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Socio-educational characteristics are associated with the choice of operation in additive questions and in multiplicative questions

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Abstract

The term socio-educational constitutes something that at the same time relates education and society, in which it extends to any dimensions that include these two aspects of the individual. Therefore, to guide the research conducted in this thesis cut, the following guiding research question was created: Do socio-educational factors interfere in the process of choosing the operation in additive or multiplicative issues? To answer this guiding question, the objective of the research was to analyze whether the student's socio-educational characteristics interfere in the choice of operation to solve additive and multiplicative questions. The instrument used to perform this analysis if there is a statistical association between the objects studied was the Chi-Square association test. The data obtained by the socio-educational questionnaire processed through the association test indicated that there was a statistical association between the choice of operation in questions and factors referring to the student's relationship with mathematics and its study.
Keywords: Mathematics Education, Socio-educational Questions, Choice of operation, Problem-solving.

Las características socioeducativas están asociadas a la elección de la operación en cuestiones aditivas y en cuestiones multiplicativas

Resumen

El término socioeducativo constituye algo que al mismo tiempo relaciona la educación y la sociedad, extendiéndose a cualquier dimensión que contemple estos dos aspectos del individuo. Ante esto, para guiar la investigación realizada en este recorte de tesis, se formuló la siguiente pregunta orientadora de investigación: ¿Factores socioeducativos interfieren en el proceso de elección de la operación en cuestiones aditivas o multiplicativas? Para responder a esta pregunta orientadora, el objetivo de la investigación fue analizar si las características socioeducativas del estudiante interfieren en la elección de la operación para resolver cuestiones aditivas y cuestiones multiplicativas. El instrumento utilizado para realizar este análisis de si hay asociación estadística entre los objetos estudiados fue el test de asociación Chi-Cuadrado. Los datos obtenidos por el cuestionario socioeducativo procesados mediante el test de asociación, indicaron que hubo asociación estadística entre la elección de la operación en cuestiones y factores referentes a la relación del estudiante con las matemáticas y su estudio.
Palabras clave: Enseñanza de Matemáticas, Cuestiones Socioeducativas, Elección de la operación, Resolución de cuestiones.

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Características socioeducacionais estão associadas à escolha da operação em questões aditivas e em questões multiplicativas

Resumo

O termo socioeducacional constitui algo que ao mesmo tempo relaciona a educação e a sociedade, em que se estende a quaisquer dimensões que contemplem esses dois aspectos do indivíduo. Diante disso, para guiar a pesquisa realizada nesse recorte de tese, foi constituída a seguinte questão norteadora de pesquisa: Fatores socioeducacionais interferem no processo de escolha da operação em questões aditivas ou multiplicativas? Para responder à essa questão norteadora, o objetivo da pesquisa consistiu em analisar se as características socioeducacionais do estudante interferem na escolha da operação para resolver questões aditivas e questões multiplicativas. O instrumento utilizado para realizar essa análise se há associação estatística entre os objetos estudados foi o teste de associação Qui-Quadrado. Os dados obtidos pelo questionário socioeducacional processados por meio do teste de associação, indicaram que houve associação estatística entre escolha da operação em questões e fatores referentes à relação do estudante com a matemática e seu estudo.

Palavras-chave: Ensino de Matemática, Questões Socioeducacionais, Escolha da operação, Resolução de questões

INITIAL CONSIDERATIONS

The term "socioeducational" refers to something that is simultaneously related to education and society, encompassing any dimensions that involve these two aspects of the individual. Contrary to popular belief, the concept of this term is not limited to formal education obtained through the school environment, but includes any educational institution, such as the family institution, that aims to shape the individual according to the social context in which they are embedded.

The teacher's knowledge of the student's reality opens up opportunities to better understand the challenges and possibilities in family and school interactions, so as not to exacerbate the already poor conditions of socioeducational inequality.

Currently, one of the major challenges faced by teachers is finding solutions to situations related to the social dimensions that involve the student. It is necessary for the teacher to always be aware that the student does not arrive at school classes, in mathematics or any other subject, without a social background that they bring with them. Whether it's from the family environment, the circle of friends, or any other social context they are part of. For example, Freire's (2019) approach highlights that education should be seen as a practice of freedom, not just as content transmission. For Alves (2003), school is an environment filled with diverse cultures that interact daily, necessitating the valorization of such expressions in the school routine. Charlot (2000) prompts reflection on the relationship students have with knowledge, a relationship that goes beyond pedagogical practices and content.

In a more contemporary sphere, Rosário et al. (2012) explore self-regulated learning, emphasizing the role of cognitive-motivational, socioeducational, and contextual variables in academic performance, especially in mathematics. Self-efficacy, self-regulation of learning, and even the student's context play a critical role in academic success. Additionally, Santos and Bacury (2022) discuss the need for a collaborative and investigative approach in

the training of mathematics teachers. Teacher training must adapt to current socioeducational demands, using investigative and collaborative practices to innovate and respond to contemporary challenges.

The context of the Covid-19 pandemic brought unprecedented challenges to education. Ramalho (2021) reflects on the actions of the Public Power and the consequences of the abrupt transition to remote learning. The pandemic intensified socioeducational inequalities, particularly in countries with marked socioeconomic disparities, such as Brazil. The difficulties faced by low-income students in accessing distance learning platforms only worsened existing inequalities. Thus, when addressing socioeducational issues, it is essential to consider both historical and contemporary aspects, always focusing on the reality and challenges students currently face, especially in mathematics education.

Grounded in this socioeducational approach, this article partially presents the results of doctoral research that analyzed the choice of operation in additive problems, multiplicative problems, and socioeducational issues. For this article, the focus was on analyzing the questionnaire on socioeducational issues applied. The results of the analyses for choosing operations in additive questions were presented by Lopes, Felix, and Sá (2023a, 2023b) and multiplicative questions by Lopes, Felix, and Sá (2022a, 2022b).

According to Lopes and Sá (2023), the choice of operation is often mentioned in academic studies on mathematical problem-solving, but it is rarely the central focus of the investigation. Usually, this choice is treated as secondary or as a complement in studies. The studies discuss the use of keywords (Nesher & Teubal, 1975), strategies for choosing operations (Bell et al., 1984), focus on indirect resolution of the chosen operation (Afekenstam & Greger, 1983), types of questions for choosing the operation (Sá & Fossa, 2008), among others.

