# Student Attitudes towards Mathematics at Elementary Level and its Relationship with Student Academic Achievement

**Actitudes de los estudiantes hacia las matemáticas en el nivel de educación primaria y su relación con el rendimiento académico estudiantil**

*El Cálculo y su Enseñanza*

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**Abstract:** The focus of this study is on the affective domain. This quantitative study examined the attitudes towards mathematics and its relationship with academic achievement in elementary grades (from 4 to 6 grade) of 711 Mexican students. According to Auzmendi (1992), attitudes have a multidimensional nature which can be expressed through different factors such as confidence, preference, emotions, beliefs, feelings, and tendency behaviors. The adjusted version of the Attitudes toward Mathematics Scale was used (Auzmendi, 1992). This survey has 23 items to measure the student attitudes based on five factors: usefulness, anxiety, confidence, motivation, and preference for learning and teaching mathematics. Results presented that students' attitudes are strong associated with academic achievement in mathematics. Moreover, the five factors are significant associated with academic achievement.

**Keywords:** Affective domain, motivation, attitudes towards mathematics, confidence, anxiety.

**Resumen:** El enfoque de este estudio es en el dominio afectivo. Este estudio cuantitativo analiza las actitudes hacia las matemáticas y su relación con el aprovechamiento académico en los grados de primaria (de cuarto a sexto grado) de 711 estudiantes mexicanos. De acuerdo con Auzmendi (1992), las actitudes son en su naturaleza multidimensionales que puede ser expresadas a través de diferentes factores como confianza, agrado, emociones, creencias, sentimientos y tendencias de comportamiento. El instrumento utilizado es una versión modificada de la Escala de Actitudes hacia las Matemáticas de Auzmendi (1992). Esta escala incluye 23 ítems que miden las actitudes de los estudiantes hacia las matemáticas basadas en 5 factores: utilidad, ansiedad, confianza, motivación, y agrado. Los resultados muestran que las actitudes de los estudiantes están fuertemente relacionadas con el aprovechamiento académico en matemáticas. Cada factor esta significativamente relacionado con el aprovechamiento académico de los estudiantes en matemáticas.

**Palabras clave:** Dominio afectivo, actitudes hacia las matemáticas, motivación, ansiedad, confianza.

## 1. Introduction

Teaching and learning mathematics have been studied with an emphasis placed in the cognitive processes. According to Hidalgo, Maroto & Palacios (2004), research focuses on the socio-cultural domain and affective domain is needed. This study is focused on the affective domain of students for learning mathematics.

The affective domain consisted of internal and subjective processes of the human being such as feelings, emotions, disposition, attitudes, and beliefs. In this case, we are talking about the affective domain of students in regards of mathematics (Garcia-Gonzalez et al. 2021). This domain plays a significant role in the student success or failure in learning mathematics. A positive or negative affectivity influences student behavior in the classroom and student interest and academic achievement in mathematics (Gil, Guerrero & Blanco, 2006; Mejía et al. 2018). According to Cueli, González, Álvarez, García & González-Pineda (2014), "student emotions are an integral part of learning with a thick interaction of cognitive and conative processes" (p. 154). In other words, affectivity is related to student knowledge and behavior.

Mathematics is very important in the study plan at all grades (k-12). Mathematics allows students to develop logical reasoning skills, problem solving skills, and intellectual development. However, mathematics is a complex study area and cognitively inaccessible for many students (Núñez et al., 2004). This has an impact on the low academic achievement in mathematics. The Program of International Student Assessment (PISA) is a standardized test that measures academic achievement in mathematics. According to the results of 2018 PISA assessment, 44% of Mexican students obtained level 2 out 5, only 1 % got level 5 in mathematics which is below the OECD average (Organisation for Economic Co-operation and Development [OECD], 2019). In Mexico, the national assessment PLANEA (National Plan for Assessment of Learning, *Plan Nacional para la Evaluación de los Aprendizajes*), evaluates students´ academic achievement in mathematics across all grade levels. The results of this test showed that only 1 out of 10 students had a satisfactory or outstanding achievement in mathematics (Instituto Nacional para la Evaluación de la Educación [INEE], 2015). After these results, we can observe that students have a hard time to acquire mathematical knowledge.

Students do not possess the mathematical knowledge required by a specific grade level, thus, they move to next grade with a gap of knowledge (Chaves, Castillo & Gamboa, 2008). This critical problem is related to high dropout rates. According to Gomez (2003), students experiment with negative feelings toward mathematics such as anxiety, boring, disengagement, frustration, and negative attitudes. These affective descriptors may limit student learning. For instance, Voica et al. (2020) pointed out student emotions, attitudes and beliefs are critical in key stages for success in problem presenting and solving.

Student affectivity can be directed toward mathematics (as a science), mathematics classroom, mathematics specific-topic content knowledge, mathematics teaching, and mathematics teacher (Mejía et al. 2018). However, Gamboa (2014) mentioned that student "goes through teaching methods that do not allow him to understand the content or solve problems in class, which produces frustration… toward the mathematics classroom" (p. 120). It means most of the time the negative affectivity is toward teaching methods or teacher which influences mathematics learning.

Of great relevance is to conduct research on the affective domain of teaching and learning mathematics. As we mentioned previously, student feelings, beliefs, emotions, and attitudes toward mathematics are presented in classrooms and out of school settings that led students to succeed or fail. It is critical to know student affectivity to create learning environments that allows students to construct their mathematical knowledge.

