mathematics Degree Program has been offered

for more than three decades, and its curricular proposals have been evolving in order to respond to social demands. The third university is located in the southeast of the African continent (Universidad Licungo - UniLicungo) located in Mozambique - Africa. It was created by the Decree 3/2019 of February 14th to restore the higher education system in Mozambique. This institution includes the human, material and financial resources of the former Pedagogical University (Quelimane e Beira Delegation) and operates in the provinces of Zambézia and Sofala. UniLicungo was born as the largest public institution of higher education in the central region of Mozambique.

A census was proposed to be carried out in the three educational institutions (a total of 630 students), but given that the process of filling out the instrument was completely voluntary, in the end it was possible to consolidate a sample of 302 people in total (equivalent to 48% of the population). Table 1 shows the demographic characteristics of informants disaggregated by educational institution. The level of participation of each institution is at least 30%, with a predominance of males in the three programmes. With regard to age, it should be noted that 83,1 per cent are aged between 15 and 25, and the participation of students from the entire curriculum was guaranteed, except for one institution that did not have the participation of eighth semester students, this aspect is very important since it is expected that as the student advances in the process of professional training, he or she will become more convinced of his or her vocation for teaching and of his or her affinity with mathematics.

Table 1
Description of the demographic characteristics of the sample members

Variable	Response options	UFPS	UDENAR	UniLicungo	Total
Country of residence	Colombia	103 34,1%	109 36,1%	0 0,0%	212 70,2%
	Mozambique	0 0,0%	0 0,0%	90 29,8%	90 29,8%
Gender	Female	48 15,9%	48 15,9%	15 5,0%	111 36,8%
	Male	55 18,2%	61 20,2%	75 24,8%	191 63,2%
Age	From 15 to 20 years old	45 14,9%	51 16,9%	21 7,0%	117 38,7%
	From 21 to 25 years old	42 13,9%	54 17,9%	38 12,6%	134 44,4%
	From 26 to 30 years old	16 5,3%	1 0,3%	21 7,0%	38 12,6%
	31 years or more	0 0,0%	3 1,0%	10 3,3%	13 4,3%
Academic semester you are studying	First	9 3,0%	8 2,6%	26 8,6%	43 14,2%
	Second	4 1,3%	3 1,0%	14 4,6%	21 7,0%
	Third	6 2,0%	32 10,6%	8 2,6%	46 15,2%
	Fourth	15 5,0%	6 2,0%	4 1,3%	25 8,3%
	Fifth	15 5,0%	15 5,0%	7 2,3%	37 12,3%
	Sixth	4 1,3%	3 1,0%	5 1,7%	12 4,0%
	Seventh	12 4,0%	16 5,3%	11 3,6%	39 12,9%

Variable	Response options	UFPS	UDENAR	UniLicungo	Total
	Eighth	18	0	7	25
		6,0%	0,0%	2,3%	8,3%
	Ninth	7	24	6	37
		2,3%	7,9%	2,0%	12,3%
	Tenth	13	2	2	17
		4,3%	0,7%	0,7%	5,6%
Total		**103**	**109**	**90**	**302**
		34,1%	**36,1%**	**29,8%**	**100,0%**

UFPS: Universidad Francisco de Paula Santander; **UDENAR:** Universidad de Nariño; **UniLicungo:** Universidad Licungo

Source. Own elaboration

2.3. Instrument

This research reports on the belief system towards mathematics exhibited by a group of teachers in training in this area of knowledge. Since belief is one of the basic descriptors of the Affective Domain, it is emphasized that the instrument provided to the informants considered all three constructs (beliefs, attitudes and emotions). It was decided to use the questionnaire as the instrument for data collection, as stated by Callejo (1994) and Buendía, González, Gutiérrez & Pegalajar (1999), with the questionnaire the aim is to find out what the informants think or think through the use of written questions which can be answered without the accompaniment of the interviewer.