In light of this, to guide the research conducted in this thesis excerpt, the following guiding research question was established: Do socioeducational factors interfere in the process of choosing the operation in additive or multiplicative questions? To answer this guiding question, the research aimed to analyze whether the socioeducational characteristics of the student interfere in the choice of operation to solve additive and multiplicative questions.

The structure of the text for presentation to the reader was divided into four parts, excluding this Introduction and the Final Considerations, namely: Production of information; The socioeducational questionnaire; Chi-Square test as an instrument for analyzing the produced data; and Analysis of the socioeducational questionnaire.

PRODUCTION OF INFORMATION

The data production occurred during the first term of 2020 at a state school located in the metropolitan region of Belém/PA. The research participants were students whose only requirement to participate in the research was being enrolled in the 6th grade of elementary school at this school. The choice of this school year was made because the National Curriculum Parameters (PCN) state that by the end of the second cycle, students are expected to have acquired competencies and skills to solve questions involving operations with decimal numbers. In total, 207 students participated.

All research-related activities were conducted within a month. In each class, activities began with the researcher's presentation by the class teacher, where the researcher explained the research with emphasis on its main points such as objective, expected result, and the importance of the students in this process. Then, each student's guardian was asked to sign the Free and Informed Consent Form (TCLE) and each student, as they were all under 18, was asked to sign the Free and Informed Assent Form (TALE). A week was allocated for signing these documents, as some students were absent, forgot the documents at home, or even lost them and needed another copy. Thus, it was possible to maximize the number of students interested in participating in the research since every guardian or student accepted the invitation to participate. No type of subsidy such as assessment or other means was used to ensure student participation; it was entirely voluntary.

In the following week, the tests began in the classes and the questionnaires were administered to the students. As all classes had three weekly math lessons, these three instruments were not applied on the same day.

The first test administered was the additive one, in which students were asked to solve the question showing the calculations and not just the result. However, there were still some cases with only the result. In the next meeting, the multiplicative test was conducted, asking the same as the additive test, and in the last meeting of the week, the socioeducational questionnaire was applied, in which students were asked to fill out all the questions, and yet some questions remained unanswered. It is important to highlight, once again, that for this article a focus was made on the application and results of the socioeducational questionnaire.

THE SOCIOEDUCATIONAL QUESTIONNAIRE

Development of the Questionnaire

The questionnaire is defined as a research instrument composed of a series of questions on a specific topic. It is presented to research participants to answer the questions and

return the completed questionnaire to the researcher, who then converts the responses into statistics (Carmo & Ferreira, 2008; Fachin, 2006; Prodanov, 2013; Vieira, 2009).

To understand the socioeducational reality of the student, Gomes and Garcia (2014) suggest that a questionnaire can be an effective tool for this purpose. According to these authors, when constructed with open or closed questions, it is possible to outline a socioeducational profile with questions that relate to gender, age, profession, income, internet access, reading habits, most interesting subjects, didactic strategies of interest, among others.

Marconi and Lakatos (2002), reinforced by Becker (1997) and Fachin (2006), state that the questionnaire should be limited in length and purpose. If it is too lengthy, it can cause fatigue and disinterest, and if too short, it may not gather sufficient information. Furthermore, these authors mention that the questionnaire "obtains answers that would be materially inaccessible" (Marconi & Lakatos, 2002, p. 99). Gil (2008, p. 127) also asserts that "it is necessary to consider that generally respondents should not feel obliged to answer the questionnaire. For this reason, only questions that are strictly necessary to meet the research objectives should be included".

Regarding the form of response from the respondents, questions in a questionnaire can be classified into two types: open or closed. Open questions, according to Marconi and Lakatos (2002, p. 101), "[...] allow the informant to respond freely, using their own language and expressing opinions". Sampieri, Collado, and Lucio (2013, p. 239) suggest that these questions "do not predefine response alternatives in advance, hence the number of categories is very high; theoretically, it is infinite and can vary from population to population".

Closed questions, on the other hand, are described by Marconi and Lakatos (2002, p. 101–107) as "those in which the respondent chooses their answer from two options: yes or no", and multiple-choice questions are "closed questions, but present a series of possible answers, covering various facets of the same subject". However, Sampieri, Collado, and Lucio (2013, p. 235) define closed questions as those that "contain categories or response options that have been predefined" and indicate that there can be more than one possible response. Therefore, for the composition of the questionnaire used in this doctoral research, the type of closed questions with several predefined choices was selected.

Additionally, Fachin (2006) and May (2004) emphasize that when developing a questionnaire, its purpose must be considered. They highlight that this is one of the most delicate parts and that the questions must have a purpose to achieve the desired research goals. Following these guidelines, the questionnaire is presented with the indication of the purpose of each question, as shown in Table 1.

Table 1: Questions comprising the questionnaire used in the research

	Question Description	Purpose of the Question
Regarding the Student and Family	1. Age: _____ year	Determine if age influenced the test results.
	2. Gender: □ Male □ Female	Determine if gender influenced the test results.
	3. What type of school did you attend last year? □ Municipal □ State □ Federal □ Private	Determine if the type of school administration influenced the test results.
	4. Are you repeating this grade? □ No □ Yes	Determine if grade repetition influenced the test results.
	5. Do you work for pay? □ No □ Yes □ Sometimes	Determine if having a paid job influenced the test results.
	6. Do you usually shop? □ No □ Yes □ Sometimes	Determine if shopping and handling money influenced the test results.
	7. What is the educational level of your male guardian? □ Incomplete Elementary □ Elementary □ High School □ Higher Education	Determine if the father figure's education level influenced the test results.
	8. What is the educational level of your female guardian? □ Incomplete Elementary □ Elementary □ High School □ Higher Education	Determine if the mother figure's education level influenced the test results.
	9. Who helps you with math homework? □ Private Tutor □ Father or Mother □ Sibling □ No one □ Other:___	Determine if the person helping with homework influenced the test results.
Regarding the Student's Relationship with Mathematics and Its Study	10. Do you like Mathematics? □ Don't like □ Like a little □ Like □ Like very much	Determine if the student's liking for Mathematics influenced the test results.
	11. Do you find it difficult to learn Mathematics? □ No □ A little □ Yes	Determine if the student's difficulty in learning Mathematics influenced the test results.
	12. Do you get distracted in math classes? □ No, I always pay attention □ I get distracted most of the time □ Yes, I can't pay attention	Determine if the student's concentration during math classes influenced the test results.
	13. How often do you study math outside of school? □ Every day □ Only on weekends □ Only before exams □ Don't study outside school	Determine if studying frequency outside of school influenced the test results.
	14. Generally, what are your grades in math? □ Above average □ Average □ Below average	Determine if the numerical grades influenced the test results.