The affective domain of teaching and learning mathematics is of great importance due to its impact on the education process (García & Farfán, 2018). As Estrada (2002) mentioned "the affective components condition student behavior and learning capability which reciprocally provokes affective reactions" (p.52). In other words, student attitudes, beliefs, and feelings toward mathematics are reflected on his behavior and learning skills. In the same way, it is worthy to know student affectivity, if this is negative "provokes predispositions or attitudes that affect student engagement in the learning process, and academic achievement" (Romero, Utrilla & Utrilla, 2014, p. 293). Studies have focused on emotions related to students´ achievement in different countries (Tze & Li, 2021). For instance, Anxiety is the factor that activates negative attitudes in students (OECD, 2017; Spangler et al., 2002).

Teachers play a critical role in the student affective domain, they can incorporate didactical situations that favor student learning. However, "most of the teachers do not know students' attitudes, they do not know how to measure them and how to determine if they are worthy for student achievement" (Auzmendi, 1992, p. 18). Therefore, conducting this research is important.

Núñez et al. (2004) pointed that "a shift of attitudes toward mathematics occurs throughout the different grade levels" (p. 2390). It means attitudes are varying from grade to grade. According to Auzmendi (1992), student attitudes tend to be positive at the first elementary grades, they change over time and become negative. In other words, student affectivity evolves unfavorably through the school years. This phenomenon is called attitudinal variation. Hence, it is vital to know when attitudes become negative to help teachers to intercede with an intervention that allows students to enhance their attitudes. Being cognizant of this, the affectivity of teaching and learning process is worthy of study. Research questions that guided this study are: (1) what are the students' attitudes toward mathematics through their transition from 4$^{th}$grade to 6$^{th}$ grade? (2) to what extent are students' attitudes associated with their academic achievement in mathematics?

The purpose of this study is to identify students' attitudes in 4$^{th}$, 5$^{th}$ and 6th grade. As well as to describe when students' attitudes toward mathematics become from positive to negative. In addition, we intend to identify factors that influence attitudinal variation and analyze if there is a relationship between students' attitudes and academic achievement.

## 2. Literature review

As mentioned before, the purpose of this study is to identify students' attitudes and see if there is a relationship between them and mathematics academic achievement. Several studies reported a relationship between student attitudes toward mathematics and academic achievement (Mata, Monteiro & Peixoto, 2012; Peng et al, 2024). They observed that students with high academic achievement have positive attitudes toward mathematics, in contrast of students with negative attitudes. Also, this was observed at the college level, students who were more motivated in mathematics they performed better (Petriz, Barona, López & Quiroz, 2010).

Studies also focused on factors that influence students´ attitudes and its impact on academic achievement in mathematics (Hwang, et al, 2021; Petriz et al., 2010; Peng, et al. 2024). Hwang, et al, (2021) mentioned the multidimensionality of attitudes which are shaped by likeness, value mathematics and confidence and influence academic achievement. Also, the preference toward mathematics is also associated with student achievement (Petriz et al., 2010). Student prior performance is also related to the students' attitudes towards mathematics, and it has its implication in their academic achievement (Fenech, 2025). Considering this gap, it is important to identify students' attitudes during several grades levels as well as their performance. This study focused on the variations in students' attitudes towards mathematics from $4^{th}$ to $6^{th}$ grade.

Gamboa (2014) mentioned that mathematics has become one of the most difficult subjects as well as the lowest achievement found there. Peixoto et al. (2017) mentioned how mathematics is perceived as a useful tool however it is considered as complex and scared. There are essential factors that influence on academic achievement such as "level of understanding in class, competency perception, preference, and confidence for participation in class" (Bazán, Espinosa & Farro, 2011, p. 66). In regards of confidence, affectivity is critical for success or failure in school. Intrinsic motivation, perception of competency, interest, and homework usefulness are key for attitudinal variation (Mata et al.,2012). Also, anxiety in a certain way lead students to performed proficient in mathematics (Batchelor et al. 2019; Garcia & Sierra, 2020; Petriz et al. 2010).

## 3. Theoretical framework

### 3.1 Affective domain

Mathematical Knowledge acquisition includes the relationship between the affective and cognitive domains. The affective domain is the focus of this study. The affective domain consists of the affective processes that a person goes through. As stated by McLeod (1989), the affective domain is "a wide range of feelings and moods that are generally regarded as something different from pure cognition. Beliefs, attitudes, and emotions are terms that express the range of affect involved in mathematical problem solving" (p. 245). Even though the focal point of this study is attitudes, its disjointing from other affective aspects, for instance, beliefs and emotions is not accomplished.

In the same way, Hidalgo et al. (2004) considered the affective domain encompasses the capability of knowing itself, success or failure attributing itself, being perseverant against difficulty, impetus controlling, self-concept, fear, emotional regulation, boring, empathy, etc. In other words, the affective domain is having emotional intelligence and being able to transfer it to the educational field to construct mathematical knowledge embracing favorable attitudes for learning. We can observe there is a link among emotions, beliefs, and attitudes. This link allows expressing affect through actions and behaviors that guide to succeed or fail in any situation.

### 3.1.1Attitudes toward mathematics

The objective of this study is to identify students´ attitudes towards mathematics. According to Auzmendi (1992), attitudes have a multidimensional nature which can be expressed through different factors such as confidence, preference, emotions, beliefs, feelings, and tendency behaviors. It means that these attitudinal factors affect student behavior and actions in positive or negative way.

Attitudes change depending on factors or situations that persons go through. Based on this, we pretend to argue what the attitudes variation of students was when they move to next grade level. As shown in several studies (Núñez et al, 2004; Hidalgo et al.,2004; Gil et al., 2006), when the school grade level of students is greater, their attitudes towards mathematics become negative.

