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Quality of Education in Mathematics: Contrasts from Emotional Aspects Correlated with Academic Performance

Raúl Prada Núñez[1], César Augusto Hernández Suárez[2], William Rodrigo Avendaño Castro[3]

[1] Master in Mathematics Education. Research professor at the Universidad Francisco de Paula Santander. E-mail: raulprada@ufps.edu.co. Orcid: https://orcid.org/0000-0001-6145-1786

[2] Master in Mathematics Education. Research professor at the Universidad Francisco de Paula Santander. E-mail: cesaraugusto@ufps.edu.co. Orcid: https://orcid.org/0000-0002-7974-5560

[3] Doctor in Social and Human Sciences. Research professor at the Universidad Francisco de Paula Santander. E-mail: williamavendano@ufps.edu.co, Orcid: https://orcid.org/0000-0002-7510-8222

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ABSTRACT

The academic performance of students in mathematics has been a topic of interest in a wide list of researches in the field of Mathematics Education, then this is the motivation that gave rise to this academic work, in which the possible correlation between factors of different emotional and academic performance in Mathematics was evaluated. These results are part of a macro project, in which data were collected from a private educational institution characterized by obtaining good results in State Tests, for which it has the recognition of quality at the regional level. A quantitative approach is applied at a descriptive correlational cross-sectional level following a field design, conforming to a sample of 285 students who joined voluntarily. The data collection took place during the second semester of the year 2021 amid the non-presence due to Covid-19, so a Google form was used. The results highlight that recognizing mathematics as indispensable for success in life, the teacher's availability and the incorporation of everyday situations in-class exercises or problems, turned out to be correlated with the academic success of the students.

Keywords: Academic performance, affective mastery of mathematics, teacher's pedagogical practice, Mathematics.

Introduction

The work of Jornet *et al*. (2016) analyzes the social value of education not as a concept but as a theoretical construct, in which two perspectives can be identified,

…can be analyzed, at first, from an objective -or objectifiable- perspective from a position that links the consequences of education with social, economic and labor insertion and promotion; but it is also clear that the perception that the citizens of any society construct about the social value that education can have for these same purposes, undoubtedly conditions the actors in the teaching-learning process, and especially the students and their families. The second perspective is based on the motivation and commitment to one's own education and to the education of one's children, which, at the social level, in turn results in a characteristic or idiosyncrasy of groups or collectives, regions and/or countries. (p. 52)

Therefore, it is clear that the educational process is the engine of development of a society since it contributes to the improvement of the people's quality of life, derived from the process of professional and academic training, which contributes to the reduction of economic gaps between classes, which is why its social value is evident (Glewwe & Kremer, 2006). According to a report by the Organization for Economic Co-operation and Development (OECD, 2010), people with more academic training have achieved higher incomes accompanied by greater job opportunities. Conversely, those countries where educational coverage is a low show high rates of poverty, violence and social inequality, among many other social problems (Pinto, 2020; Jornet *et al*., 2016).

But access to education is not enough, it is necessary to ensure quality education (Gamboa, 2006). Therefore, attention should be focused on the term "quality", since it is recurrently used to assess aspects related to the provision of services, to the products used or purchased, to the processes carried out and even to the life characteristics of the people themselves; therefore, it is a rather broad term that could be ambiguous. In Aguilar-Barreto *et al*. (2017), it is stated that

…most Latin American nations underwent processes of modernization of the educational system during the first half of the 20th century, a period in which they tried to copy and apply the ideals of the universal education model developed in European countries throughout the 19th century. The speed with which important political and social changes took place in Latin American countries during that century shaped new profiles in the field of education, placing hope in this medium as the possibility of inculcating citizen values in accordance with the construction of the new modern states (p. 86)

In the particular case of the country, the advances in industrial processes at the beginning of the 20th century generated an environment of constant transformation that demands evolutions also in the fields of education, health services, provision of public services and society in general. Because of this need, a variety of educational policies have been proposed to fulfill the social commitment to the educational process. Then there are functions that society demands from the educational system, among which it is worth highlighting: to achieve equivalent learning results among groups of students from different social conditions, to train the professionals demanded by the country, the socialization of new generations in the construction of cultural identity and the qualification of people in the development of fundamental skills accompanied by higher reasoning processes that allow them to learn quickly and autonomously within the context of globalization (Schmelkes, 2000).