Regarding Teaching Practices in Mathematics Study	15. Which math operation do you find most difficult? □ □ □ □ Division? □ Addition □ Subtraction □ Multiplication □ Division	Determine if difficulty with a specific mathematical operation influenced the test results.
	16. Do math classes capture your attention to learn the content taught? □ No □ Yes □ Sometimes	Determine if the attractiveness of math classes influenced the test results.
	17. What types of activities and/or assignments does your math teacher mostly use for learning assessment? □ Exams/Simulations □ Weekly Tests □ Seminars □ Research □ Projects	Determine if activities conducted in class influenced the test results.
	18. How are most of your math classes started? □ With definition followed by examples and exercises □ With the history of the subject before exploring concepts □ With a problem situation before introducing the subject □ With a model for a situation and then analyzing the model □ With games before systematizing concepts	Determine if the teacher's introduction model in class influenced the test results.
	19. How does your teacher usually practice math content? □ Present a list of exercises to be solved □ Ask students to find questions about the subject to solve □ Present games involving the subject □ Does not propose questions to practice the content studied □ Ask students to solve exercises from the textbook	Determine if the model used to practice the content studied in class influenced the test results.

Source: Adapted from Silva (2015b).

As delineated in Table 1, the questionnaire comprises 19 questions categorized into three groups: 1) Personal questions concerning the student; 2) Questions regarding the student's relationship with mathematics and its study; and 3) Questions related to teaching practices in the study of mathematics. Through these groups of questions, it is believed a comprehensive overview can be achieved regarding observations on the dimensions of the socioeducational context of students.

Method of Tabulating Responses to Questionnaire Items

The tabulation of responses from the applied socioeducational questionnaire was synthesized by grouping classes in electronic spreadsheets. The data tabulation involved a simple count of the items provided in the questionnaire, distinguishing between responses and not counting unanswered questions or questions whose responses were not relevant to the posed question.

To facilitate the counting of each item from the questionnaire responses, a command was executed in the spreadsheet that linked each student's results from the additive and multiplicative tests with the questionnaire responses, displaying the quantity at each data intersection.

Chi-Square Test as an instrument for analyzing produced data

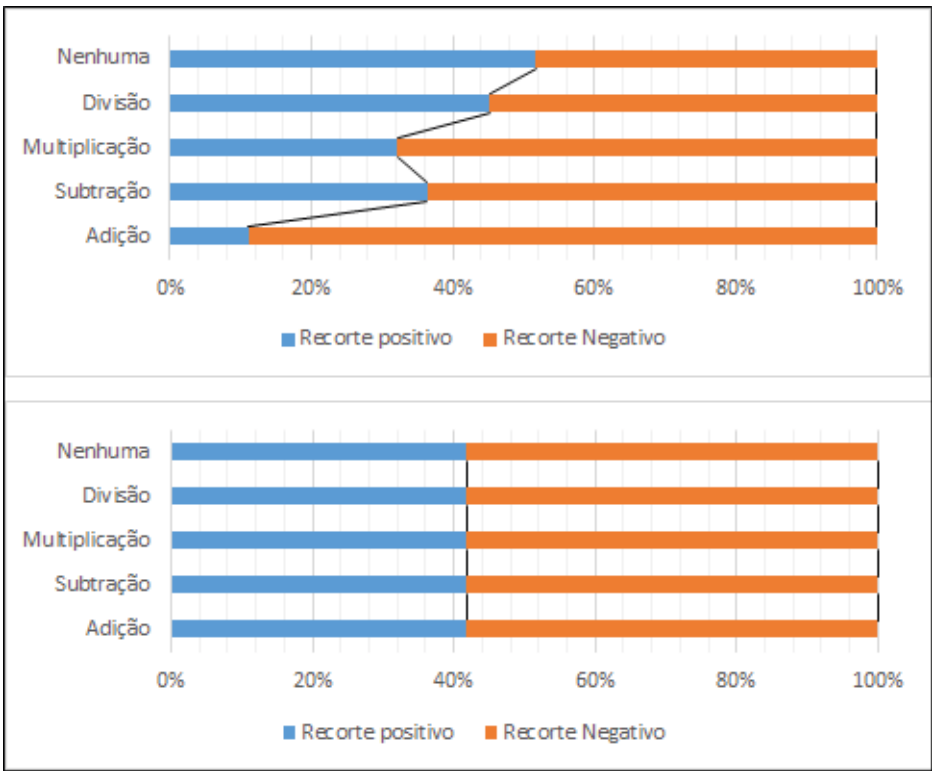
Statistics are usually associated with numbers, tables, graphs, and mathematical symbols used to organize and present data from a quantitative study. However, as Barbetta (2012, p. 15) indicates, "statistics can be present in various stages of a social research, from its planning to the interpretation of its results, and can even influence the research process conduct."

According to Barbetta (2012, p. 227), the Chi-Square Test is widely used in social research as it "can be applied to research problems with independent samples with a qualitative (categorical) response variable." For example, it can be used to compare teaching methods for students, where the response variable is the outcome of pass or fail. Another example is in comparing populations of men and women regarding their vote in a particular election, with the response variable being whether or not they voted for a specific candidate.