In the last three decades, a large number of questionnaires have been proposed and implemented with the intention of characterizing these descriptors of the affective domain, which are adjusted in number and wording to the characteristics of the informant. With the above, the questionnaire used has the following characteristics:

- For the beliefs, the questionnaire developed by Caballero, Guerrero y Blanco (2014) was used. It contains a total of 36 items distributed in four dimensions: beliefs about the nature of mathematics and its teaching and learning (8 items), beliefs about oneself as a mathematics learner (12 items), beliefs about the role of the mathematics teacher (6 items), and beliefs raised by the socio-familial context (10 items).

- For the attitudes, the questionnaire proposed by Auzmendi (1992) was used. It consists of 25 items grouped into five factors associated with the various components of attitudes towards mathematics: liking (4 items), anxiety (9 items), motivation (3 items), utility (6 items) and confidence (3 items).

- The questionnaire proposed by Fernandez-Cézar et al. (2016) was used for the emotions. It is a modification of the Auzmendi questionnaire (1992) which contains 10 items in total without presenting a classification of them.

Then the questionnaire applied is composed of 71 items that must be evaluated by the informant according to their degree of conformity by means of a Likert scale with five levels of response: a) two with a negative tendency reflected in the grades 1 (Strongly disagree) and 2 (Disagree); b) an intermediate level with grade 3 (Neither accept nor reject); c) two with a positive tendency reflected in the grades 4 (Agree) and 5 (Strongly agree). Before supplying the questionnaire to the informants, the validation process was carried out, understood as the capacity of the instrument to measure the construct that is to be quantified. In this case, the validation was done by experts who, based on the original wording of the items, suggested some adjustments that were specific to the characteristics of the target population. A panel of five professionals was formed, two of whom were Mathematics graduates with a Master's degree in Mathematical Education, two pedagogues with a postgraduate degree in Pedagogical Practice and a philologist.

2.4. Management process

The criteria for the inclusion of participants in this research were two: a) to be enrolled in an academic program of Bachelor of Mathematics during the first semester of 2020; and b) to be willing to answer the questionnaire, which was created as an online version and sent to them via email sharing the access link to it. The whole month of May has been left as a window for observation.

2.5. Data analysis

Once the data collection time was over, the data was downloaded to an Excel file and then exported to the SPSS v.25 software, where the data was created and the respective analyses were carried out at the level of reliability, uni and bivariate descriptions, possible correlations and analysis of variances.

3. Results

3.1. Reliability testing

Before analyzing in detail the belief system observed in the informants with respect to mathematics, we proceeded to determine the reliability, which corresponds to the property of showing similar results after the repeated application of the questionnaire. In order to determine whether the proposed questionnaire met this requirement, the Cronbach's Alpha coefficient was determined, since it is the one suggested in the literature, each time Likert scales are used as response options (De Franco and Josefina, 2009). Table 2 shows that the values of Cronbach's Alpha coefficient for each construct as well as for the global structure of the affective domain are higher than 0,75, which according to Ruiz Bolívar (2002) and Palella and Martins (2003) are high.

Table 2
Questionnaire Reliability Report

Construct	**Descriptions**
Beliefs towards Mathematics	Cronbach's Alpha = 0,924 N° of elements = 36
Attitudes towards Mathematics	Cronbach's Alpha = 0,865 N° of elements = 25
Emotions associated with Mathematics	Cronbach's Alpha = 0,798 N° of elements = 10
Affective Domain toward Mathematics	Cronbach's Alpha = 0,948 N° of elements = 71

Source. Own elaboration

3.2. Belief system towards mathematics

For the analysis of the belief system, a deductive approach will be adopted, initially comparing students' positions according to the educational institution in the four categories suggested in Caballero, Guerrero and Blanco (2014). Later, we will analyze in detail what happens in each of the categories. To simplify the comparative analysis between educational institutions, the five levels of response are reduced to three categories by defining the following process: a) The opinions of Totally Disagree and Disagree are grouped into a new category called

Reject; b) The opinions Neither Accept nor Reject is maintained as an intermediate level but is called Indifferent; c) The opinions Totally Agree and Agree are grouped into a new category called Accept.