Focusing attention on the issue of quality of education, it is necessary to explore the relationship between school management and the quality of education. School management appears linked to educational quality at the moment when the results obtained by students in standardized tests are analyzed, which motivated a good amount of research that allowed within many findings to highlight the importance that aspects both internal and external to the students have on learning, highlighting for example, the family climate (Mendez-Omaña & Jaimes-Contreras, 2018; Dolores *et al*., 2018), the epistemological nature of knowledge (Hernández-Suárez *et al*., 2017; Mendoza et al., 2019), educational and institutional culture and policies (Bigi *et al*., 2018; Niebles-Núñez *et al*., 2019; Díaz-Guecha *et al*., 2020), the pedagogical practices implemented by teachers (Jaimes-Ojeda, 2017; Villamizar-Acevedo *et al*., 2017; Pineda *et al*., 2019), the evaluative processes applied by teachers (Acevedo-Jaimes & González-García, 2017; García-Quintero & Villamizar, 2017), the incorporation of

technological resources in the teaching process (López-García & Gutiérrez-Niño, 2018) or the influence of feelings on learning (Fernández-Cézar *et al*., 2018; Fernández-Cézar *et al*., 2019), among many others.

The quality of education in many cases is measured in terms of the academic performance of students (Gamboa *et a*l., 2020). Within the school curriculum, there is a wide range of disciplines with which various characteristics are associated, but the subject of Mathematics has been one of the disciplines that focuses the attention of researchers since it has become a generator of repetition and academic loss regardless of the level of schooling that is analyzed (Ramirez et al., 2018; Prada *et al.*, 2020) and this is evidenced in the results of the different standardized tests in which students participate, for example, Colombian students in 2018, 70% of them were placed below level 2 in Mathematics remaining within the ten OECD countries with the worst performance in Pisa Tests (OCDE, 2018).

Mathematics is an essential subject in the professional and personal formation of human beings since it allows them to acquire a wide range of cognitive skills (Vanegas *et al*., 2022) as well as the capacity for abstraction and the skills for mathematical calculation that in the future allows them to advance to more complex mental processes. Accordingly, it is attractive for researchers to reflect critically, statistically and objectively on the pedagogical practice that teachers advance in the classroom, at all levels of the formative process (Urbina, 2017) resulting in valid to correctly and reliably delimit a microsphere in all these levels, so for reasons of this research it focuses its attention on the fourth to eleventh grades of Basic Education.

Sánchez *et al.* (2015) present alarming data on the Colombian educational system, stating that for every ten students who enter Primary Basic Education, five of them graduate as high school graduates, two enter higher education and only one managed to graduate as a professional. Additionally, these students who enter higher education obtain an average in Mathematics in the Saber 11 tests that do not exceed 50% of the scale. Therefore, education is established as the pillar where the progress and development of a country are sustained, which leads to the responsible assumption of a quality educational system in which the achievement of high academic performance is encouraged and motivated, understood as the optimal achievement of competencies that the student must have and manage to achieve good performance.

Academic performance currently has various concepts that allow a more adequate understanding and comprehension as such, but it should be noted that it is a highly complex construct in which endogenous and exogenous conditions of the student participate. For Morales *et al*. (2016), academic performance is a synthesis of measurement methods, through scales, quantitative and qualitative assessment for the improvement of the quality not only of the person involved but also of the educational institution, since it must translate in terms of figures their contributions in educational progress for better social development.

Among the works that have been carried out in Spanish-speaking countries, in the opinion of Gutiérrez and Montañez (2012),

It is possible to distinguish some whose objective has been to conceptualize inequalities in the distribution of schooling and the opportunities to receive it. The second group of work is made up of those that set out to measure and locate such inequalities. A third group is made up of studies dedicated to examining trends over time in the distribution of educational opportunities, the relationship between different social groups and the quantity and quality of education received (p.12).

Therefore, depending on the context or the educational institution, different kinds of academic performance can be mentioned, such as individual and group, regardless of the contrast between the two, it should be of utmost importance for the teacher, since they are the closest method to verify their effectiveness and improvement in their work. It is also worth mentioning the objective and subjective academic performance, the objective highlights the quantitative part that the student obtains by mastering the subjects and the subjective is all the teacher's appreciation of the student, taking into account everything he knows about him (Calleja *et al*., 1990).

An aspect directly associated with academic performance is the evaluation process used within the educational institution. The Ministry of National Education (Mineducación hereinafter) assures that the evaluation should contribute to continuous improvement, for which it should be objective, pertinent, transparent, participatory and equitable, where the student identifies his shortcomings, allows him to analyze and improve his process, without considering that reprisals are taken against him for such difficulties (Mineducación, 2003).

