ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v38a210057

ARTICLE

Mathematical anxiety is associated with the school context: correlational study between rural, urban and suburban schools

Ansiedade Matemática está associada ao contexto escolar: estudo correlacional entre escolas rurais, urbanas e suburbanas

Rayza de Oliveira **Souza**[*]
ORCID iD 0000-0002-8934-8614
Tadeu Oliver **Gonçalves**[**]
ORCID iD 0000-0002-2704-5853
Marcos Guilherme **Moura-Silva** [***]
ORCID iD 0000-0003-3589-1897

Abstract

We investigated the influence of the school context on the prevalence of Mathematical Anxiety (MA) and on the mathematical performance of school children, considering different educational contexts (rural, urban, and suburban) and the gender of the participants (female, male). We applied the self-reported scale of mathematical anxiety - Anxiety Rating Scale for Elementary Children- MARS-E- translated and adapted into Portuguese in nine Brazilian public schools, totaling 312 students from the 5th and 6th year of elementary school, aged between 9 and 12 years. The mathematical performance was obtained from the average of the bimonthly evaluations of the participants provided by each school. The results indicate that MA is related to the school context when associated with gender. For urban/suburban school contexts, girls in the suburban group had higher MA when compared to girls in the urban group. For rural/suburban contexts, boys who study in the rural area had higher MA compared to their peers in the suburban group. No results were found associated with rural/urban contexts. Thus, our findings suggest that depending on the school context, MA seems to impact gender differently. Similarly, mathematical performance is also a critical factor when looking at specific school contexts, with the rural context being the most representative of the low mathematical performance of the participants. Our results contribute to the study of social and environmental influences of Mathematical Anxiety, indicating that the school context influences both the prevalence of Mathematical Anxiety and mathematical performance when considering gender.

Keywords: Mathematical anxiety. Academic achievement. Mathematical education. School context. Gender.

[*] Mestre em Educação em Ciências e Matemáticas. Universidade Federal do Pará (UFPA). Professora da Educação Básica (SEMEC), Jacundá, Pará, Brasil, e-mail: rayzzasouza19@gmail.com
[**] Doutor em Educação Matemática (UNICAMP). Professor Voluntário (UFPA), Belém, Pará, Brasil, e-mail: tadeuoliver@yahoo.com.br
[***] Doutor em Educação em Ciências e Matemáticas. Universidade Federal do Pará (UFPA). Professor do Magistério Superior (UFPA), Belém, Pará, Brasil, e-mail: marcosgmouras@yahoo.com.br

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v38a210057

Resumo

Investigamos a influência do contexto escolar na prevalência da Ansiedade Matemática e no desempenho matemático de crianças escolares, considerando distintos contextos educacionais (rural, urbano e suburbano) e o gênero dos participantes (feminino, masculino). Aplicamos a escala autorrelatada de ansiedade matemática - Anxiety Rating Scale for Elementary children- MARS-E- traduzida e adaptada para o português em nove escolas públicas brasileiras, totalizando 312 estudantes do 5° e 6° ano do ensino fundamental, com idades entre 9 e 12 anos. O desempenho matemático foi obtido a partir da média das avaliações bimestrais dos participantes fornecidas por cada escola. Os resultados indicam que a AM está relacionada ao contexto escolar quando associada ao gênero. Para os contextos escolares urbano/suburbano, as meninas do grupo suburbano apresentaram maior AM quando comparadas as meninas do grupo urbano. Para os contextos rural/suburbano, os meninos que estudam na área rural apresentaram maior AM em relação aos seus pares do grupo suburbano. Não foram encontrados resultados associados aos contextos rural/urbano. Assim, nossos achados sugerem que dependendo do contexto escolar, a AM parece impactar o gênero de maneira diferente. De igual modo, o desempenho matemático também é fator crítico quando se observa os contextos escolares específicos, sendo o contexto rural o mais representativo do baixo desempenho matemático dos participantes. Nossos resultados contribuem com o estudo das influências sociais e ambientais da Ansiedade Matemática, indicando que o contexto escolar exerce influência tanto na prevalência da Ansiedade Matemática quanto no desempenho matemático, quando se considera o gênero.

Palavras-chave: Ansiedade Matemática. Desempenho acadêmico. Educação matemática. Contexto escolar. Gênero.

1 Introduction

It is estimated that students from rural Brazilian schools have a lower average performance in mathematics than students from urban schools. Data released by the National Institute of Educational Studies and Research Anísio Teixeira (INEP), show that, in rural schools, only 6% of the students from the 5th and 9th grades of elementary school have an adequate performance in mathematics, which corresponds to half of the rate verified in urban schools (Brasil, 2011). More recent results, resulting from large-scale evaluation, continue to show this disparity. For instance, when comparing the level of proficiency between students of urban and rural public education, it is estimated an average of 28.69 points of difference between both groups (Brasil, 2018).