Table 3
Comparison of average performance according to the belief system considered

Belief system	Educational Institution	Reject	Indifferent	Accept
Beliefs about the nature of mathematics	UFPS	44%	18%	38%
	UDENAR	50%	18%	32%
	UniLicungo	42%	12%	46%
Beliefs about oneself as a math learner	UFPS	21%	20%	59%
	UDENAR	21%	21%	58%
	UniLicungo	15%	19%	66%
Beliefs about the math teacher	UFPS	16%	18%	66%
	UDENAR	18%	22%	60%
	UniLicungo	12%	21%	67%
Beliefs raised by the family context	UFPS	28%	23%	49%
	UDENAR	34%	26%	40%
	UniLicungo	23%	25%	52%

UFPS: Universidad Francisco de Paula Santander; **UDENAR:** Universidad de Nariño; **UniLicungo:** Universidad Licungo

Source. Own elaboration

In the construct corresponding to the Beliefs about the nature of mathematics, at least 88% of students in each educational institution identify as a strength the recognition of the importance of mathematics in the resolution of problems generated from diverse situations that life offers, for that very reason they reject any statement that shows mathematical knowledge to be far from reality. Following this same line of argument, students state that in the resolution of mathematical problems the procedure implemented is very important, and for this reason they resort to various forms or methods of solution. This situation is observed with greater intensity in more than 84% of Colombian students who say that it is crucial to connect mathematical concepts with everyday situations, while in Mozambican students this percentage is lower by about 15%. As can be seen, there are difficulties in making a true approach to the subject by the teacher, and this affects their understanding. This may be generated by what Godino (2002) states: there are Mathematics teachers with deficient knowledge, which prevents them from solving the difficulties that their students may have.

Analyzing the second construct that corresponds to the Beliefs about oneself as an apprentice in mathematics in at least 75% of the students in each institution ratify that their like in mathematics has been a preponderant factor in the selection of the professional training program selected at the university for their life project. In that same percentage, they reject the fact that luck has an influence when it comes to successfully solving mathematical problems. On the contrary, they recognize that this competition is only possible if more time is dedicated to its development.

Given that this category of beliefs is very subjective and therefore can be influenced by the characteristics of the environment and the experiences lived by each person, some additional aspects are evident in each country: a) in Colombian institutions, more than 75% say that students with outstanding results in mathematics enjoy social recognition in their social and academic context, but this good performance largely depends on the attitude of the teacher and the innate or developed skills of the student (Ocak & Yamaç, 2013; Gafoor & Kurukkan, 2015);

(b) in the African institution, at least 70% of informnates consider that like and good results in mathematics come from secondary education and are confirmed by the choice of the vocational training programme given the importance or status that being recognized for these high performances gives them at the social level. Additionally, they claim that mathematical concepts are the basis on which the concepts of physics or chemistry are built, for that reason their mathematical skills allow them to be calm when solving mathematical problems.

Continuing with the third construct, we now analyze the Beliefs about the mathematics teacher by identifying as common strengths (in more than 75% of the cases) in the three educational institutions, the good social relations that students have with their teachers, while also recognizing their pedagogical skills and attitudes as characteristic features of good teachers (Aslan, Gürgah Oğul & Taş, 2013;). It is discovered as an aspect to emphasize that approximately 35% of the Colombian students identify as a weakness that their teachers in the explanations have a limited variety of didactic resources where the mathematical concepts are related to daily situations, while in the Mozambican students this percentage is reduced to half. As complementary attitudes manifested by 60% of the students surveyed as important in their math teachers, are the permanent disposition to clarify doubts that arise during the class and the accompaniment in their academic evolution that is possible to do due to the reduced number of students per group (20 students or less per course on average). Authors such as Caballero, Blanco and Guerrero (2008), Pezzia and Di Martino (2011) and Mata, Monteiro and Peixoto (2012) have highlighted in their works that teachers' beliefs and emotions towards mathematics influence students' academic performance as well as their beliefs and attitudes towards mathematics. In the same vein, Padrón (2008) argues that both cognitive and affective deficiencies of mathematics teachers lead to an impoverishment of teaching, also threatening the consolidation and development of appropriate pedagogical practices. Finally, as mentioned by Fernández, Prada and Solano (2018), teachers' mathematical knowledge, pedagogical practices and beliefs towards mathematics could compromise their performance and teaching effectiveness.