The Ministry of Education, in Decree 1290 (2009), regulates the evaluation of learning and promotion of students at the basic and secondary education levels, granting autonomy to each educational institution to define its performance assessment scale according to its evaluation system, guaranteeing its equivalence with the levels of superior, high, basic and low performance (defined in the national assessment scale). This decree states that,

The term basic performance is understood as the overcoming of the necessary performances concerning the mandatory and fundamental areas, taking as a reference the basic standards, the orientations and guidelines issued by the Ministry of National Education and what is established in the institutional educational project. Low performance is understood as not surpassing them (Mineducación, 2009, p. 2)

It is necessary to contextualize the measurement of academic performance in Colombia, as mentioned in the previous paragraph, each educational institution is autonomous to define its assessment scale in coherence with its evaluation process; therefore, a mechanism for comparison of this variable at the national level corresponds to the results of the Saber Tests which are under the responsibility of the Colombian Institute for the Evaluation of Education (ICFES hereinafter). In Castro *et al*. (2014), several works were compiled in which the factors that determine academic performance through the results of these standardized tests were observed, added to the discovery of the causes of low academic performance from different perspectives.

Some research results on this topic in Colombia have highlighted that, for example, Cárcamo and Mola (2019) concluded that women performed better in the Spanish Language and men in the area of Mathematics; in Bonilla (2011), it was determined that the double day was associated with the decline in the quality of the educational process since it generates apathy; likewise Beneyo (2015), highlights in his findings that if the mother had a good educational level, this could positively influence the academic performance of her child. In this research line, previously Gaviria and Barrientos (2001), analyzing the results in Mathematics and Language of the ICFES tests of 1999 concluded that parents, with a good level of education and economic stability, had more time and dedication to their children, which contributes positively to obtaining academically favorable results that contribute to their children's comprehensive and intellectual formation.

For the purposes of this study, academic performance is understood as the analysis of the students' performance during the school year, but as it has been seen, it is a variable influenced by a wide range of factors, then in this process it is intended to identify the possible correlation that may exist between the descriptors of the affective domain towards mathematics and the mathematical processes that the

teacher promotes in his classroom pedagogical process, with the academic performance of students in the area of Mathematics.

Affective mastery of mathematics

When teaching or learning Mathematics, there is a diversity of factors that contribute to the generation of feelings associated with this subject or with all that it implies in the formative process. The factors are diverse, they could be intensely linked to people, being responsible for behaviors and actions in front of the objects that are part of the process, and having a domain in which, according to Page *et al*. (1990), are associated with preferences, beliefs, appreciations, emotions, values, feelings and attitudes; and according to Lafortune and Saint-Pierre (as cited in Gómez-Chacón, 2002) are values, attitudes, feelings, ethical and moral behavior, attributions, feelings, which are associated with motivation, personal and social development of the individual. McLeod (cited in Gómez-Chacón, 2002) is inclined to include beliefs, emotions and attitudes as basic factors of this domain, which he defines as "an extensive range of feelings and moods (states of mind) that are generally considered as something different from pure cognition" (p. 22).

In addition, different researchers have shown in their work that the effects experienced by students are key to understanding how people learn mathematics. In this sense, it could be said that the possible relationship between the learning process and affect is cyclical, since the individual's beliefs affect his or her learning, while his or her experiences in the study of this subject lead to certain emotional responses that affect learning itself.

Beliefs, attitudes and emotions are could be considered as the basic descriptors of the affective domain of Mathematics, as referred to in McLeod's various works.

Beliefs toward mathematics

To understand this concept, it is necessary to understand what is understood as true and what is true, where the person considers as true that which is verified or can be verified. The concept is very ambiguous, for example in psychology it has to do with traits of the person or instincts, as well as it can also be reasoning that one has of any subject (Díaz, 2017).

According to Gómez-Chacón (2002), the investigations that have focused on beliefs could be grouped into the following categories: a) Those that seek to identify and describe the belief system that the person possesses; b) Those that seek to establish the effects of the belief system that the individual possesses; c) Those aimed at discovering the origin and evolution of belief systems; d) Those that seek to generate changes in beliefs.

Mathematical beliefs are based on the experiences that the individual has had regarding the processes of teaching and learning mathematics, and are then defined according to the experiences and knowledge of both the students and the teacher. Bermejo (cited in Díaz, 2017), proposes two major classifications of the beliefs that students experience around mathematics: a) *Beliefs about mathematics itself*, in which they affect them have little interference, specifying the importance of the application of mathematics with their performance. They originate from the educational environment, classroom work and the educational proposal itself; and b) *Beliefs of students about mathematics*, which are a function of aspects such as self-confidence or self-concept. The latter has been identified as a predictor of student performance.