Affective factors are associated with a low level of performance. As evidenced previously (Dowker; Bennett; Smith, 2012; Maloney; Beilock, 2012), proficiency in mathematics does not come in isolation from cognitive skills, but is also influenced by emotional factors and attitudes. Emotions seem to play several roles in reasoning (Damásio, 2012), affecting the way information is processed (Blair, 2007).

In this context, Mathematical Anxiety (MA) is listed as one of the most studied emotional interferences in the mathematical reasoning process, contributing significantly to the scenario of deficits in this type of academic performance in students worldwide, with cognitive, physiological and behavioral consequences. (Pekrun *et al*., 2017; Ho *et al*., 2000; Van Der Beek

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v38a210057

et al., 2017).

Conceptually, MA corresponds to a global and highly prevalent phenomenon, defined as a "sensation of tension and anxiety that interferes with the manipulation of numbers and the resolution of problems related to a wide variety of situations in ordinary and academic life" (Richardson; Suinn, 1972, p.551). Studies indicate that MA starts in childhood, being detectable since the first series of early childhood education (Harari; Vukovic; Bailey, 2013), and may increase with age (Dowker; Sarkar; Looi, 2016), remaining in adulthood (Baloglu; Koçak, 2006). Given this context, the importance of studies that detect MA since childhood and in various educational contexts is justified.

Of the little evidence that explored the effects of MA and mathematical performance in specific contexts, Hlalele (2012) cites the experience of high school students in rural schools, noting the adverse effects of MA on confidence, motivation and performance of these students, indicating the school as one of its causes. On the same perspective, Rao and Chaturvedi (2017) investigated the relationship of academic anxiety in relation to the school context, finding a significant difference in the level of anxiety among students from high schools located in rural and urban areas. Bezerra and Kassouf (2006), in a study conducted in Brazil, pointed out that the motivation for study, empathy for the subjects, school backwardness and teacher training were the variables with greater implications ion the low performance of students from rural contexts in relation to urban ones; however, the role of MA in these contexts has not been investigated. Finally, Johnson-Brow (2014) showed that the higher the school rurality, the worse the academic performance, so that suburban and rural schoolchildren showed inferior performances in relation to urban students, nevertheless, the mathematical anxiety variable was not considered in the comparison between the groups in this study.

By correlating these results, we can infer that MA may be one of the determining factors in the recent results of INEP regarding the difference in performance between urban and rural schools. However, as far as we know, there are no studies that have investigated such variables in a Brazilian context, indicating the need for a mapping in this sense. Based on these perspectives, we draw as a research question: Does the school context[1] influence the prevalence of MA and the mathematical performance in school children? For those considered, we include urban and rural schools, and, in the sense of having a median factor or a counterpoint between the rural / urban, we include suburban schools, optimizing our methodological design.

[1] Defined by the authors by location in which the school is located, urban, suburban and rural.

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v38a210057

2 Method

2.1 Classification according to the research approach

This research takes a quanti-qualitative approach, as it articulates qualitative and quantitative dimensions in its scope. Through this, we aim to be aligned with what Gamboa (2013) foreshadows, with regard to overcoming technical dualism and the epistemological dichotomy in the production of educational knowledge. The methodological paths are based on an empiricist current, built from the theoretical perspectives prevalent in the studies on Mathematical Anxiety.

2.2 Locus of research

The data gathering was carried out in nine Brazilian public schools located in four different municipalities in the state of Pará. The considered school locations were classified as rural, urban and suburban, according to the most recent census of the Brazilian Institute of Geography and Statistics - IBGE. For the referred body, the municipal headquarters (cities) and the district headquarters are urban. The areas furthest from these conglomerates (metropolitan region) are specified as suburban, and finally, rural areas are defined by excluding urban space, whose classification criteria are determined by municipal law. We emphasize that the location of the school was used to characterize the school context.

2.3 Participants

312 school students from 5th and 6th year elementary public school system, aged between 9 and 12 years, participated in the research, 112 rural school children, 100 urban and 100 suburban. Of this total 57.7% were female and 42.3% male. As for the school year, 52.6% students were in the 5th year and 47.4% were in the 6th year. And they had no history of class/school year detention. It was not in the interest of the research to investigate the socioeconomic status or family structure of the investigated subjects, or regarding attending private math classes.

Populations of students with grade/age distortion (students over 12 years of age) were excluded, as were visual, auditory, intellectual and mental PwD populations. The process of excluding participants from our population of interest took place after data collection, all

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v38a210057

students participated indistinctly in the research

All research participants were previously authorized to participate by the coordination of each school and by their legal guardians, through the TCLE-Term of Free and Informed Consent. Table 1 summarizes the number of terms delivered and returned by students.

Table 1 - List of terms delivered, returned, authorized, and not authorized.