The Chi-Square Test, denoted by X^2, is a statistical test applied to categorical data to assess how likely any observed difference occurred by chance. More specifically, Levine et al. (2008) describe it as a hypothesis test aimed at finding a dispersion value for two nominal categorical variables and evaluating the existing association between qualitative variables. The Chi-Square Test is considered non-parametric as it does not depend on population parameters such as mean and variance (Levine et al., 2008). The principle underlying this test is the comparison of proportions and potential discrepancies between observed frequencies and expected frequencies in a given event. This test is useful in various research areas, such as health, economics, natural and biological sciences, among others.

For a graphical view, Figure 1 contrasts the obtained frequency (upper graph) with the expected frequency (lower graph), where the series line shows the difference between proportional data. For the expected frequency in this type of graph, the series line is vertical. That is, the closer the series line's inclination is to vertical, the closer the variation of data approaches the expected frequency.

Figure 1: Example of proportional graphs between obtained frequency (upper graph) and expected frequency (lower graph)



Source: Research data.

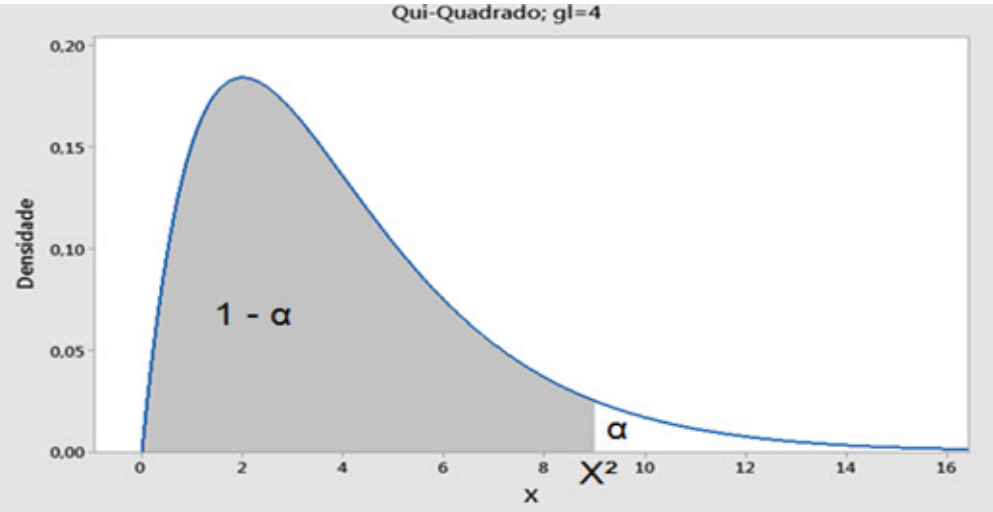
The Chi-Square Test can be utilized in two scenarios: 1) To verify if the frequency of a particular observed event in a sample significantly deviates from the expected frequency; and 2) To compare the distribution of various events in different samples, in order to assess if the observed proportions of these events show significant differences or if the samples significantly differ in the proportions of these events (Larson et al., 2010). In a more formal view, Meyer (1983) indicates that the Chi-Square distribution has several important applications in statistical inference, and one can find in the table (see Table 2), the value denoted by X_n^2 that satisfies $P(Z \leq X_n^2) = \alpha, 0 < \alpha < 1$ (see Figure 2).

A consideration in the Chi-Square Test is if expected frequencies in a category are too low, the test results may not be valid, even with Yates' Correction application. Thus, if one or more categories have too low expected frequencies, they can be combined with adjacent categories or, if possible, removed.

Given the density function $f(x) = \begin{cases} \frac{\beta^\alpha}{\Gamma(\alpha)} x^{\alpha-1} e^{-\beta x}, & x > 0 \\ 0, & x \leq 0 \end{cases}$, where α is the shape parameter $(\alpha > 0)$, β is the scale parameter $(\beta > 0)$ and the gamma function $\Gamma(\alpha) = \int_0^\infty x^{\alpha-1} e^{-x} dx$, the Chi-Square Distribution occurs when $\alpha = \frac{n}{2}$ and $\beta = \frac{1}{2}$, i.e.,

$f(x) = \frac{x^{\frac{n}{2}-1} \cdot e^{-\frac{x}{2}}}{2^{\frac{n}{2}} \cdot \Gamma\left(\frac{n}{2}\right)}$ where n is the degrees of freedom value. Figure 2 represents the function for 4 degrees of freedom.

Figure 2: Graphical Representation of the Chi-Square standardized for degrees of freedom equal to 4



Source: Simulation adapted from Minitab Software.

And Table 2 represents the critical values for x^2 in relation to degrees of freedom and established confidence.

Table 2: Chi-Square Distribution Standardized

N / $1-\alpha$	0,05	0,10	0,50	0,90	0,95
1	0,004	0,016	0,455	2,706	3,841
2	0,103	0,211	1,386	4,605	5,991
3	0,352	0,584	2,366	6,251	7,815
4	0,711	1,064	3,357	7,779	9,488
5	1,145	1,610	4,351	9,236	11,070
6	1,635	2,204	5,348	10,645	12,592
7	2,167	2,833	6,346	12,017	14,067
8	2,733	3,490	7,344	13,362	15,507
9	3,325	4,168	8,343	14,684	16,919
10	3,940	4,865	9,342	15,987	18,307

Source: Adapted from Vieira (2008).

The calculation of the Chi-Square Test is the sum of the squares of the differences between the obtained and expected values, as indicated by Costa Neto (2002) through the formula

$$X_n^2 = \sum_{i=1}^{k} \frac{(O_i - E_i)^2}{E_i}$$

Where X_n^2 represents the test statistic with n degrees of freedom; O_i the observed frequency; E_i the expected frequency; and k the number of classes or values considered. If the X_n^2 value is above the specified critical value in Table 2, it indicates an association between the obtained results.

ANALYSIS OF THE SOCIOEDUCATIONAL QUESTIONNAIRE

To analyze the questionnaires with the aid of the Chi-Square Test, it is necessary to establish a parameter regarding the correct and incorrect choices of operation in questions involving natural numbers and decimal numbers. Thus, two groups were established based on the 178 answered questionnaires: the first group, termed 'Positive Segment,' comprises students who correctly chose the operation in 50% or more of the pairs of questions in the additive test (at least 3 out of a total of 6) and, likewise, 50% or more in the multiplicative test pairs of questions (at least 3 out of a total of 6). The total data is presented in Table 3.