Gómez-Chacón (2002), points out that "beliefs about oneself about Mathematics Education have a strong affective charge and include beliefs related to self-concept, causal attribution of school success and failure, and confidence" (p.23). Following McLeod (1989; 1992), the student's self-concept as a learner of mathematics should be seen as a hierarchical division of the beliefs held by the student, which together with attitudes, emotions, expectations and motivations, are part of the affective domain towards mathematics. Montero *et al*. (2007) consider that how the subject visualizes him/herself based on the successful or frustrating experiences he/she has had in the learning process, becomes integral element of the affective and emotional dimension of the student. According to the same authors, those internal factors that influence success or failure are favorable, since they are aspects that can be worked on and modified.

In contrast to what was stated above, if the individual attributes his positive or negative results to external factors, it has an adverse effect on his performance and motivation, since he considers that these are factors over which he has no influence (Remolina, 2018).

The diversity of variables that influence the process of teaching and learning mathematics is very broad, among which student self-confidence can be considered. Alarcón *et al*. (2020) affirm that self-confidence has always been present in research on attitudes. Cantoral *et al*. (2005) highlight as an influential factor in academic performance in mathematics, the availability that the student has towards learning the subject.

Attitudes toward mathematics

They are a disposition toward something, in the case of mathematics, it is referred to as mathematical attitudes that are those cognitive abilities towards the subject, but when talking about attitudes towards mathematics, reference is made to the affective as the appreciation, interest or curiosity to learn them, they also influence the person positively or negatively, reflecting through behaviors, opinions or feelings (Cárdenas *et al.*, 2014). According to Gómez-Chacón (2002), the way students approach the proposed activities is a reflection of the attitudes they have towards mathematics.

In coherence, attitudes are influenced by the individual's traits, among which the motivation to succeed and his or her self-concept, which is influenced by the epistemological nature of the subjects, stand out. It can be observed, through the measurement instruments, that these are designed to measure specific components of attitude (McLeod, 1989): a) Usefulness of mathematics from the student's perception; b) Student's self-concept about mathematics; c) Influence of parents and teachers on the student's perception; d) the anxiety experienced by the student when facing the mathematical activity.

Some have considered attitude as a positive or negative evaluation that conditions the behavior and therefore the intentions of the person. Therefore, three constitutive elements of attitudes are identified: a cognitive, an affective and an intentional component. Now, if the object of study is Mathematics, two classifications are distinguished in the opinion of Cárdenas *et al*. (2014): a) *Attitudes towards Mathematics*, which refer to the valuation and appreciation of this discipline and the interest in this subject and its learning, and emphasize more the affective component than the cognitive one; b) *Mathematical attitudes*, contrary to the previous one, have a cognitive origin and refer to the way of using general abilities such as flexibility of thought, open-mindedness, critical spirit, objectivity, etc., which are important for mathematical work.

Emotions toward mathematics

For Goleman (2010), emotions are impulses that lead to act, it is an automatic reaction of the human being, it also "refers to a feeling and thoughts, biological states, psychological states and the type of

tendencies to action that characterize it" (p. 12). In Gómez-Chacón (2002), it is highlighted that the researches whose objective is to investigate the relationship between learning in mathematics and the affective component of the individual are few, but much less are those that have focused on the emotions experienced by students, possibly due to the absence of theoretical bases on the subject, which influences the scarce existence of objective instruments associated with the subject.

Following McLeod (1990), who affirms that

The lack of attention to emotion is probably because research on affective issues has, for the most part, looked for attitudinal factors that are stable and can be measured by questionnaires. Nevertheless, there have been a few studies directed at the processes involved in learning mathematics that has paid attention to emotions... But they have never played a relevant role in research on the affective domain in mathematics. The major problem has been the lack of a theoretical framework within which to interpret the role of emotions in mathematics learning. Mandler's theory may be a good starting point for constructing such a theoretical framework... (p. 21).

Emotions applied to the mathematical domain have been investigated by Debellis and Goldin (1991; 1993), Goldin (1988), Mandler (1989), and McLeod and Adams (1989), as main pioneers in this field. Emotions are responses in which a wide range of systems such as the cognitive, physiological, psychological and experiential systems interact. It appears as a reaction to an event, which is surely loaded with negative or positive meaning, depending on the person's experience. Therefore, these perspectives are manifestations derived from the person's belief system. Therefore, in the opinion of Gómez-Chacón (2000) "emotions are strong affective responses that are not only automatic or the consequence of physiological activations, but are the complex result of learning, social influence and interpretation" (p. 14).