TCLE handed out	TCLE returned authorized	TCLE not returned authorized	TCLE returned Unfilled	TCLE no returned
465 terms	312 terms	25 terms	16 terms	112 terms

Source: authors' documentary collection

2.4 Instruments

Anxiety Rating Scale for Elementary children- MARS-E (Richard; Suinn, 1988). It is a Likert Scale type of questionnaire from 1 to 5, containing 26 situations related to numerical competence, test situations and everyday situations. The MARS-E scale has high levels of reliability, with an internal consistency coefficient of 0.88, showing that the average of intercorrelations of the items in the test is high. As for the validity of the instrument, it was determined through correlations between the MARS-E and the Stanford Achievement Test scores. The correlation was significant (0.001), with a subtest of the mathematical concept (r = -29), mathematical applications (r = - 26), mathematical calculation (r = -26) and SAT score (r = -31).

2.5 Mathematical Performance

The parameter used in the measurement of mathematical performance considered the grade obtained by students in the bimonthly evaluations of the discipline of mathematics carried out by each school.

3 Procedures

3.1 Constitution of data

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v38a210057

All methodological procedures developed in the study were submitted and approved by the Research Ethics Committee (CEP) of the Federal University of Pará - Institute of Health Sciences, CAAE: 76887417.2.0000.0018, opinion number: 2.305.203, being conducted in accordance with the resolutions and regulations of the National Health Council (CNS).

The research granting institutions signed terms in which they authorized the study within their facilities and all the legal guardians of the students signed a Free and Informed Consent Form (IC) containing the information of the activity to be carried out, in order to authorize or not their representatives to participate in the study.

3.2 Application of the MARS-E Scale

Participants were assigned to the school's own classroom, in the same study shift. With the scale delivered to the students, instructions were given on how to complete it, among which: that the answer would be individual, with no side conversations being allowed during the process; that for each item, only one option should be checked and that they must be precise and honest in their answers. All clarifications and doubts were answered before the questionnaire was delivered, without any intervention from the researchers while filling out the scale. There was no time limit to answer the questionnaire, but, on average, participants answered the questionnaire within 20 minutes. For the better comprehension of the students, the word *nervous* was used in place of *anxiety*.

In order for the children to clearly understand how they would have to proceed; the following question model was carried out before the participants had access to the items on the scale: *Mark how nervous you are when adding up: 976 + 50 mentally*. Then, the participants were encouraged to carefully read each item on the scale and choose, among the five degrees available, only one degree of *anxiety* and mark it (√) according to how they would feel given the situation presented.

When returning the completed scale, an item-by-item check was performed and if there was an error in filling in, the participant was requested to make the correction. In the case of more than one option checked, the student was instructed to choose only one; in the case of unfilled items, participants were asked to complete it.

3.3 Obtaining Mathematical Performance

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v38a210057

The mathematical performance of the participants was measured considering the grades obtained by them in the bimonthly evaluations of the discipline of mathematics carried out by each school. The grades obtained by the students in each mathematics assessment carried out by the schools themselves were added and divided giving us a simple arithmetic mean; subsequently, these notes were entered into a single spreadsheet according to each participant's identification code.

3.4 Statistical Analysis

The analysis corresponding to the Student's t-test among our groups of interest were conducted considering estimation graphs originated from the web (https: // www.estimationstats.com), according to the recommendations of Ho *et al*. (2019). SPSS (version 20) was also used with significance defined at $p < 0.05$ to determine descriptive statistics and Spearman's correlation was defined to assess the degree of correlation between variables *mathematical anxiety*, *mathematical performance* and *school context*.

4 Results

After the data analysis according to the MARS-E scores, it was found that 59% of our total sample had a high level of MA (general average = 62.43 ± 18.47). Results of descriptive analysis related to age, mathematical performance and mathematical anxiety can be seen in Table 2, arranged by the three groups considered. As shown, the highest performances were observed in urban schools, which in turn also had the lowest averages in relation to the degree of MA.

Table 2 - Descriptive statistics about age, mathematical performance, and mathematical anxiety for each analyzed group

Domain	Mean ± SD		
	Rural School	**Suburban School**	**Urban School**
Age	11.22 ± 0.81	11.3 ± 0.65	10.57 ± 0.57
Mathematical Performance	6.33 ± 1.52	6.41 ± 1.55	7.62 ± 1.38
Mathematical Anxiety	63.72 ± 17.15	63.09 ± 19.25	60.31 ± 19.08

Source: elaborated by the authors

Our correlation analysis showed that there is a negative association between Mathematical Anxiety and mathematical performance ($r = -0.202$; $p < 0.001$) and it is reciprocal ($r = -0.229$; $p < 0.001$), corroborating with extensive previous researches that indicated that the

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v38a210057

greater the mathematical anxiety, the poorer is the mathematical performance.