Table 3: Quantitative Representation of Positive and Negative Segments

Segment	Number of Students	Proportional Representation
Positive Segment	72	40,45%
Negative Segment	106	59,55%
Total	178	100,00%

Source: Research data.

Additional segmentation simulations with 1 to 6 correct choices in establishing relationships between pairs of questions from the additive and multiplicative tests are also shown in Table 4.

Table 4: Quantitative Representation of Other Positive and Negative Segments Based on Minimum Correct Answers

Minimum Correct Choices in Pairs of Questions in Additive and Multiplicative Tests	Positive Segment	Negative Segment
1	136 (76,40%)	42 (23,60%)
2	107 (60,11%)	71 (39,89%)
3[4]	72 (40,45%)	106 (59,55%)
4	50 (28,09%)	128 (71,91%)
5	22 (12,36%)	157 (87,64%)
6	5 (02,81%)	173 (97,19%)

Source: Research data.

Regarding the tabulation of the questionnaires, there were students who left questions blank. Therefore, the total quantitative values obtained for each question may vary

[4] Minimum number of correct answers in each test, additive and multiplicative, established for analysis.

but are always less than the total of 173 answered questionnaires. As with the additive and multiplicative tests, the questions left blank were not used in the execution of the Chi-Square Test.

Before starting the analyses, it is essential to emphasize that the hypotheses established by the tests are limited to the researched sample space. Thus, there is no foundation to generalize the results to the universe. A situation to exemplify this restriction to the research sample is the predominant way students indicated how the teacher usually practices the studied content (Table 23), where 141 out of 172 students answered this question indicating the same item. Therefore, in any hypothetical situation where there is more variation in the students' indications regarding how the teacher practices the studied content, the results could be different from those obtained in this research.

The analysis of the questions began, in order, with the group 'Related to the student and family,' which consists of questions 1 to 9. The data and the result of the Chi-Square Test related to question '1. Age' can be observed in Table 5. The conclusion about this question is that, based on the obtained data, the age of the students is not associated with the responses to the additive and multiplicative tests.

Table 5: Chi-Square Test Result for Question "1. Age"

Question	1. Age				
	Positive Segment	**Negative Segment**	**Totals**	**X^2 for Association**	**$X^2 > 9,488$**
11	32	31	63	**Obtained Result**	3,934
12	25	48	73	**Established Significance**	**P-value <0,05**
13	6	10	16	**Obtained Result**	0,4151
14	5	7	12		
15	3	4	7		
Totals	71	100	171		
Conclusion	Based on the obtained data, the age of the students is not associated with the responses to the additive and multiplicative tests.				

Fonte: Dados da pesquisa.

From question '2. Gender,' the data and the result of the Chi-Square Test are set out in Table 6. The conclusion from this question is that, based on the obtained data, the gender of the students is not associated with the responses to the additive and multiplicative tests.

Table 6: Chi-Square Test Result for Question "2. Gender"

Question	2. Gender				
	Positive Segment	**Negative Segment**	**Totals**	**X^2 for Association**	**$X^2 > 3,841$**
Female	36	44	80	**Obtained Result**	1,147
Male	34	58	92	**Established Significance**	**P-value <0,05**
Totals	70	102	172	**Obtained Result**	0,2842
Conclusion	Based on the obtained data, the gender of the students is not associated with the responses to the additive and multiplicative tests.				

Source: Research data.

The data related to the question '3. What type of school did you attend last year?' and the result of the Chi-Square Test are presented in Table 7. The conclusion is that, based on the obtained data, the level of government autonomy responsible for managing the school is not associated with the students' responses obtained through the additive and multiplicative tests.

Table 7: Chi-Square Test Result for Question "3. What type of school did you attend last year?"

Question	3. What type of school did you attend last year?				
	Positive Segment	**Negative Segment**	**Totals**	**X^2 for Association**	**$X^2 > 5,991$**
Municipal	19	32	51	**Obtained Result**	0,665
Estadual	49	63	112	**Established Significance**	**P-value <0,05**
Particular	3	5	8	**Obtained Result**	0,7172
Totals	71	100	171		
Conclusion	Based on the obtained data, the level of government autonomy responsible for managing the school is not associated with the students' responses obtained through the additive and multiplicative tests.				

Source: Research data.

Regarding question '4. Are you repeating this grade?', Table 7 provides the data and the result of the Chi-Square Test. The conclusion is that, among the surveyed student group, being a repeating student (failing the previous year in the same grade being studied at the time of the research) or being new to the 7th grade of Elementary School is not associated with the students' responses obtained in the additive and multiplicative tests.

Table 8: Chi-Square Test Result for Question "4. Are you repeating this grade?"

Question	4. Are you repeating this grade?				
	Positive Segment	**Negative Segment**	**Totals**	**X^2 for Association**	**$X^2 > 3,841$**
Sim	6	17	23	**Obtained Result**	2,145
Não	62	85	147	**Established Significance**	**P-value <0,05**
Totals	68	102	170	**Obtained Result**	0,1430
Conclusion	Among the surveyed student group, being a repeating student or new to the 7th grade of Elementary School is not associated with the students' responses obtained in the additive and multiplicative tests.				

Source: Research data.

The data related to question '5. Do you work for pay?' and the result of the Chi-Square Test are presented in Table 9. Based on this, the conclusion is that, in the surveyed group, being engaged in paid work or not is not a factor associated with the students' responses in the additive and multiplicative tests.

Table 9: Chi-Square Test Result for Question "5. Do you work for pay?"

Question	5. Do you work for pay?				
	Positive Segment	**Negative Segment**	**Totals**	**X^2 for Association**	**$X^2 > 5,991$**
Yes	5	9	14	**Obtained Result**	0,192
Sometimes	10	16	26	**Established Significance**	**P-value <0,05**
No	53	76	129	**Obtained Result**	0,9086
Totals	68	101	169		
Conclusion	In the surveyed group, being engaged in paid work or not is not a factor associated with the students' responses in the additive and multiplicative tests.				

Source: Research data.

Table 10 presents the data related to question '6. Do you usually shop?' and the result of the Chi-Square Test. Based on these data, the conclusion is that, in the group of surveyed students, making purchases in commercial establishments is not a factor that generates association for the students to solve the questions of the additive and multiplicative tests.