Finally, around pedagogical practice, Ríos (2018) defines it as an activity that "registers not only objects of knowledge, but also notions, concepts and models that account for the search for systematicity of pedagogy" (p. 32). Regarding the same term, Avalos (2002) conceives it as "the axis that articulates all curricular activities of teacher training, theory and practice" (p. 113), in which the teacher puts into play all his or her skills to ensure the success of the teaching process.

With the above, it can be affirmed that academic achievement in mathematics has been a topic of interest for numerous authors, agreeing that the influential factors are as diverse as the characteristics of each context in which each of these investigations has taken place.

METHODOLOGY

This section establishes the methodological characteristics that delimited this research process. It is assumed that this epistemological and pedagogical space (Gamboa, 2019) has been framed within the characteristics of the quantitative approach that according to Hernández *et al*. (2014) is reported as an organized and sequential process that is validated based on the statistical processing of the data collected. Citing the same authors, the research design is non-experimental at a descriptive correlational level, so it does not manage changes in the variables or the environment, but collects data at the time it happens and in its natural environment, to be later processed and analyzed. It is clarified that the measurement was carried out at a single moment, therefore the measurement is transversal.

Since at the time of the measurement the educational institution was in the process of developing remote activities assisted by ICT resources, we resorted to the use of Google Form to design and apply a questionnaire composed of 60 items with which we intended to characterize each basic descriptor of the affective domain: for Beliefs, all the items (36) of the questionnaire proposed by Caballero *et al*. (2014), while 14 items from Auzmendi's (1992) questionnaire were selected for Attitudes, and from the questionnaire proposed by Fernández *et al*. (2016) 10 items associated with emotions were included. Each item is assessed using a Likert scale with five response levels. Before data collection, the researchers obtained permission from the educational institution to contact the legal representatives of each minor informant, who voluntarily agreed to have their children fill out the questionnaire. Then, as mentioned above, the population consisted of all students enrolled between the fourth and eleventh grades during the year 2021 in a private educational institution, and from them a total of 283 students were selected in a non-probabilistic way to form the sample of this study.

RESULTS

The characteristics of the group of informant students are presented in Table 1, which shows that they are predominantly female, with an average age of 13 years, 74% of them between 12 and 14 years of age. Approximately two out of every three students live in households made up of their biological parents and siblings. Approximately 45% of the students are enrolled in grades 6 to 9. Finally, it was identified that 87% of them like and enjoy the mathematics classes that take place at the school.

Table 1. Demographic and academic profile of surveyed students.

Characteristic	Answer options	Percentage
Gender	Female	68.6%
	Male	31.4%
	Total	100.0%
Age Range	Between 9 and 11 years old	26.9%
	Between 12 and 14 years old	34.6%
	Between 15 and 17 years old	38.5%
	Total	100.0%
Persons with whom you live	Both parents and siblings	70.4%
	Only with one parent and siblings	21.0%
	Other relative	8.6%
	Total	100.0%
Level of schooling you are currently enrolled in	Primary school	22.9%
	Basic Secondary	44.8%
	Technical High School	32.3%
	Total	100.0%
Do you like math classes?	Yes	87.0%
	No	13.0%
	Total	100.0%

Initially, an attempt was made to find out whether this manifest liking for the subject was influenced by the student's gender. Then, using Table 2, it was possible to verify that the liking for the subject in the educational institution is independent of gender. This result coincides with Gil *et al*. (2006) who

conclude that self-confidence and the confidence that students experience when solving mathematical situations are not correlated with the student's gender so that the mathematical self-concept is not conditioned by the biological characteristics of the person.

Table 2. Contingency table on subject liking according to gender.

		Do you like math classes?		Total
		No	Yes	
Genre	Female	12,4%	87,6%	100,0%
	Male	14,3%	85,7%	100,0%
	Total	13,0%	87,0%	100,0%

Characterization of the basic descriptors of the affective domain toward mathematics

Next, the beliefs, attitudes, emotions and degree of conformity that students have towards mathematics are characterized, taking into account the fundamental role they play in specific terms of liking or rejection in the teaching-learning processes of mathematics. But before doing so, it is necessary to review the validity of the instrument used in the measurement of each of the basic descriptors of the affective domain, since it has been constructed, by the researchers, from the instruments outlined in the background review. Table 3 shows that the value of Cronbach's Alpha coefficient obtained for each of the constructs evaluated is evidence of good internal consistency, as described in Oviedo and Campo-Arias (2005).