Student attitude is influenced by emotions and beliefs related with mathematics throughout his or her educational experience. Depending on favorable or unfavorable student attitudes toward mathematics, it will allow to grasp or limit the mathematics learning. According to Auzmendi (1992), there are factors that influence attitudes toward mathematics such as usefulness, anxiety, confidence, motivation, and preference.

Anxiety is one of the attitudinal factors that shape attitudes towards mathematics. According to Auzmendi (1992), anxiety is a factor which refers to the fear against mathematics courses exhibited by students. Feelings of tension, nervousness, apprehension are involved (Caviola et al., 2022). Moreover, mathematics anxiety is defined “as a way of talking about the general

lack of comfort that someone might experience when required to perform mathematically" (Wood, 1988, p. 11).

According to Auzmendi (1992), the factor of preference means to like or enjoy the mathematics work. The factor of preference for learning and teaching mathematics means that students like or enjoy mathematics activities. Students learn better what they like it, thus, the preference promotes mathematics learning.

The usefulness factor reveals the meaning that students provide to the mathematics, as well as its efficacy for their further professional life (Auzmendi, 1992). In other words, usefulness indicates the value assigned to mathematics, and how it has to do with students´ academic future and real life.

Another attitudinal factor that influences attitudes towards mathematics is motivation. The motivation is a desire felt by the student to study and use mathematics (Auzmendi, 1992). It means an impetus that student feels about mathematics learning and its usefulness.

And the last attitudinal factor is confidence, which is about self-assurance produced by the mathematical skills (Auzmendi, 1992). In other words, to what extent students are sure and determined when they study mathematics.

## 4. Methodology

Attitudes toward mathematics are part of the affective domain of human being. However, they can be considered as multidimensional variables that can be quantified. Thus, this research is quantitative in nature. The methodological design consisted of two parts: a descriptive analysis of students' attitudes; and the second part is a correlational analysis of students' attitudes and academic achievement in mathematics. This design is in concordance of the two research questions.

### 4.1 Sample

The sample for this study consisted of 711 Mexican students. According to Tashakkori and Teddlie (2003), the convenience sampling strategy implies the selection of the sample that is "…both easily accessible and willing to participate in the study…" (p.170). This definition of sampling matched the process for sampling implemented in this study. The sample was

drawn from four elementary schools in Mexico. Those were three public elementary schools and one private. From this sample, 82% of the sample belonged to public schools, and the remaining 18%, were students in the private school.

Participating students were at 4th, 5th, and 6th grade. There were 254 students at 4th grade, 213 students at 5th grade, and 244 students at 6th grade. From this sample, 336 students were female (47.3%) and 375 were male (52.7%).

Four schools were in underprivileged areas. However, the public schools have all services for basic needs such as potable water and electricity. In classrooms, chairs and tables are in a poor condition, air conditioners were not working, and there was a shortage of didactical materials. In the private school, they have air conditioning, classrooms are well equipped with didactical materials and technology. The public schools are named as GRR, JG, YP and the private school is NM to identify their demographics (see Table 1).

**Table 1**

***Participating School Demographics.***

| Id School | GRR | JG | YP | NM |
|---|---|---|---|---|
| Student enrollment | 705 | 630 | 112 | 149 |
| Students per classroom | 39 | 35 | 20 | 27 |
| Teacher | 20 | 22 | 12 | 10 |
| Student achievement in mathematics | Deficient 90% | Deficient 74.2% | Deficient 38.9% | Deficient 61.1% |
| School Type | Public | Public | Private | Public |

## 4.2 Variables

The following independent variable was considered in the analysis of this study: the student attitudes toward mathematics which refers to the student preference, interest and curiosity toward the study of mathematics. The dependent variable is academic achievement. Student attitudes were measured through the Attitudes toward Mathematics Scale (Escala de Actitudes hacia las Matemáticas). Regarding the academic achievement, it was measured

through the students´ grades of the last evaluated period. Indeed, this helped us to answer the research questions of this study.

### 4.3 Instrument

The instrument used in this study is an adjusted version of the Attitudes toward Mathematics Scale (Escala de Actitudes hacia las Matemáticas) designed by Auzmendi (1992). The original survey was designed to measured attitudes of students at the high school and college level, thus the survey was adjusted for children of elementary school. This survey measured the student attitudes based on five factors: usefulness, anxiety, confidence, motivation, and preference for learning and teaching mathematics. The survey consisted of 25 items, however, two items were removed because the meaning was misunderstood by the students. The adjusted instrument has 23 items. The adjustment of this survey was basically about appropriateness of vocabulary without altering the meaning of the item. Only 5 items needed the vocabulary adjustment (see Table 2),

**Table 2**

***Items adjusted on the survey***.

| Item |
|---|
| 1. I think that Mathematics is an important subject for my education |
| 6. I want to know more about mathematics |
| 10. Mathematics is useful for people who want to be a scientific, but no for the remaining. |
| 11. Learning mathematics will allow me to have a job when I would be an adult. |
| 21. Study Mathematics class is the most important to be what I want when I grow up. |

Other adjustment done to the survey was the choices provided in each item. The adjusted survey has Likert scale items which choices are: yes, sometimes, few times, and no. As mentioned previously, this survey is divided by five factors (usefulness, anxiety, confidence, motivation, and preference for learning and teaching mathematics) that influence the attitudes

toward mathematics. The alpha coefficient technique (Cronbach, 1951) was implemented to assess the reliability of this adjusted instrument. The alpha coefficient is $\alpha = 0.8$, this means the items are internally consistent. In addition the alpha coefficient was computed for each factor: the items that measured anxiety are internal consistent ($\alpha = 0.74$); the alpha coefficient for the preference factor items reported an acceptable internal consistency ($\alpha = 0.63$); the alpha coefficient for usefulness factor items is $\alpha = 0.46$ which means.a low internal consistency among these items; the alpha coefficient for motivation factor items reported a high internal consistency ($\alpha = 0.7$); and the alpha coefficient for the confidence factor items is $\alpha = 0.23$ which indicates a low consistency. However, this instrument was implemented because its reliability and internal consistency as a whole instrument. Table 3 shows the items and their corresponding factor.