The last construct corresponds to the Beliefs raised by the family context, from which it can be highlighted that at least 63% of all students surveyed (regardless of the university) state that in their homes one of their parents encourages them and expects them to obtain good results in mathematics, given that they consider that this ensures their professional success regardless of the academic programme they study, and social recognition as a competent person. It stands out as a very important aspect that more than 50% of the informants reject the assertions that mathematics is for intelligent and creative people who demand little time for analysis in search of solutions to problems, since they consider that with dedication and constant work high performances can be achieved in this subject. A clear example of the influence (positive or negative) that the social and family context in which the person interacts can have, is mentioned in Gil, Blanco & Guerrero (2006) who affirm that frequently the parents, friends or companions of the students who enter the educational system (independently of the level) usually comment on their bitter experiences and feelings of failure that they have experienced around this discipline, which ends up generating in the students feelings of anguish, anxiety and certain predisposition (Álvarez-González, 2016; Hernández-Suárez, Prada-Núñez & Ramírez-Leal, 2017).

3.3. Establishing possible contextual differences

Around the study of beliefs some possible relationships between variables have been generated, many of them associated with the characteristics of the context or with the aspexes of the student, for example:

- Are there significant differences between men and women with respect to the belief system around mathematics?
- Are there significant differences by educational institution with respect to the belief system around mathematics?

- Are there significant differences by semester with respect to the belief system around mathematics?

In order to answer these questions, the analysis of variance - ANOVA is applied as a mechanism to perform sub-subject validations of hypothesis tests of differences in means. Table 4 identifies that of the 36 items contained in the Belief System questionnaire suggested by Caballero, Guerrero y Blanco (2014), significant gender differences were found in eight of them (items C1, C2, C3, C7, C8, C11, C14 and C31), showing a much more favourable position towards the female gender in seven items, with the exception of item C11 which corresponds to a clear example of gender discrimination, since informants consider that men obtain more recognition than women by being good at mathematics (Rodríguez Pérez & Limas Hernández, 2017).

Table 4
Belief System ANOVA with significant gender differences

		Sum of squares	gl	Media quadratic	F	Sig.
C1. Mathematics is useful and necessary in all areas of life	Between groups	10,283	1	10,283	9,976	0,002
	Within groups	309,214	300	1,031		
	Total	319,497	301			
C2. Math is difficult, boring and far from reality	Between groups	4,527	1	4,527	5,588	0,019
	Within groups	243,062	300	,810		
	Total	247,589	301			
C3. In mathematics it is fundamental to learn by heart the concepts, formulas and rules	Between groups	9,802	1	9,802	7,036	0,008
	Within groups	417,907	300	1,393		
	Total	427,709	301			
C7. The skills or abilities used in math classes to solve problems have nothing to do with those used to solve everyday problems	Between groups	6,105	1	6,105	6,302	0,013
	Within groups	290,597	300	,969		
	Total	296,702	301			
C8. When solving a mathematical problem, I look for different ways or methods of solution	Between groups	4,900	1	4,900	4,396	0,037
	Within groups	334,349	300	1,114		
	Total	339,248	301			
C11. Good students in math are more valued and admired by their peers	Between groups	17,788	1	17,788	13,557	0,000
	Within groups	393,629	300	1,312		
	Total	411,417	301			
C14. When you spend more time studying math, you get better results in solving problems	Between groups	5,834	1	5,834	6,146	0,014
	Within groups	284,775	300	,949		
	Total	290,609	301			
C31. People who like math are usually a little weird	Between groups	18,785	1	18,785	13,857	0,000
	Within groups	406,688	300	1,356		
	Total	425,474	301			

Source. Own elaboration

Table 5 identifies that of the 36 items contained in the Belief System questionnaire, in half of them significant differences were found with respect to the opinion expressed by the students of the various educational institutions:

- It was determined that the percentage of UniLicungo students who consider mathematics boring and difficult is higher than that observed in students of the two Colombian universities.
- There are significant differences by country with respect to considering mathematics as a body of concepts and formulas that can be learned by heart, being observed with greater intensity in UniLicungo students.
- There are significant differences by country with respect to considering that the solution of a problem demands little time as long as the process is known by the teacher or book, being the students of UniLicungo those that support with greater intensity this position.
- There are significant differences by country regarding the search for different forms or methods to solve a mathematical problem, evidencing that this practice is more frequent in Colombian universities.
- There are significant differences by country regarding the choice of the modality for the technical average conditioned by the like for mathematics, evidencing with greater effect in UniLicungo students.
- There are significant differences by university in determining that the like for mathematics strongly influenced the selection of the professional training program to be studied, with UDENAR being much higher in this aspect than UFPS.
- There are significant differences by country since the percentage of Mozambican students who say they are more valued and admired for having good performance in mathematics is higher in them than in the Colombian context.
- There are significant differences by country in considering that mastery of mathematics contributes to mastery of subjects such as Physics or Chemistry, with this effect being stronger in UniLicungo students.
- There are significant differences by university with respect to the doubts that arise when correctly solving a problem, this feeling being stronger in UDENAR students and less intense in UniLicungo.
- There are significant differences by country in considering that luck influences success in solving a mathematical problem, with this belief being more deeply rooted in Mozambican students.
- There are significant differences by country in recognizing the use of a great variety of media and practical examples where mathematics is related to everyday situations, this being a strength in the Mozambican university.
- There are significant differences by university in assessing the relationship with the teacher as satisfactory, being more positive in UFPS, followed by UniLicungo and with less effect in UDENAR.
- There are significant differences by country in terms of the teacher's assessment of the effort and work done by the student, with Mozambican students recognising this as a great strength in their university.
- There are significant differences between the opinions given by students at Colombian universities in recognizing the pressure exerted on them by some of their parents in the hope of good results in mathematics, being more intense in UFPS students.
- There are significant differences by country, with UniLicungo students having stronger support from their parents to encourage them to solve problem situations in mathematics, compared to students at the two Colombian universities.

- There are significant differences by country showing greater intensity in UniLicungo students in that they are seen as oddball people simply because they like math.
- There are significant differences by country showing greater intensity in UniLicungo students in considering mathematics to be for intelligent and creative people.
- There are significant differences by university in considering that people with good math skills should not spend a lot of time thinking about the solution of a problem, ranked from lowest to highest intensity being UDENAR, UFPS and UniLicungo.

For Vallant (2010) the construction of the professional identity that begins in the initial teacher training and continues throughout their professional practice. This identity does not arise automatically as a result of a professional qualification; on the contrary, it must be built. And this requires an individual and collective process of a complex and dynamic nature that leads to the configuration of subjective representations of the teaching profession (Skott, 2015).

Table 5
Belief System ANOVA with significant differences from the educational institution

		Sum of squares	gl	Media quadratic	F	Sig.
C2. Math is difficult, boring and far from reality	Between groups	23,181	2	11,590	15,443	0,000
	Within groups	224,409	299	,751		
	Total	247,589	301			
C3. In mathematics it is fundamental to learn by heart the concepts, formulas and rules	Between groups	80,887	2	40,443	34,867	0,000
	Within groups	346,822	299	1,160		
	Total	427,709	301			
C4. Almost all math problems are usually solved in a few minutes, if the formula, rule or procedure explained by the teacher is known	Between groups	34,826	2	17,413	10,535	0,000
	Within groups	494,224	299	1,653		
	Total	529,050	301			
C8. When solving a mathematical problem, I look for different ways or methods of solution	Between groups	12,981	2	6,491	5,948	0,003
	Within groups	326,267	299	1,091		
	Total	339,248	301			
C9. The like for mathematics influenced me to choose a certain mode in the tenth and eleventh grades	Between groups	10,765	2	5,383	3,724	0,025
	Within groups	432,202	299	1,445		
	Total	442,967	301			
C10. The like for mathematics influenced me to select a vocational training program at the university	Between groups	9,162	2	4,581	3,801	0,023
	Within groups	360,361	299	1,205		
	Total	369,523	301			
C11. Good students in math are more valued and admired by their peers	Between groups	30,820	2	15,410	12,106	0,000
	Within groups	380,597	299	1,273		
	Total	411,417	301			
C12. If mathematics is not understood, it is difficult to assimilate and master other related subjects such as physics or chemistry	Between groups	15,208	2	7,604	5,103	0,007
	Within groups	445,508	299	1,490		
	Total	460,715	301			
C15. When I solve a problem I often doubt whether the result is correct	Between groups	9,233	2	4,617	3,953	0,020
	Within groups	349,230	299	1,168		
	Total	358,464	301			
C20. Luck influences the successful solution of a mathematical problem	Between groups	20,802	2	10,401	8,919	0,000
	Within groups	348,671	299	1,166		
	Total	369,474	301			
C21. In mathematics classes, teachers use a variety of means and practical examples that enable students to relate mathematics to everyday situations	Between groups	26,963	2	13,481	9,485	0,000
	Within groups	424,975	299	1,421		
	Total	451,937	301			
C23. My relations with mathematics teachers have been satisfactory	Between groups	8,396	2	4,198	4,972	0,008
	Within groups	252,439	299	,844		
	Total	260,834	301			
C26. In math class, teachers value effort and recognize the student's daily work in the subject	Between groups	21,105	2	10,553	10,575	0,000
	Within groups	298,378	299	,998		