Table 3. Validity report of the instrument used.

Construct	Number of Items	Cronbach's Alpha Coefficient
Beliefs	36	0.893
Attitude	14	0.854
Emotions	10	0.791
Affective Domain	60	0.839

Beliefs toward Mathematics

Considering that the affective dimension has a great impact on learning, as well as on the teaching of mathematics education, we proceed to characterize the beliefs, attitudes, emotions and the degree of conformity that students present towards mathematics, being decisive factors in these processes.

For simplicity in the interpretation of the results, the researchers have decided to reduce the response levels for each item from five to three: agree, indifferent and disagree. From the results shown in Table 4, it was possible to identify that on average 57% of the beliefs considered have been accepted by the students, which could be grouped into three possible categories: a) Beliefs of the student towards mathematics, within which at least 80% of the cases the valuation of mathematics for its applicability in life, the search for various forms or methods of solution to a proposed situation together with dedicating sufficient time to study the subject, as referred to in the findings of Fernández-Cézar *et al*. (2019); b) Beliefs towards the Mathematics teacher, highlighting with at least 80% of the cases aspects such as the good relationships they have, the availability of the teacher to explain and clarify the doubts that arise from the educational process and the interest he/she has on the academic progress of the students, coinciding with the findings of the research of Duarte *et al*. (2018) who affirm that the teacher plays a leading role in the student's learning process; c) Family beliefs towards Mathematics,

highlighting the confidence they have in them at home in obtaining optimal results in this subject. Of the statements rejected by at least one out of every two students surveyed, aspects such as associating that difficulties in Mathematics influence subjects of a similar nature or that luck influences obtaining the correct answer to proposed situations or giving up at the first attempt stand out.

Table 4. Assessment of students' beliefs about mathematics.

Items Beliefs	Response Level		
	Agree	**Indifferent**	**Disagree**
Mathematics is useful and necessary in all aspects of life.	81.2%	9.9%	8.9%
Mathematics is difficult, boring and far from reality.	14.3%	25.6%	60.1%
In Mathematics it is essential to learn by heart the concepts, formulas and rules.	62.7%	16.6%	20.6%
Almost all math problems can be solved in a few minutes, if you know the formula, rule or procedure that the teacher has explained or that is in the book or guide.	63.2%	17.0%	19.7%
The best way to learn mathematics is through self-study.	39.4%	31.4%	29.2%
When trying to solve a problem, the result is more important than the process followed.	31.0%	21.2%	48.0%
The skills or abilities used in mathematics classes to solve problems have nothing to do with those used for everyday problems.	35.9%	25.1%	39.0%
When solving a problem in mathematics, I look for different ways or methods of solution.	78.9%	9.4%	11.6%
My enjoyment of mathematics has influenced my academic decisions	56.5%	26.5%	17.1%
Good students in mathematics are more valued and admired by their peers.	47.1%	26.0%	26.9%
Because I do not understand mathematics, it is difficult for me to understand and master other mathematics-related subjects	28.7%	19.7%	51.6%
Achievement in mathematics depends largely on the teacher's attitude toward the student	65.9%	15.2%	18.8%
When more study time is devoted to mathematics, better results are obtained.	80.7%	10.8%	8.5%
When I solve a problem I tend to doubt whether the result is correct.	68.6%	15.2%	16.1%
I have confidence in myself when faced with math exercises or problems.	48.9%	22.0%	29.2%
I consider myself very capable and skilled in mathematics.	52.9%	25.1%	21.9%
I am calm and composed when I solve math exercises or problems	50.2%	19.3%	30.5%