**Table 3**

***Items by factor***

| Factor | Items |
|---|---|
| Anxiety | The subject of mathematics is hard to me (La clase de matemáticas se me hace difícil). |
| | Studying math scares me (Me asusta estudiar matemáticas). |
| | The subject of mathematics scares me (La clase de matemáticas me da miedo). |
| | I trust in myself when I am solving a math problem (Confió en mi cuando resuelvo un problema de matemáticas). |
| | When I am solving a math problem, I cannot think right (Cuando resuelvo un problema de matemáticas, no puedo pensar bien). |
| | I keep calm when I am solving a math problem (Estoy calmado y tranquilo cuando resuelvo un problema de matemáticas). |
| | Studying math makes me feel nervous (Estudiar matemáticas me hace sentir nervioso). |
| | Mathematics makes me feel uncomfortable (Las matemáticas hacen que me sienta incómodo). |
| Preference | Using math is fun (Usar matemáticas es divertido). |
| | It is fun to talk about mathematics with others (Me divierte hablar con otros de matemáticas). |
| | Mathematics are nice and I like it (Las matemáticas son agradables y me gustan). |
| | If I can attend more mathematics classes, I will do it (Si pudiera, tomaría más clases de matemáticas). |
| Usefulness | I think that Mathematics is an important subject for my education(Considero a las matemáticas como una clase importante en mi educación). |
| | I want to know more about mathematics (Quiero saber más matemáticas). |

| | |
|---|---|
| | I hope to use rarely mathematics in my future professional life (Espero usar poco las matemáticas en mi vida profesional). |
| | I think that there are other subjects more important than mathematics for what I want to study (Considero que existen materias más importantes que las matemáticas para lo que quiero estudiar). |
| | I would like to have a job where mathematics are used (Me gustaría tener un trabajo donde se usen las matemáticas). |
| | Study Mathematics class is the most important to be what I want when I grow up. (La clase de matemáticas es la más importante para lo que quiero estudiar de grande). |
| Motivation | Mathematics is useful for people who want to be a scientific, but no for the remaining (Las matemáticas son útiles para quienes quieren ser científicos, pero no para los demás). |
| | Mathematics class is bored (Es aburrida la clase de matemáticas). |
| Confidence | Learning mathematics will allow me to have a job when I would be an adult (Saber matemáticas permitirá que cuando sea mayor tenga un buen trabajo). |
| | I feel good when I solved mathematics problems (Me siento bien cuando resuelvo problemas de matemáticas). |
| | If I wish to learn mathematics proficiently, I can do it (Si yo quisiera, podría saber bien las matemáticas). |

In regards of the variable academic achievement, the students' grades of the 4$^{th}$ evaluated period are the values considered. These grades are from 1 to 10. Then, we conducted a correlational analysis between both variables: attitudes toward mathematics and academic achievement.

### 4.4 Data Analysis

A descriptive and inferential analysis was performed according to the methodological design. To answer the first research question, descriptive statistics were applied. For the inferential analysis, data analysis was conducted using a correlational analysis (Pearson coefficient) to identify any relationship between students' attitudes toward mathematics and academic achievement. The use of this parametric technique was conducted to respond the second research question.

The variable of academic achievement has been categorized according to the grades for the analysis. Table 4 shows the academic achievement categories and their corresponding grades. All the procedures of this descriptive and inferential analysis were performed using the tool for data analysis of the Statistical Package for the Social Sciences software (SPPS).

**Table 4**

***Academic Achievement Categories.***

| Category | Grade |
|---|---|
| Outstanding | 10 |
| Excellent | 9 a 9.9 |
| Good | 8 a 8.9 |
| Approved | 7 a 7.9 |
| Suspense | 6 a 6.9 |
| Failing | 5 a 5.9 |

## 5. Results

We conclude that students at the elementary grades (4th, 5th, and 6th) possess favorable attitudes toward mathematics. The results reported from 18 out of 23 items were positive attitudes. Only 3 items reported a negative attitude toward mathematics. In general, students´ attitudes toward mathematics are positive in elementary school.

The examination of students' attitudes was conducted through the mean scores of the items. A classification is defined to determine if attitudes are favorable or unfavorable. Mean scores from 1.0 to 2.5 refers to an unfavorable or negative attitude. Favorable or positive attitudes are located on the range from 2.6 to 4.0 mean scores.