		Sum of squares	gl	Media quadratic	F	Sig.
	Total	319,483	301			
C27. Some of my parents have expected me to do well in math	Between groups	7,079	2	3,539	3,067	0,048
	Within groups	345,014	299	1,154		
	Total	352,093	301			
C28. My parents have encouraged and helped me with math problems	Between groups	20,459	2	10,229	7,065	0,001
	Within groups	432,896	299	1,448		
	Total	453,354	301			
C31. People who like math are usually a little weird	Between groups	57,377	2	28,688	23,303	0,000
	Within groups	368,097	299	1,231		
	Total	425,474	301			
C33. Mathematics is for intelligent and creative people	Between groups	12,965	2	6,482	5,562	0,004
	Within groups	348,466	299	1,165		
	Total	361,430	301			
C36. People who are good at math don't have to spend time thinking about how to solve a problem	Between groups	32,055	2	16,027	11,140	0,000
	Within groups	430,187	299	1,439		
	Total	462,242	301			

Source. Own elaboration

Table 6 identifies that of the 36 items contained in the Belief System questionnaire, in 20 of them significant differences were found with respect to the opinion expressed by students in the various educational institutions, identifying a growing trend towards greater appreciation and appreciation of mathematics as it progresses through the semesters of its curriculum; they highlight its usefulness and importance in the solution of everyday problems and in the exercise of the teaching profession. In the first trimester there is a strong presence of positions that consider the memorization of mathematics, the solution of problems as long as the solution algorithm or individual work has already been worked on over cooperative work. As a curious aspect in the informants, it is emphasized that as time goes by, their like for mathematics does not increase, but their understanding and competences improve, then it can be said that they arrive at the academic program convinced of that like for the subject.

Table 6

ANOVA of the System of Beliefs with significant differences with respect to the informant's current semester

		Sum of squares	gl	Media quadratic	F	Sig.
C1. Mathematics is useful and necessary in all areas of life	Between groups	24,913	9	2,768	2,744	0,004
	Within groups	294,583	292	1,009		
	Total	319,497	301			
C3. In mathematics it is fundamental to learn by heart the concepts, formulas and rules	Between groups	62,308	9	6,923	5,532	0,000
	Within groups	365,400	292	1,251		
	Total	427,709	301			
C4. Almost all math problems are usually solved in a few minutes, if the formula, rule or procedure explained by the teacher or given in the guide text is known	Between groups	90,684	9	10,076	6,712	0,000
	Within groups	438,366	292	1,501		
	Total	529,050	301			
C5. The best way to learn mathematics is through individual study	Between groups	34,106	9	3,790	3,492	0,000
	Within groups	316,917	292	1,085		
	Total	351,023	301			
C8. When solving a mathematical problem, I look for different ways or methods of solution	Between groups	23,368	9	2,596	2,400	0,012
	Within groups	315,881	292	1,082		
	Total	339,248	301			
C9. The like for mathematics influenced me to choose a certain mode in the tenth and eleventh grades	Between groups	33,499	9	3,722	2,654	0,006
	Within groups	409,468	292	1,402		
	Total	442,967	301			
C10. The like for mathematics influenced me to select a vocational training program at the university	Between groups	24,202	9	2,689	2,274	0,018
	Within groups	345,321	292	1,183		
	Total	369,523	301			
C13. Performance in mathematics depends largely on the teacher's attitude towards the student	Between groups	22,815	9	2,535	2,057	0,033
	Within groups	359,874	292	1,232		