4.1 School context, gender, and their relationship with Mathematical Anxiety

In the intra-group comparison, we found a significant effect of MA in relation to the *suburban* school context when evaluating the gender of the participants, so that female students from suburban contexts had a higher level of MA compared to male students. In the other groups, no differences were found. The results are described in Table 3:

Table 3- Effect of the unpaired estimation test in relation to gender and MA. In the suburban context, females had higher MA compared to males

	Cohen's d	***P***
Rural group	0.112 [95.0% CI -0.272, 0.501]	0.549
Suburban Group	-0.905 [95.0% -1.33, -0.48]	0.0 *
Urban group	-0.0844 [95.0% CI -0.484, 0.313]	0.679

Source: elaborated by the authors

In the comparison between the groups, it was found that only boys differ in relation to MA in the rural-suburban relationship (Figure A). The effect size was defined as d = -0.726 [CI 95.0% -1.2, -0.258] with a value of p = 0.0014, indicating that boys from rural areas have a higher level of MA compared to boys from suburban locations. The same test, also, showed no significant difference in relation to girls (d = 0.316 [CI 95.0% -0.0452, 0.67]; p = 0.0902), as shown in Figure B.

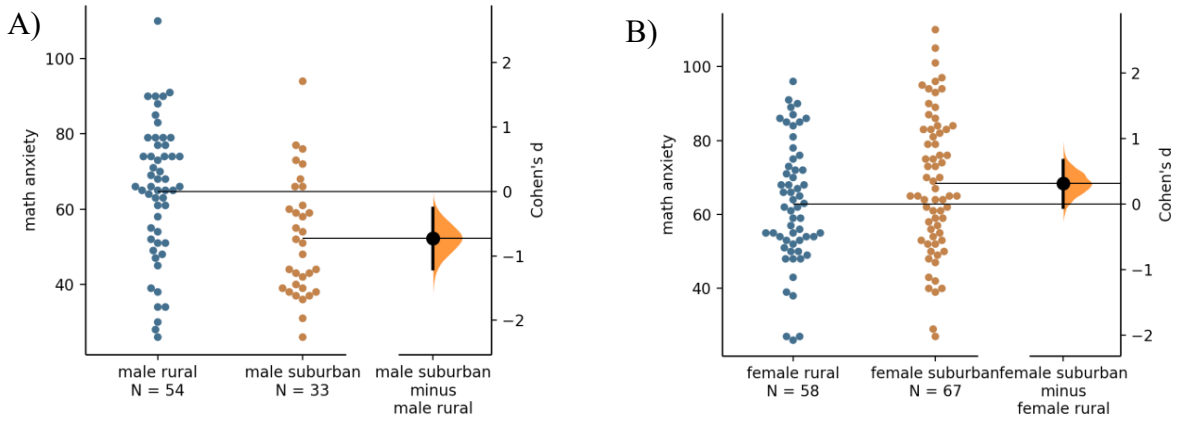

Figure 1- Difference between male students from rural school contexts and male students from suburban school contexts in relation to Mathematical Anxiety. Boys from rural areas have more MA than boys from suburban areas (d = -0.726 [CI 95.0% -1.2, -0.258] p = 0.0014). **B)** difference between female students from rural contexts and female students from suburban contexts. There was no significant effect in relation to girls (d = 0.316 [CI 95.0% -0.0452, 0.67] p = 0.0902).

Source: graphic generated by the authors at https: // www.estimationstats.com

Considering the rural / urban context, no differences in MA were found for any of the

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v38a210057

gender. The observed effect size was d = -0.0904 [95.0% -0.488, 0.318] p = 0.653, indicating that there was no significant difference between rural girls and urban girls (figure C) in relation to Mathematical Anxiety. Likewise, no difference was found when comparing boys from rural and urban groups (d = -0.276 [CI 95.0% -0.65, 0.121], p = 0.155), as shown in Figure D.