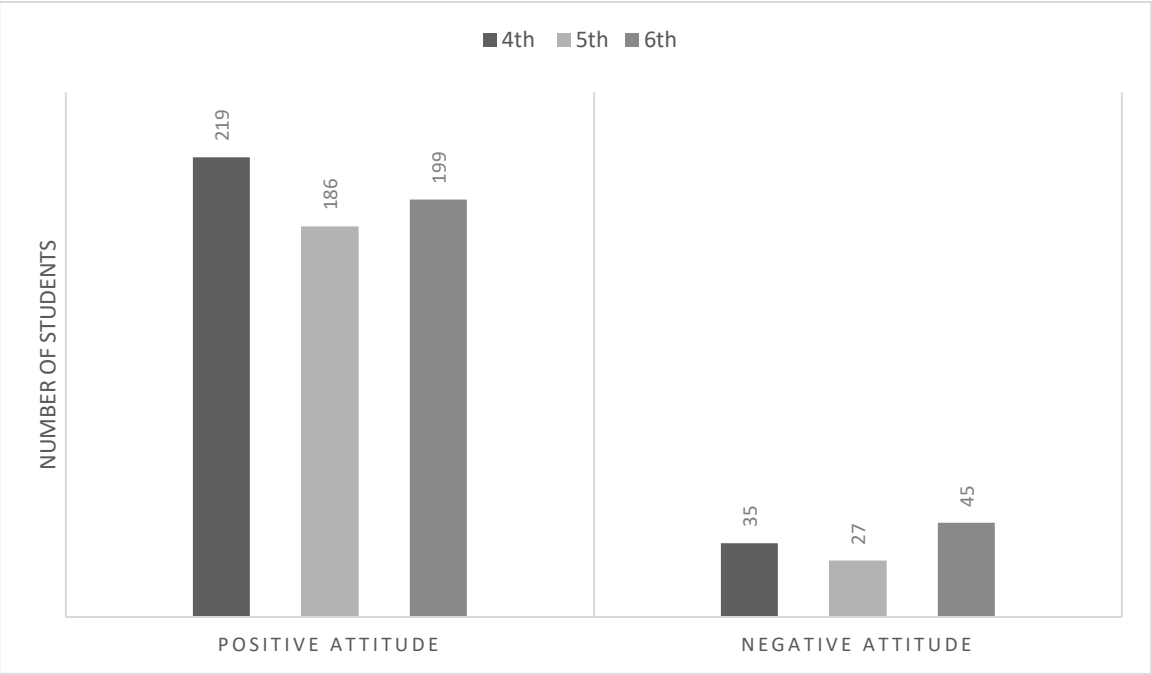


*Figure 1*. Students´ Attitudes towards Mathematics.

There were 604 students who possessed positive attitudes (85%) as presented in Fig 1. In the other side, there were 107 participating students with negative attitudes (15%). In other words, most of the students showed a favorable attitude toward mathematics. This agrees with Mato, Espiñeira and Chao (2014). They found that most of the students had a positive perception of their teachers, about themselves and mathematics.

The number of students per grade differs among them. There are 254 students at 4$^{th}$ grade, 213 students at 5$^{th}$ grade and 244 students at 6$^{th}$ grade. Figure 1 shows the students' attitudes. We can observe fifth grade students show a better attitude due to 87.3% has favorable attitudes. There are more students with a negative attitude at 6th grade (18.4%). However, students from 4$^{th}$, 5$^{th}$, and 6$^{th}$ grades have similarly favorable attitudes toward mathematics.

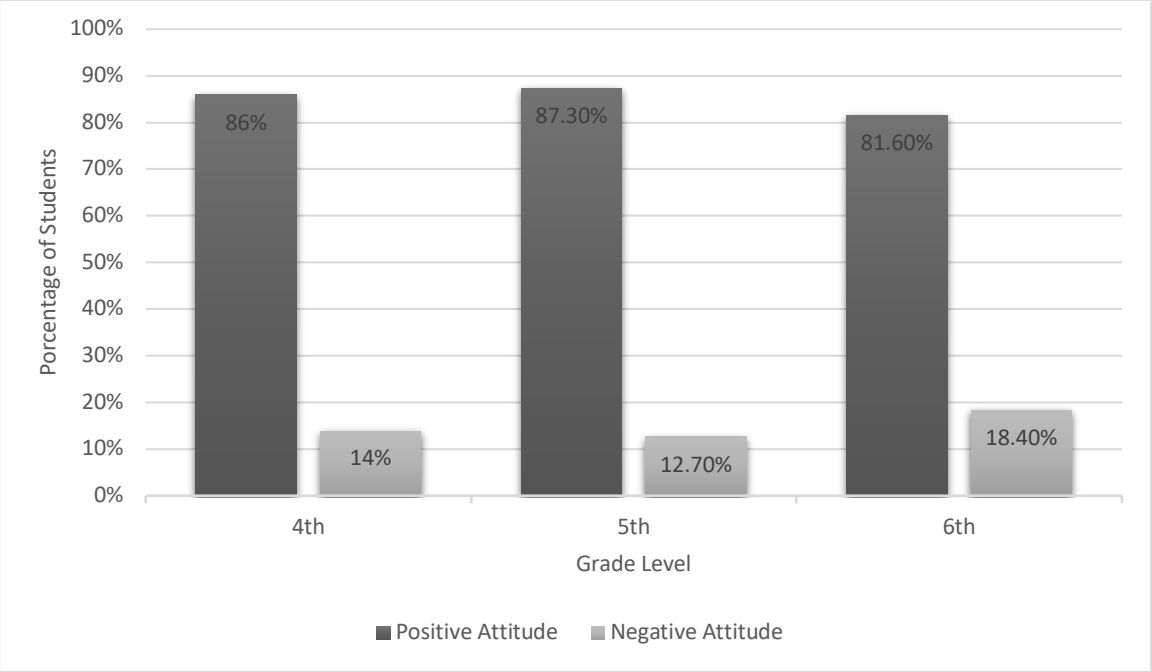


*Figure 2.* Students' attitudes toward mathematics per grade level

Figure 2 shows how the three grade levels have similar favorable attitudes. Also, we can observe 6th grade is which students' attitudes toward mathematics began to become negative because there is a growth up to 18.4%. Núñez et al. (2004) mentioned that a greater grade level, more negative attitudes toward mathematics are observed. In addition, results from the descriptive analysis of the attitudinal factors that shape attitudes towards mathematics are reported by factor.