		Sum of squares	gl	Media quadratic	F	Sig.
	Total	382,689	301			
C14. When more study time is spent on math, better results are obtained in problem solving	Between groups	25,687	9	2,854	3,146	0,001
	Within groups	264,922	292	,907		
	Total	290,609	301			
C17. I consider myself very capable and skilled in mathematics	Between groups	26,318	9	2,924	3,449	0,000
	Within groups	247,550	292	,848		
	Total	273,868	301			
C18. I'm calm and collected when I solve math problems	Between groups	29,872	9	3,319	3,381	0,001
	Within groups	286,674	292	,982		
	Total	316,546	301			
C19. When I try to solve a problem I usually find the right result	Between groups	21,088	9	2,343	2,338	0,015
	Within groups	292,687	292	1,002		
	Total	313,775	301			
C23. My relations with mathematics teachers have been satisfactory	Between groups	16,097	9	1,789	2,134	0,027
	Within groups	244,737	292	,838		
	Total	260,834	301			
C24. Good teachers who explain quite clearly, with pleasure and enthusiasm make them like mathematics	Between groups	24,043	9	2,671	2,953	0,002
	Within groups	264,142	292	,905		
	Total	288,185	301			
C25. Mathematics teachers are interested in the evolution and performance of the student in that subject	Between groups	26,783	9	2,976	3,097	0,001
	Within groups	280,595	292	,961		
	Total	307,377	301			
C26. In math class, teachers value effort and recognize the student's daily work in the subject	Between groups	20,057	9	2,229	2,173	0,024
	Within groups	299,426	292	1,025		
	Total	319,483	301			
C28. My parents have encouraged and helped me with math problems	Between groups	33,189	9	3,688	2,563	0,008
	Within groups	420,165	292	1,439		
	Total	453,354	301			
C30. Mathematics is important because the highest paid professions are related to it	Between groups	33,220	9	3,691	2,918	0,003
	Within groups	369,390	292	1,265		
	Total	402,609	301			
C33. Mathematics is for intelligent and creative people	Between groups	30,891	9	3,432	3,032	0,002
	Within groups	330,540	292	1,132		
	Total	361,430	301			
C36. People who are good at math don't have to spend time thinking about how to solve a problem	Between groups	36,084	9	4,009	2,747	0,004
	Within groups	426,157	292	1,459		
	Total	462,242	301			

Source. Own elaboration

4. Conclusions

This research report continues to provide evidence on the influence of affect on the teaching and learning processes of mathematics. Focusing solely on the belief system observed in a group of undergraduate students in mathematics from three different educational institutions, it was intended to highlight the strong impact that they have on the process of training future teachers in this discipline. As mentioned by Gómez (1998), school failure in mathematics depends strongly on the role played by affective aspects.

In general, it was determined that students have beliefs about mathematics that have been transmitted by their teachers in a conscious or unconscious way that are influencing the way they see the subject and understand its teaching and learning processes, This is an aspect of vital importance given that in less than five years these students will be assuming their professional role as teachers and surely with their actions they will be able to contribute to the change and appreciation of the subject or deepen the feelings of rejection and apathy.

With regard to the comparison of the results obtained in the three educational institutions, it could be seen that there were significant differences in many aspects but associated with the characteristics of each country, then this reaffirms that the educational process is a training activity closely linked to the society or context where it takes place.

Finally, in spite of having carried out the validity and reliability analyses, it could be stated that these results are a sample of what could be happening with this group of students, that is to say, that the findings contribute to the knowledge of the problem but could not be scaled up as a country position since the sample selection process has not been probabilistic. A sample is used, which has been facilitated by the closeness of the researchers in terms of common interests and relatively similar contextual characteristics.

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