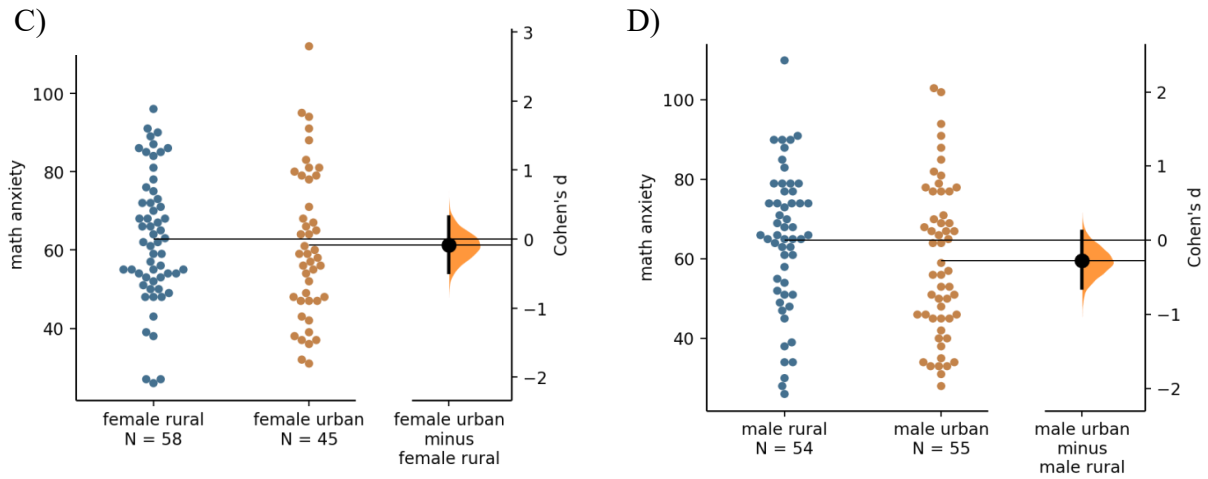

Figure 2- difference between female students from rural school contexts and female students from urban school contexts in relation to Mathematical Anxiety. No significant effect was found in relation to girls (d = -0.0904 [CI 95.0% -0.488, 0.318] p = 0.653). **D)** difference between male students from rural contexts and male students from urban contexts. No significant effect was found in relation to boys (d = -0.276 [CI 95.0% -0.65, 0.121], p = 0.155).
Source: graphic generated by the authors at https: // www.estimationstats.com

Finally, in the urban / suburban comparison, we found significant differences in relation to the female gender. Girls located in urban contexts have a lower level of MA compared to the group of suburban girls, d = -0.383 [CI 95.0% -0.765, 0.012] p = 0.0526, as shown in Figure E. Even so, no significant effect was found when comparing student boys in suburban contexts and student boys in urban contexts d = 0.403 [CI 95.0% -0.0292, 0.83], p = 0.0686, as shown in Figure F.

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v38a210057

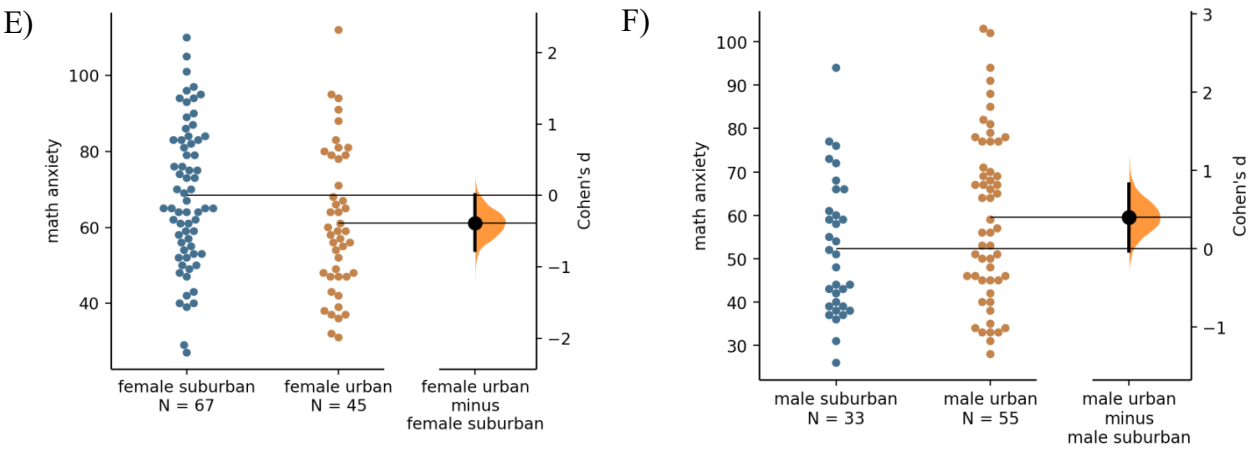

Figure 3- difference between female students from suburban context and female students from urban contexts. Urban girls have a higher level of MA in relation to the group of suburban girls (d = -0.383 [CI 95.0% -0.765, 0.012] p = 0.0526). **F)** difference between male students from suburban context and male students from urban contexts. There was no significant effect in relation to boys (d = 0.403 [CI 95.0% -0.0292, 0.83], p = 0.0686). Source: graphic generated by the authors at https: // www.estimationstats.com

4.2. School context, gender and Mathematical Performance

In the intragroup comparison, considering the mathematical performance and its relationship with the school context based on gender, we did not find any significant results, so that girls and boys demonstrated the same level of mathematical performance. The results are described in Table 4:

Table 4: Effect of the unpaired estimation test in relation to gender and mathematical performance by context. No internal differences were found between the groups.