Table 10: Chi-Square Test Result for Question "6. Do you usually shop?"

Question	6. Do you usually shop?

	Positive Segment	**Negative Segment**	**Totals**
Yes	29	36	65
Sometimes	28	48	76
No	13	18	31
Totals	70	102	172

X^2 for Association	**$X^2 > 5,991$**
Obtained Result	0,901
Established Significance	**P-value <0,05**
Obtained Result	0,6730

Conclusion	In the group of surveyed students, making purchases in commercial establishments is not a factor that generates association for the students to solve the questions of the additive and multiplicative tests.

Source: Research data.

Regarding the education level of the students' parents or guardians, Tables 11 and 12 show the data related to questions '7. What is the education level of your male guardian?' and '8. What is the education level of your female guardian?' respectively. Based on the shown data and the conducted Chi-Square Test, it can be concluded that, in the group of surveyed students, the education level of either parent or guardian is not associated with the students' outcomes in solving the questions of the additive and multiplicative tests.

Table 11: Chi-Square Test Result for Question "7. What is the education level of your male guardian?"

Question	7. What is the education level of your male guardian?

	Positive Segment	**Negative Segment**	**Totals**
Incomplete Elementary	11	17	28
Complete Elementary	5	15	20
High School	26	20	46
Higher Education	9	11	20
Totals	51	63	114

X^2 for Association	**$X^2 > 7,815$**
Obtained Result	6,072
Established Significance	**P-value <0,05**
Obtained Result	0,1081

Conclusion	In the surveyed student group, the education level of the male guardian is not associated with the students' outcomes in solving the questions of the additive and multiplicative tests.

Source: Research data.

Table 12: Chi-Square Test Result for Question "8. What is the education level of your female guardian?"

Question	8. What is the education level of your female guardian?

	Positive Segment	Negative Segment	Totals
Incomplete Elementary	8	12	20
Complete Elementary	10	17	27
High School	29	29	58
Higher Education	9	13	22
Totals	56	71	127

X^2 for Association	$X^2 > 7,815$
Obtained Result	1,593
Established Significance	P-value <0,05
Obtained Result	0,6611

Conclusion	In the surveyed student group, the education level of the female guardian is not associated with the students' outcomes in solving the questions of the additive and multiplicative tests.

Source: Research data.

To conclude the group of questions 'Related to the student and family,' the data for question '9. Who helps you with math homework?' are shown in Table 13. According to the Chi-Square Test, the assistance of a specific person or the lack thereof does not have an association with the students' ability to answer the additive and multiplicative tests conducted in the research.

Table 13: Chi-Square Test Result for Question "9. Who helps you with math homework?"

Question	9. Who helps you with math homework?

	Positive Segment	Negative Segment	Totals
School friend	5	4	9
Grandparents	2	2	4
Sibling	4	6	10
Mother	18	36	54
Both Parents	4	3	7
No one	24	34	58
Father	4	9	13
Private tutor	6	5	11
Totals	67	99	166

X^2 for Association	$X^2 > 14,067$
Obtained Result	4,386
Established Significance	P-value <0,05
Obtained Result	0,7343

Conclusion	For the researched group, the assistance of a specific person or the lack thereof does not have an association with the students' ability to answer the additive and multiplicative tests conducted in the research.

Source: Research data.

The analysis of the questions from the group 'Questions related to the student's relationship with mathematics and its study' starts with Question 10 and ends with Question 14. The data and the result of the Chi-Square Test related to question '10. Do you like studying Mathematics?' can be observed in Table 14. The conclusion for this question is that, based on the obtained data, the student's interest in learning mathematics is associated with the responses to the additive and multiplicative tests.

Table 14: Chi-Square Test Result for Question "10. Do you like studying Mathematics?"

Question	10. Do you like studying Mathematics?				
	Positive Segment	**Negative Segment**	**Totals**	**X^2 for Association**	**$X^2 > 5,991$**
~~**Dislike**~~[5]	~~1~~	~~1~~	~~2~~	**Obtained Result**	11,560
Like a little	11	40	51	**Established Significance**	**P-value <0,05**
Like	32	36	68	**Obtained Result**	0,0031
Like very much	27	25	52		
Totals	71	102	173		
Conclusion	In the obtained data, the student's enjoyment of learning mathematics is associated with the responses to the additive and multiplicative tests.				

Source: Research data.

In Table 15, the data related to the question '11. Do you have difficulty learning mathematics?' and the result of the Chi-Square Test are presented. Based on these data, the conclusion is that, in the group of surveyed students, the difficulty admitted by the students in learning mathematics is associated with the data obtained through the questions of the additive and multiplicative tests.

[5] The Chi-Square calculations are only valid when all expected values are greater than 1.0, and at least 20% of the expected values are greater than 5. Therefore, to be able to perform the calculation, this group of responses was removed due to the low number of responses.

Table 15: Chi-Square Test Result for Question "11. Do you have difficulty learning mathematics?"

Question	11. Do you have difficulty learning mathematics?		
	Positive Segment	**Negative Segment**	**Totals**
No	24	14	38
A little	45	68	113
Yes	2	15	17
Totals	71	97	168

X^2 for Association	$X^2 > 5,991$
Obtained Result	13,560
Established Significance	**P-value <0,05**
Obtained Result	0,0011

Conclusion	In the group of surveyed students, the difficulty admitted by the students in learning mathematics is associated with the data obtained through the questions of the additive and multiplicative tests.

Source: Research data.

Regarding the question '12. Do you get distracted in math classes?', the data and results of the Chi-Square Test are displayed in Table 16. The outcome of the hypothesis test indicates that the level of distraction of the student participating in the research interfered with the results obtained through the applied additive and multiplicative tests.

Table 16: Chi-Square Test Result for Question "12. Do you get distracted in math classes?"

Question	12. Do you get distracted in math classes?		
	Positive Segment	**Negative Segment**	**Totals**
No, I always pay attention	49	39	88
I get distracted in most classes	22	57	79
Yes, I cannot pay attention	1	7	8
Totals	72	103	175

X^2 for Association	$X^2 > 5,991$
Obtained Result	16,16
Established Significance	**P-value <0,05**
Obtained Result	0,0003

Conclusion	The level of distraction of the student participating in the conducted research interfered with the results obtained through the applied additive and multiplicative tests.