**Anxiety**

According to Auzmendi (1992), anxiety is the fear that students express against the mathematics courses. The sample of this study possessed mathematics anxiety with a mean score of 2.86. The 4$^{th}$ graders showed more mathematics anxiety, followed them by the students of 5$^{th}$ grade and then 6$^{th}$ graders. Moreover, students who belonged to private schools had more mathematics anxiety than students in public schools. The students of this sample liked mathematics. These students had a mean score of 3.03 on preference for learning and teaching mathematics. Also, we reported that students who earned better grades presented more anxiety with a mean score of 3.4 (students in the category of outstanding).

Indeed, student mathematics anxiety promote a favorable attitude for learning. Due to a greater mathematics anxiety, attitudes toward mathematics are more positive. This result is

contrasting what is mentioned by Mato & Muñoz (2010). They found that if math anxiety increases, academic achievement decreases.

**Preference for learning and teaching mathematics**

The factor of preference for learning and teaching mathematics means to like or enjoy the mathematics work. Students learn better what they like it, thus, the preference promotes mathematics learning. The students of this sample liked mathematics. These students had a mean score of 3.03 on preference for learning and teaching mathematics. Students at 4$^{th}$ grade were who enjoyed more mathematics. 6$^{th}$ graders presented less preference for mathematics. Furthermore, students in public schools liked more mathematics (mean score of 3.06) than students at the private school (mean score of 2.89). We observed that students in the category of outstanding presented more preference for learning mathematics with a means score of 3.54. In addition, we add to the discussion that students enhance their grades when they like mathematics. In other words, the factor of preference for mathematics affects the students' attitudes toward mathematics.

**Usefulness**

According to Auzmendi (1992) the usefulness factor reveals the meaning that students provide to the mathematics, as well as its efficacy for their further professional life. The results of this study reported that participating students perceived mathematics as useful (mean score of 2.94).

We did not find any significant difference in regards of the kind of school and the usefulness of mathematics. Regarding grade levels, 5$^{th}$ grade perceived more the usefulness of mathematics than 4$^{th}$ and 6$^{th}$ grades, even though 6$^{th}$ grade reported the lowest mean score of usefulness. We also observed when students enhanced their grades in mathematics, they also perceived more the usefulness of mathematics. For instance, students who failed mathematics obtained a mean score of 2.58 in comparison with outstanding students (mean score of 3.28). Summarizing, we can say the usefulness factor influence the formation of the positive students' attitudes toward mathematics.

## Motivation

The motivation factor is a desire felt by the student to study and use mathematics (Auzmendi, 1992). The participants of this study showed motivation toward mathematics, the mean score was 2.90. The fifth graders were more motivated toward mathematics with a mean score of 2.99. The less motivated students were at 4th grade (mean score of 2.80). Moreover, students who belong to private schools were more motivated (mean score of 2.98) in comparison with students from public schools (mean score of 2.89).

In regards of the academic achievement and motivation factor, we found that students' grades in mathematics improved when students' motivation toward mathematics increased. For instance, students who were failing had a mean score of 2.79 in the motivation factor, and students with outstanding grades had a mean score of 3.35. Summarizing, we can say that motivation have an effect on the attitudes toward mathematics. Mata, Monteiro & Peixoto (2012) mentioned that the negative change in the attitudes toward mathematics is associated with the students' intrinsic motivation. Thus, student motivation shapes the attitudes towards mathematics.

## Confidence

Confidence refers to the feeling of assurance that provokes ability in mathematics (Auzmendi, 1992). Students from the sample of this study showed very good self-confidence during their studies in mathematics (mean score of 3.5). Students presented confidence in learning mathematics: at $4^{th}$ grade, there was a mean score of 3.54; at $5^{th}$ grade, the mean score was of 3.52; and at $6^{th}$ grade, the mean score was of 3.47. We can observe that students' confidence declined steadily throughout these grade levels. In this study, students from private and public schools presented the same confidence (mean of 3.51). In addition, we can see that students with better grades had more confidence. For instance, outstanding students had a mean of 3.79 in confidence.

Indeed, participants of this study showed high self-confidence during mathematics learning. These results show the great influence that confidence has on the students' attitudes toward mathematics. According to Gómez (2009), studying mathematics promotes confidence for learning and solving problems.

### 5.1 Relationship between attitudes toward mathematics and student academic achievement

The following results answered the research question: to what extent are students' attitudes associated with their academic achievement in mathematics? Academic achievement was measured through the students' grades of the last assessed period (fourth period). We used the categories presented in Table 2. These categories are: outstanding (grade of 10), excellent (grades from 9.0-9.9), good (grades from 8.0-8.9), approved (range of 7.0-7.9), suspense (range of 6.-6.9), Failing (range of 5.0-5.9). Figure 3 presents the students' grades distribution by category.