	Cohen's d	**P**
Rural group	-0.0377 [95.0% CI -0.426, 0.326].	0.847
Suburban Group	-0.102 [95.0% CI -0.536, 0.338]	0.631
Urban group	0.00691 [95.0% CI -0.389, 0.398]	0.974.

Source: elaborated by the authors

In the analysis between the groups, regardless of gender, we found that there are differences between rural / urban students (d = 0.886 [CI 95.0% 0.58, 1.18] p = 0.0), as shown in Figure G, indicating that students from the rural group had lower mathematical performance when compared to the group of students from the urban context. When comparing students from the urban / suburban group, the results continue to show better performance from students of the urban group (d = 0.823 [CI 95.0% 0.513, 1.13] p = 0.0), as shown in Figure H. For students from rural / suburban groups, no significant difference was found (d = 0.0534 [CI 95.0% -0.213, 0.338] p = 0.694), as shown in figure I.

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v38a210057

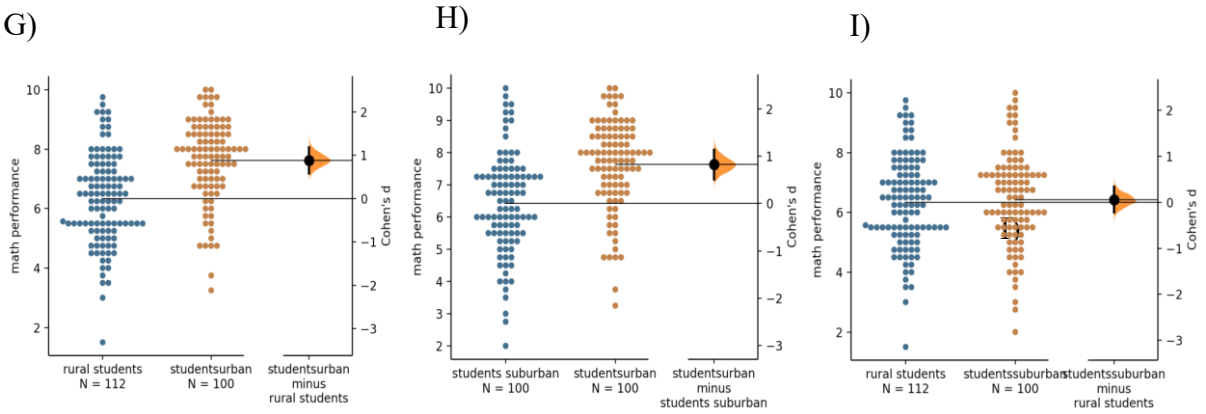

Figure 4- difference between students from rural school contexts and students from urban school contexts in relation to mathematical performance. Urban students have a higher level of performance compared to the group of rural students (d = 0.886 [CI 95.0% 0.58, 1.18] p = 0.0). **H)** difference between students in a suburban school context and students in an urban school context. Urban students have a higher level of performance compared to the suburban student group (0.823 [CI 95.0% 0.513, 1.13] p = 0.0). **I)** difference between students in a rural school context and students in a suburban school context. No significant differences were found between the groups (d = 0.0534 [CI 95.0% -0.213, 0.338] p = 0.694).

Source: graphic generated by the authors at https: // www.estimationstats.com

Based on that, we verified the influence of gender on the found differences. The results indicate that gender can influence performance when considering the school context.

In the rural-suburban relation, no significant differences were found between school context and mathematical performance when considering the gender of the participants, nor in relation to rural student girls in relation to suburban student girls (d = 0.0712 [CI 95.0% -0.299, 0.443] p = 0.694), as shown in Figure J, nor in relation to the boys from the rural groups and boys from the suburban group (d = 0.00315 [95.0% CI -0.449, 0.451] p = 0.997), as in Figure K.