Source: Research data.

The data related to the question '13. How often do you study mathematics outside of school?' can be observed in Table 17. The conclusion for this question is that, based on the obtained data, the frequency with which the student studies mathematics outside of school is associated with the responses to the additive and multiplicative tests.

Table 17: Chi-Square Test Result for Question "13. How often do you study mathematics outside of school?"

Question	13. How often do you study mathematics outside of school?		
	Positive Segment	**Negative Segment**	**Totals**
Every day	23	12	35
Only on weekends	20	34	54
Only the day before the exam	25	43	68
I do not study outside of school	4	14	18
Totals	72	103	175

X^2 for Association	**$X^2 > 7,815$**
Obtained Result	12,300
Established Significance	**P-value <0,05**
Obtained Result	0,0064

Conclusion	Based on the obtained data, the frequency with which the student studies mathematics outside of school is associated with the responses to the additive and multiplicative tests.

Source: Research data.

To conclude the group of questions 'Related to the student's relationship with mathematics and its study,' the data for the question '14. Generally, what are your grades in mathematics?', and the result of the Chi-Square Test are in Table 18. The Chi-Square Test, according to the responses of this group of surveyed students, indicates that performance according to their grades in the Mathematics subject is associated with the choice of operation in the questions that make up the additive and multiplicative tests.

Table 18: Chi-Square Test Result for Question "14. Generally, what are your grades in mathematics?"

Question	14. Generally, what are your grades in mathematics?		
	Positive Segment	**Negative Segment**	**Totals**
Above Average	46	36	82
Average	23	48	71
Below Average	2	19	21
Totals	71	103	174

X^2 for Association	**$X^2 > 5,991$**
Obtained Result	18,530
Established Significance	**P-value <0,05**
Obtained Result	0,0001

Conclusion	In this group of surveyed students, performance according to their grades in the Mathematics subject is associated with the choice of operation in the questions that make up the additive and multiplicative tests.

Source: Research data.

The analyses of the questions from the last group 'Related to teaching practices in the study of mathematics' are comprised of questions 15 to 19. Regarding the data and Chi-Square Test of the question '15. Which operation do you find most difficult in mathematics?', the information and test result are displayed in Table 19. Based on the data obtained

from the additive and multiplicative tests, along with the questionnaire, for this researched sample, having difficulty in a specific operation or none at all did not interfere with the test outcomes.

Table 19: Chi-Square Test Result for Question "15. Which operation do you find most difficult in mathematics?"

Question	15. Which operation do you find most difficult in mathematics?

	Positive Segment	Negative Segment	Totals
Addition	1	8	9
Subtraction	4	7	11
Multiplication	9	19	28
Division	43	52	95
None	15	14	29
Totals	72	100	172

X^2 for Association	$X^2 > 9,488$
Obtained Result	6,331
Established Significance	P-value <0,05
Obtained Result	0,1758

Conclusion	For this researched sample, having difficulty in a specific operation or none at all did not interfere with the test outcomes.

Source: Research data.

The data related to the question '16. Do math classes capture your attention for learning the content taught?' are shown in Table 20. According to the Chi-Square Test, whether math classes capture the students' attention for their studies or not had an association with these students in answering the conducted additive and multiplicative tests.

Table 20: Chi-Square Test Result for Question "16. Do math classes capture your attention for learning the content taught?"

Question	16. Do math classes capture your attention for learning the content taught?

	Positive Segment	Negative Segment	Totals
Yes	40	54	94
Sometimes	28	37	65
No	3	11	14
Totals	71	102	173

X^2 for Association	$X^2 > 5,991$
Obtained Result	2,426
Established Significance	P-value <0,05
Obtained Result	0,2974

Conclusion	Whether math classes capture the students' attention for their studies or not had an association with these students in answering the conducted additive and multiplicative tests.

Source: Research data.

Table 21 shows the data and the Chi-Square Test results for the question '17. What kinds of activities or assignments does your math teacher most use for learning assess-

ment?'. For this group of students, the test result indicates that the way the teacher conducts their assessment is not associated with the outcomes obtained from the Addition and Multiplication Tests.

Table 21: Chi-Square Test Result for Question "17. What kinds of activities or assignments does your math teacher most use for learning assessment?"

Question	17. What kinds of activities or assignments does your math teacher most use for learning assessment?

	Positive Segment	**Negative Segment**	**Totals**
Exams/Simulations	28	54	82
Weekly Tests	42	40	82
Seminars	1	2	3
~~**Research**~~[6]	~~0~~	~~4~~	~~4~~
~~**Projects**~~[7]	~~1~~	~~0~~	~~1~~
Totals	71	96	167

X^2 for Association	**$X^2 > 5,991$**
Obtained Result	4,995
Established Significance	**P-value <0,05**
Obtained Result	0,0823

Conclusion	For this group of surveyed students, the method the teacher uses for assessment is not associated with the choice of operation in the questions that make up the additive and multiplicative tests.

Source: Research data.

Table 22 contains the research data and the Chi-Square Test result for the question '18. How are most of your math classes started?'. The result indicates that, for the surveyed group, the math class model offered is not associated with the choice of operation in the questions that comprise the additive and multiplicative tests.

[6] The Chi-Square calculations are only valid when all expected values are greater than 1.0, and at least 20% of the expected values are greater than 5. Therefore, to be able to perform the calculation, this group of responses was removed due to the low number of responses.

[7] The Chi-Square calculations are only valid when all expected values are greater than 1.0, and at least 20% of the expected values are greater than 5. Therefore, to be able to perform the calculation, this group of responses was removed due to the low number of responses.

Table 22: Chi-Square Test Result for Question "18. How are most of your math classes started?"

Question	18. How are most of your math classes started?