When I put effort into solving an exercise or problem in mathematics, I usually arrive at the correct answer.	75.3%	13.9%	10.8%
Luck plays a role in successfully solving a math exercise or problem.	22.5%	18.8%	58.7%
In mathematics classes, teachers use a variety of means and practical examples that allow students to relate mathematics to everyday life.	70.8%	15.2%	13.9%
Mathematics teachers are always ready to help with any doubts or difficulties that arise during class.	84.3%	6.3%	9.4%
My relationships with mathematics teachers have been satisfactory.	80.3%	12.6%	7.1%
Good mathematics teachers are characterized by explaining with enthusiasm and clarity, producing pleasure and enjoyment for mathematics.	84.8%	8.1%	7.2%
Mathematics teachers are interested in the student's evolution and academic performance.	84.3%	7.6%	8.1%
In math class teachers value effort and recognize the student's daily work in the subject.	75.8%	13.0%	11.2%
Some of my parents have expected good results in mathematics from me.	84.3%	8.1%	7.6%
My parents have encouraged and helped me with math problems.	69.0%	16.6%	14.4%
My friends do not like mathematics	40.8%	36.8%	22.4%
Mathematics is important because the best paying professions are related to it	40.8%	33.2%	26.0%
People who like mathematics tend to be a bit rare.	26.9%	23.8%	49.3%
Increasing one's mathematical knowledge makes a person feel competent in society	48.0%	30.5%	21.5%
Mathematics is for intelligent and creative people	22.9%	31.8%	45.3%
Mastering math makes it easier to succeed in other subjects.	49.7%	26.9%	23.3%
Mastering mathematics will allow me to be a successful person in the future.	53.4%	27.8%	18.9%
When faced with a complicated problem, I tend to give up easily.	26.0%	23.8%	50.3%
People who are good at mathematics do not have to spend a lot of time thinking about how to solve a problem.	61.0%	22.0%	17.1%
Average	**56.8%**	**18.8%**	**24.4%**

Attitudes toward Mathematics

Attitudes are usually known as the behaviors or dispositions that a person has when faced with specific situations. From Table 5 it can be observed that on average approximately 62% of the attitudes have been positively valued by at least 70% of the students surveyed, highlighting the role of the teacher as the main generator of positive attitudes in the students towards the subject, based on his attitude, communication and interest in the student, which added to the dedication and personal effort, could

guarantee favorable results in Mathematics. In a complementary way, it is highlighted that one out of two respondents ratify that good results in Mathematics are not a matter of luck of considering a person out of the ordinary. Gamboa (2014) recognizes the influence on mathematics learning of what students feel, perceive, do or believe, together with what "teachers feel, perceive, their expectations, beliefs and attitudes regarding the discipline, also play an important role in the type of teaching they do and the affective dimension of their students" (p. 117).

Table 5. Students' Assessment of Attitudes toward Mathematics.

Items	Response Levels		
	Agree	**Indiferent**	**Disagree**
When I try hard to solve math exercises, I usually come up with the correct answer.	70.4%	19.7%	9.9%
Luck plays a role in the success of a math exercise	24.2%	22.9%	52.9%
I find mathematics easier when the teacher in class uses different examples that allow me to relate mathematics to everyday life situations.	75.8%	15.7%	8.5%
When I see the teacher's willingness to clarify doubts that arise during class, I feel more interested in mathematics.	78.9%	13.5%	7.6%
Having good communication with the mathematics teacher awakens my interest in studying the subject.	79.4%	15.2%	5.3%
If the teacher explains with clarity and joy, it makes me like mathematics.	83.9%	12.6%	3.6%
I feel committed to mathematics when the teacher is interested in my academic performance.	73.5%	16.6%	9.9%
I feel committed to mathematics when the teacher appreciates my effort in the subject.	82.1%	12.6%	5.4%
Having a family member who likes mathematics, I feel attracted to study it	40.8%	32.3%	26.9%
I feel different from others because I like mathematics.	22.5%	27.4%	50.2%
As I learn more Mathematics, it makes me feel like a competent person in society	50.2%	24.7%	25.1%
I feel confident when I solve math exercises.	59.7%	22.9%	17.5%
Mastering Mathematics will enable me to succeed in my further studies.	64.6%	20.2%	15.3%
Being good at Mathematics helps me to perform well in other subjects.	57.4%	28.3%	14.4%
Average	**61.6%**	**20.4%**	**18.0%**

Emotions brought about by the study of Mathematics

For Sutil (2013), emotion is an "intense affective alteration that accompanies or immediately follows the experience of a happy or unhappy event" (p. 351), so emotions demand cognitive processing that originates physiological responses. From Table 6, it can be observed that on average approximately

55% of the emotions mentioned have been positively valued by at least 63% of the students surveyed, highlighting the happiness they experience when they correctly solve an exercise knowing that they have achieved it thanks to their perseverance and dedication or cooperative work, which is reflected in the curiosity they feel when exercises are proposed to them to be solved. It continues to ratify the rejection exhibited by one out of every two students surveyed when they give up at the first attempt when asked to solve mathematical situations. In Gómez (2003), it is stated that

Anxiety, fear, dread and despair are essentially undesirable affective states...[and]... the educator's challenge is to interrupt and interrupt negative feelings as a preliminary step to the necessary affective/cognitive reconstruction that must take place for the student's progress by finding didactic paths that favor these aspects (p. 127).