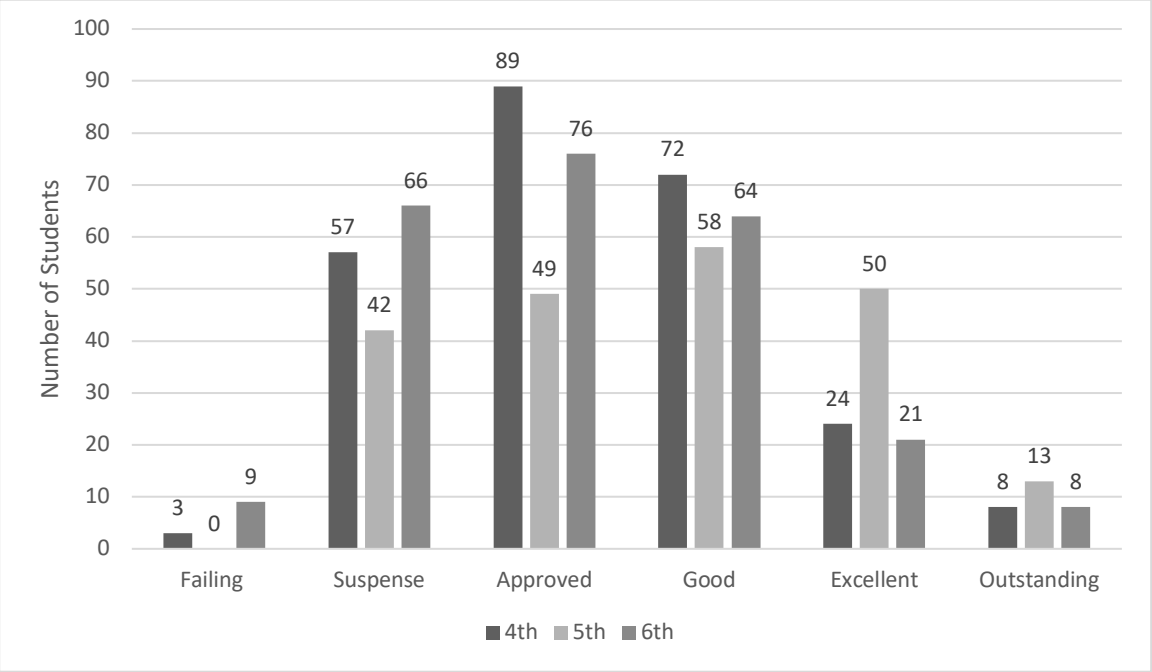


*Figure 3*. Students' Academic Achievement.

In Figure 3, we can observe students' grades by category of academic achievement. In the category of failing, there is a percentage of 1.7% of the students. A 23.2% of the students are in the category of suspense. There is a 30.1 % of students under the category of approved. This is the category which has more students. In the category of good, there is a 27.3% of students. The 13.4% of students have an excellent grade. Only 4% of students have an outstanding academic achievement.

The mean score of the sample was of 7.66 in academic achievement in mathematics. Breaking down this data by grade level, we found the following mean scores: it is a mean of

7.6 at the 4th grade; 8.0 is the mean score for 5th grade; and for 6th grade, the mean is 7.4. In addition, we analyzed the data by grade levels and academic achievement. In the category of failing, there is a 1.2% of 4th grade students. There is 3.2% of students with an outstanding academic achievement at 4th grade. Regarding fifth grade, there is no failing students, and there is 6.1% students with an outstanding academic achievement. Analyzing 6th graders, 3.7% are in the failing category, however, 3.3% of these students have an outstanding academic achievement.

In other words, 5th grade classrooms did not report any failing grade. However, 6th grade had the biggest number of failing students. In regards of outstanding academic achievement students, 4th grade had the fewest number of students, and 5th grade had the greatest number of students. Thus, 5th grade students have the best academic achievement, due to the number of outstanding students (greatest number) and failing students (smallest number).

A correlational analysis between the attitudes toward mathematics and the academic achievement was conducted. The results reported a statistically significant correlation ($r(711)=.283$, $p<.01$). This means that the students' academic achievement in mathematics are better when students' attitudes are positive. This result is in concordance with Gargallo et al. (2007), Mata, Monteiro & Peixoto (2012), they mentioned that students with positive attitudes earn better grades. Moreover, we can observe the 5th grade students had better grades and showed positive attitudes toward mathematics. However, students at the 6th grade presented more unfavorable attitudes toward mathematics and poor academic achievement in mathematics class.

Furthermore, we analyzed if the factors that influence the attitudes toward mathematics (usefulness, anxiety, confidence, motivation, and preference for learning and teaching mathematics) are correlated with student academic achievement as shown in Table 5. There was a significant correlation between students' anxiety and academic achievement in mathematics ($r(711)= .272, p <.01$). In other words, there is a relationship between anxiety and academic achievement. This indicates that students who presented more anxiety, they got better grades in mathematics. This is an unexpected result. Zubeidat, Fernández, Sierra & Salinas (2007) mentioned that higher levels of anxiety led to deficient learning which

preceded to a poor academic achievement. However, we reported the participating sample showed better grades when they felt anxiety.

**Table 5**

***Correlations Among Academic Achievement and Each Factor***

| Factor | Academic Achievement |
|---|---|
| Anxiety | .272** |
| Preference for Learning and Teaching | .133** |
| usefulness | .170** |
| motivation | .247** |
| confidence | .192** |

** Significant correlation at 0.01 level

The preference for learning and teaching mathematics factor is associated with students' academic achievement ($r(711) = .133$, $p < .01$). This reveals a statistically strong correlation between the preference for learning and teaching mathematics is associated with students' academic achievement. This means that students with better grades in mathematics showed more preference for mathematics. In addition, students with lower grades presented less preference for mathematics.