	Positive Segment	Negative Segment	Totals
Begins with definition followed by examples and exercises	45	72	117
Begins with the history of the topic before exploring the concepts	9	15	24
Begins with a problem situation before introducing the topic	12	10	22
Begins with a model for situation then analyzing the model	4	5	9
~~**Begins with games before systematizing concepts**~~	~~2~~	~~0~~	~~2~~
Totals	70	102	172

X^2 for Association	$X^2 > 7,815$
Obtained Result	2,144
Established Significance	**P-value <0,05**
Obtained Result	0,5430

Conclusion	For the surveyed group, the math class model offered is not associated with the choice of operation in the questions that comprise the additive and multiplicative tests.

Source: Research data.

To conclude the group of questions 'Related to teaching practices in the study of mathematics,' the data for the question '19. How does your math teacher usually practice the math content?', and the Chi-Square Test result are indicated in Table 23. The Chi-Square Test, according to the responses from the surveyed student group, indicates that the method the teacher uses to practice the studied content is not associated with the choice of operation in the questions that make up the additive and multiplicative tests.

Table 23: Chi-Square Test Result for Question "19. How does your math teacher usually practice the math content?"

Question	19. How does your math teacher usually practice the math content?

	Positive Segment	Negative Segment	Totals
Presents a list of exercises to be solved	60	81	141
Asks students to find questions on the topic to solve	8	13	21
Presents games involving the topic	3	4	7
Does not propose questions to practice the studied content	1	2	3
~~**Asks students to solve exercises from the textbook**~~[8]	~~0~~	~~2~~	~~2~~
Totals	72	100	172

X^2 for Association	$X^2 > 7,815$
Obtained Result	0,243
Established Significance	**P-value <0,05**
Obtained Result	0,9704

Conclusion	For this group of surveyed students, the method the teacher uses to practice the studied content is not associated with the choice of operation in the questions that make up the additive and multiplicative tests.

Source: Research data.

In order to synthesize the Chi-Square Tests on the questions, Table 24 shows the results obtained for each question that made up the questionnaire, with a separation by question group, question, and result of the Chi-Square Test.

Table 24: Summary of Chi-Square Tests by Question

	Question Description	Chi-Square Test Result
Regarding the Student and Family	1. Age	No association
	2. Gender	No association
	3. What type of school did you attend last year?	No association
	4. Are you repeating this grade?	No association
	5. Do you work for pay?	No association
	6. Do you usually make purchases?	No association
	7. What is the education level of your male guardian?	No association
	8. What is the education level of your female guardian?	No association
	9. Who helps you with math homework?	No association
Regarding the Student's Relationship with Mathematics and Its Study	10. Do you like Mathematics?	Association
	11. Do you have difficulty learning Mathematics?	Association
	12. Do you get distracted in math classes?	Association
	13. How often do you study mathematics outside of school?	Association
	14. Generally, what are your grades in mathematics?	Association
Regarding Teaching Practices in Mathematics Study	15. Which operation do you find most difficult in mathematics?	No association
	16. Do math classes capture your attention for learning the content taught?	No association
	17. What kinds of activities or assignments does your math teacher most use for learning assessment?	No association
	18. How are most of your math classes started?	No association
	19. How does your math teacher usually practice the math content?	No association

Source: Research data.

The students who participated in the survey are products of the community in which they are embedded and surrounded by internal and external factors to them. From living in their homes with their families to their school environment with other students and education professionals, they encounter experiences that shape the social being of the individual, developing their cognitive, behavioral, social, and emotional capabilities. Table 24 collects questions involving the domestic, emotional, and school factors of the student, classifying them into three groups of questions.

The results presented by Table 24 highlight that all the questions that make up each of the three groups had the same result for the Chi-Square Test. That is, all the questions within the same group obtained the same result of "No association" or "Association". Thus, the result of the Chi-Square Test is indicated in Table 25.

Table 25:Result by Question Group

Question Group	Chi-Square Test Result
Related to the Student and Family	No association
Related to the Student's Relationship with Mathematics and Its Study	Association
Related to Teaching Practices in the Study of Mathematics	No association

Source: Research data.

Therefore, without intending to generalize to all students and inferring indications that are reserved for the studied group, it can be seen from the results obtained by the questionnaire that the factors defining how the student relates to mathematics and its study have an association in the choice of operations during the resolution of mathematical problems. Meanwhile, external factors to the student, such as commercial activities, the educational level studied by their guardians, or the teacher's classroom method, were not indicated as influencing factors in the research.

The fact that care is constantly highlighted to pay attention to the limitations of this research is because these results are inherent to these students. For instance, there are contrasting marks in these students, perhaps justified by being from the same school, where there is a tendency to indicate a large volume of the same item in a specific question, where students either correctly or incorrectly chose the operation having the same teaching process in that school, something that might not occur if the research were conducted with a group of students with greater variation in the responses to some questions.

FINAL CONSIDERATIONS

This article presents the results of research aimed at analyzing whether the socio-educational characteristics of the student interfere with the choice of operation to solve additive and multiplicative questions. Given this objective, it can be established that the research

was satisfactorily achieved, as the data obtained from the socio-educational questionnaire processed through the Chi-Square Test indicated that there was a statistical association between the choice of operation in questions and factors related to the student's relationship with mathematics and its study. Similarly, it indicated that there was no statistical association between the choice of operation in questions and the student's family environment or teaching practices in the study of mathematics.

However, it is necessary to contextualize these results obtained through the socio--educational questionnaire, as there is no basis to assert that in another social context, the factors that did not influence this group of students would not influence another group of students.

For example, the item about the teacher's performance in the classroom may not have influenced the results of this group of students because they were only taught by one teacher in the same school, and facing students from the same community and with the same materials provided by the educational institution, may have the same approach in their classes. Since all students had very similar experiences with the same teacher, this teacher's method might not influence the results. Thus, in a different context, with other students, more teachers, and more schools involved, the results regarding the questionnaire items could be different.

With the publication of the results of this research through scientific means, it is expected that the dimensions of the socio-educational context will be increasingly taken into account in classes, especially in mathematics classes. Because teaching and learning do not occur in a context where the individual is isolated from the social environment or isolated from their own feelings. The fact that this research indicates that the choice of operation is statistically associated with factors related to the student's relationship with mathematics and its study leads to reflection on the relationship between teacher and student from the perspective of the student's feelings, and not as in a banking education, strongly criticized by Freire (1997).

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