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v38a210057

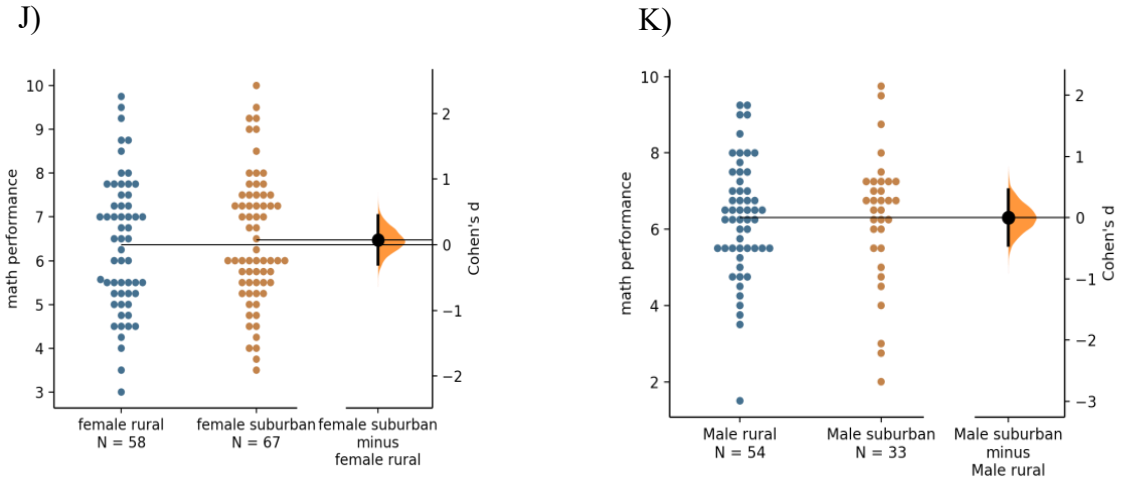

Figure 5- Difference between female students from rural school context and female students from suburban school context in relation to mathematical performance. No significant effect was found in relation to girls (d = 0.0712 [CI 95.0% -0.299, 0.443] p = 0.694). **K)** difference between male students from rural school context and male students from suburban school context. No significant effect was found in relation to boys (d = 0.00315 [95.0% CI -0.449, 0.451] p = 0.997).

Source: Source: graphic generated by the authors at https: // www.estimationstats.com

In view of the school contexts rural / urban, we found results that indicate notable differences in relation to the circumstances when observing the of the participants, so that girls who study in the rural context have a lower level of mathematical performance compared to girls who study in an urban condition (d = 0.909 [95.0% CI 0.479, 1.34], p = 0.0), as shown in Figure L. Similarly, boys who study in the rural context also have lower mathematical performance when compared to boys who study in the urban context (d = -0.863 [95.0% -1.25, -0.442]. p = 0.0), as in figure M.

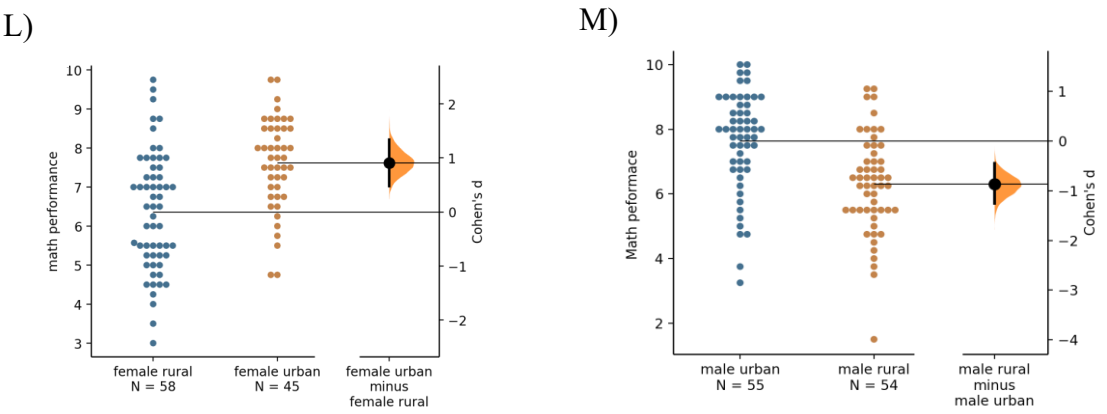

Figure 6- Difference between female students in a rural school context and female students in an urban school context in relation to mathematical performance. Rural girls have a lower level of mathematical performance compared to urban girls (d = 0.909 [95.0% CI 0.479, 1.34], p = 0.0). **M)** difference between male students in a rural school context and male students from an urban school context. Rural boys have a lower level of mathematical performance compared to urban boys (d = - d = -0.863 [CI 95.0% -1.25, -0.442]. p = 0.0).

Source: graphic generated by the authors at https: // www.estimationstats.com

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v38a210057

Definitely, when comparing urban / suburban groups while considering gender, we also find differences in mathematical performance. For these contexts, girls from the suburban group had a lower mathematical performance than the urban female group (d = 0.847 [CI 95.0% 0.439, 1.26], p = 0.0002), as shown in Figure N. As well, student boys in a suburban context, it has a lower performance when compared to boys in the urban group (d = 0.819 [CI 95.0% 0.309, 1.28] p = 0.0), as shown in figure O.