In regards of the usefulness factor, there is a significant correlation between mathematics usefulness and student academic achievement ($r(711) = .170$, $p < .01$). In other words, students with better grades perceived more usefulness of mathematics than students who got low grades. However, students perceive less the usefulness of mathematics when they go through more advanced mathematics courses (Núñez et al. 2004).

There is a statistically significant correlation between the motivation factor and academic achievement ($r(711) = .247$, $p < .01$) as shown in Table 5. This correlation means that students who earn good grades in mathematics courses are more motivated toward mathematics than students with low grades. According to Petriz et al. (2010), students who are well motivated toward mathematics perform better in their mathematics classes.

We report a correlation of $r(711) = .192$, with a $p<.01$ between the factor of confidence and academic achievement (see Table 5). This showed a strong relationship between students' confidence and academic achievement in mathematics. On one side, students who earned better grades in mathematics courses presented self-confidence. On the other side, students with low grades showed less self-confidence in learning mathematics.

In conclusion, several significant results were obtained in regards of student academic achievement and the five factors that influence attitudes toward mathematics. We reported positive correlations among the variables mentioned. We can say that students who are better motivated, feel more preference for mathematics, possess more self confidence in mathematics, better identify the usefulness of mathematics and feel more anxiety, are the students who earn better grades in mathematics.

## 6. Conclusions

The results of this study report that students possess positive attitudes toward mathematics 4th, 5th, and 6th grades. These students showed interest for learning mathematics. They perceived the usefulness of mathematics. Also, the participating students presents mathematics anxiety. It was evident that attitudes are becoming negative through more advanced grade levels. For instance, 4th and fifth graders show a positive attitude toward mathematics, however, the number of students with negative attitudes is higher at 6th grade. As Nuñez et al. (2004) mentioned the attitudes toward mathematics evolve negatively at the time students transit to the next grade levels. Moreover, we reported a significant correlation ($r=.283$, $p<.05$) between attitudes toward mathematics and academic achievement. In other words, students with good academic achievement presented more positive attitudes (Gargallo et al, 2007) and students with more positive attitudes enhance their grades in mathematics.

A contrasting finding reported that students who earned better grades presented more anxiety. This result is opposing what is mentioned by Mato & Muñoz (2010). They found that if math anxiety increases, academic achievement decreases. This result adds to the discussion that anxiety may guide students to become handworkers to study mathematics. This fear or discomfort felt by students can be readdressed to promote a successful academic achievement. Thus, anxiety can be interpreted as an advantage that helps students to do their mathematics work making their best effort. Zimmerman (2000) and Bandura (1997) argued

that the presence or absence of anxiety does not the impact on academic achievement, the intensity of anxiety is what really affects in a positive or negative way. Students surveyed may have low level of intensity and used it to perform successfully in mathematics. According to Peng et al (2024) mathematics anxiety regulates the reciprocal relations between mathematics self-efficacy and mathematics academic achievement. They found that low levels of anxiety can influence positively the self-efficacy and the academic achievement relation. Therefore, anxiety in a certain way led students to performed proficient in mathematics (Batchelor et al. 2019; Garcia & Sierra, 2020; Petriz et al. 2010).

Summarizing, it is concluded that attitudes towards mathematics influence students' success or failure during mathematics learning, as mentioned by Gil, Guerrero and Blanco (2006). In the same way, students' attitudes shown in class affect their behavior and perception toward the mathematics teacher. Therefore, it is of great relevance to be cognizant of the affective domain involved in mathematics learning and teaching process.

### 6.1 Contributions to the practice/theory

This study contributes to the field with evidence of the influence of students´ attitudes on academic achievement. Thus, students' attitudes should be considered by teachers. Also, the affective domain should be included in the curriculum to help students to learn about their attitudes and achieve quality in mathematics education. Being cognizant of this, a proficient academic achievement in mathematics can be encouraged.

This research allowed teachers to identify their students' attitudes toward mathematics. The Attitudes toward Mathematics Scale provides teachers information to know if their students have mathematics anxiety, preference for mathematics, and mathematics usefulness. Also, using this scale, teachers can identify their students' motivation and self-concept toward mathematics during learning mathematics. Once the students' attitudes are identified, teachers can consider them and design lesson plans with activities that engage students and promote positive attitudes. All this to enhance students' academic achievement.

### 6.2 Limitations

This study has several limitations. One limitation is the discrepancies among the different groups in the sample. For instance, there are more males than females, there are less five

graders, most of the participants belonged to public schools (four public schools and one private school participated in the study).

Other limitation was the arrangement of the number of items of the Attitudes toward Mathematics Scale per factor. The adjusted instrument has 23 items: 8 items are about mathematics anxiety, 4 items are about preference toward mathematics, 6 items focused on usefulness, 2 items analyzed motivation, and 3 items measure the confidence. It would be more appropriate to have the same number of items per factor to have a more accurate measure. Moreover, there is a low internal consistency among the items of usefulness and confidence factors. However, the instrument was already validated with a high internal consistency according to its alpha Cronbach coefficient as a whole instrument.

Summarizing, this research presents the relevant role that the affective domain plays on learning mathematics. Specifically, the focus of this study was on student attitudes toward mathematics which include preference, worthiness, interest, and appreciation for mathematics classes from the affective domain perspective. The correlation between attitudes and academic achievement in mathematics was reported by gender, grade level, and type of school. Therefore, it is evident that several factors influence student attitudes toward mathematics which intervene in the process of learning and teaching mathematics.

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