Table 6. Students' appraisal of emotions derived from the study of mathematics.

Items	Response Levels		
	Always	**Sometimes**	**Never**
I give up easily when I am asked to solve an exercise in mathematics.	17.1%	36.8%	46.2%
I am curious to know the answer when the teacher asks me to solve a math exercise.	63.2%	25.1%	11.7%
I feel nervous when the teacher asks me by surprise to solve a math exercise on the board.	49.8%	24.2%	26.0%
When I solve math exercises in a group, I feel calmer.	64.6%	22.4%	13.0%
When I don't get the solution to a math exercise, I start to feel insecure, anxious and nervous.	48.0%	31.8%	20.2%
If I don't find the solution to a math exercise, I feel like I have failed and wasted my time.	36.3%	24.2%	39.4%
I feel happy when I solve a math exercise correctly.	85.7%	10.3%	4.0%
When I fail to solve an exercise in Mathematics, I try again, but using another method of solution.	53.4%	29.1%	17.5%
Solving an exercise in Mathematics requires effort, perseverance and patience.	79.4%	15.7%	4.9%
I am calm and quiet when I solve Mathematics exercises	48.9%	30.0%	21.1%
Average	**54.6%**	**25.0%**	**20.4%**

Academic Performance in Mathematics

Students' knowledge in Mathematics cannot be measured by a single test; however, on this occasion and for this research, a knowledge test is used as a mechanism to rate the academic performance of each of the courses. These scores range on a scale of 0 to 10, from which the following performance levels are defined: a) Low Performance for scores below 5 points; b) Medium Performance for scores between 5 and 7 points; and, c) High Performance for scores above 7 points. From Table 7 it can be seen that approximately 66% of the students have obtained a score above the mean of the scale.

Table 7. Academic performance levels according to diagnostic tests.

Performance	Percentage
High Performance	34.1%
Medium Performance	31.8%
Low Performance	34.1%
Total	**100.0%**

Academic Performance in Mathematics and Affective Mathematics Proficiency

To identify the possible correlations between the various aspects evaluated in the affective domain and academic performance in Mathematics, the Pearson Chi-square test was applied, and Table 8 reports only those items that were significantly correlated with academic performance in Mathematics (approximately 18% of the total), highlighting aspects already mentioned in the antecedents cited in this paper.

Table 8. Items correlated with academic performance in the opinion of the students surveyed.

Construct	Item	Pearson's Chi-square
Beliefs	In mathematics classes, teachers use a variety of media and practical examples that allow students to relate mathematics to everyday life.	0.033
	Mathematics teachers are always willing to help with any doubts or difficulties that arise during class.	0.027
	My relationships with mathematics teachers have been satisfactory.	0.047
	Mathematics is important because the best paid professions are related to it.	0.003
	Mastering mathematics makes it easier to succeed in other subjects.	0.027
	Mastering mathematics would allow me to be a successful person in the future.	0.046
Attitudes	When I struggle to solve math exercises, I usually come up with the correct answer.	0.012
	I feel engaged in mathematics, when the teacher takes interest in my academic performance	0.034
	Being good at mathematics helps me to perform well in other subjects.	0.047
Emotions	I feel nervous when the teacher asks me by surprise to solve a math exercise on the board.	0.039
	Solving a math exercise requires effort, perseverance and patience.	0.014

CONCLUSIONS

After the completion of this pedagogical process, the following conclusions are drawn from the processing of the data collected, highlighting that the students surveyed have a positive perception of mathematics, regardless of gender, age or the course in which they were enrolled.

The influence that emotions, beliefs and attitudes have on the positive perception towards the subject demonstrated by the students is highlighted, possibly propitiated by the teachers who have oriented it in the educational institution, highlighting both pedagogical and human characteristics of their teachers and their relationship in the academic work of formation.

Taking into account that this research was carried out virtually due to the confinement derived from the Covid-19 pandemic and although the institution provided a space for the application of the instruments, the sample was obtained in a non-probabilistic way, a situation that prevents making inferences at the institutional level, but it becomes a precedent of the importance of the emotional component in the learning process of mathematics.

Finally, taking into account the limitations presented in this research, it is recommended to deepen and contrast in other areas that allow a broader analysis of possible factors that influence academic performance, allowing to contribute to quality education in the country.

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