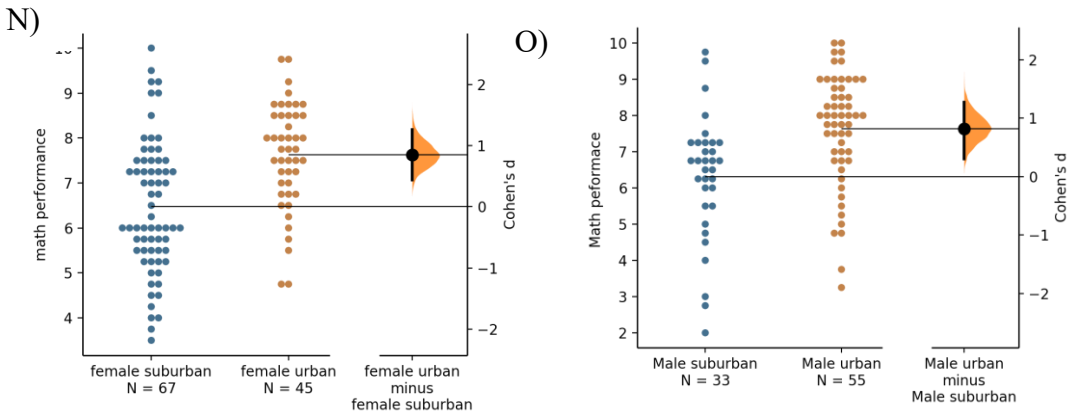

Figure 7- Difference between female students from the suburban school context and female students from the urban school context in relation to mathematical performance. Suburban girls have a poorer performance when compared to urban girls (d = 0.847 [95.0% 0.439, 1.26], p = 0.0002). **O)** difference between male students in a suburban school context and male students in an urban school context. Suburban boys have a poorer performance when compared to urban boys (d = 0.819 [CI 95.0% 0.309, 1.28] p = 0.0).

Source: graphic generated by the authors at https: // www.estimationstats.com

In the Frame 1, we summarize our range of results for MA and mathematical performance, relating them by school context and by the gender of the participants.

	female		**Male**	
	MA	Performance	MA	Performance
Urban - Suburban	Girls who study in urban contexts have lower Math Anxiety	Girls who study in urban contexts perform better	No effect	Boys who study in urban contexts perform better
Suburban - Rural	No effect	No effect	Boys who study in rural contexts have higher Mathematical Anxiety	No effect
Rural - Urban	No effect	Girls who study in urban contexts perform better	No effect	Boys who study in urban contexts perform better

Frame 1 - Comparison between results related to school contexts, gender and their relationship with Mathematical Anxiety and Mathematical Performance
Source: elaborated by the authors

5 Discussion

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v38a210057

We aim to investigate the influence of the school context on the prevalence of Mathematical Anxiety and on the mathematical performance of school children, taking into account different educational circumstances: rural, urban and suburban. In the comparison between groups, our results indicate that MA is related to school contexts. This result is in line with that found in Rao and Chaturvedi (2017) on academic anxiety and school context, where it was suggested that there is a significant difference in academic anxiety between students located in rural and urban areas. Similarly, Sultan and Bhat (2019) also found results in this perspective, noting that rural high school students have more academic anxiety than urban school students. We emphasize, however, that our results differ from the aforementioned studies from three specific aspects: the first, of course, it concerns our variable of interest *mathematical anxiety* which is a different construct from the *academic anxiety* investigated in previous studies. The second refers to the academic locus, because while the studies by Rao and Chaturvedi (2017) and Sultan and Bhat (2019) investigated participants in high school, we investigated in elementary school. The third aspect concerns the contexts considered, since we investigated three distinct school contexts: rural, urban and suburban. Studies investigating MA in specific school contexts are still limited, showing the need to expand research between such variables.

When considering the gender variable, the results continue to show noteworthy variabilities in the levels of MA according to the school context investigated. Analyzing the urban / suburban contexts, we find contrast between girls in the suburban group in relation to their peers in the urban group, pointing out that girls who study in suburban school settings have higher MA. For rural / suburban contexts, it was observed that boys in the rural group had higher MA compared to boys in the suburban group.

Previous studies that investigated the role of the school context in MA, considering gender, did not find notable results. Yaratan and Kasapoğlu (2012), for example, indicated that there are no differences in students' levels of anxiety about gender and school context. In the same sense, Rao and Chaturvedi (2019) found that there is no difference in the level of academic anxiety between high school boys and girls in relation to rural and urban groups. Our results contribute to the debate, showing that MA can impact gender depending on the school context considered.

Specifically, in the relationship between MA and gender, a previous study found a higher incidence of MA related to males when compared to females (Miller; Bichsel, 2004). On the other hand, Stipek and Gralinski (1991) and Devine *et al*. (2012), suggest a slight difference in

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v38a210057

degrees of mathematical anxiety in females in relation to males. Other evidence, suggests that there are no gender differences in the relationship with Mathematical Anxiety (Wu, 2012). Our findings indicate that, depending on the school context, MA may impact gender differently. We recommend further investigations in this perspective, correlating the variable gender and MA, considering different school contexts.

In the association between mathematical performance and MA, our findings show that the higher the MA, the lower the performance, being in line with extensive previous results that investigated these same variables (Hembree, 1990; Ho *et al*., 2000; Ashcraft, 2002; Miller; Bichsel, 2004; Carmo; Simionato, 2012; Carmo; Mendes; Fassis, 2014; Young; Wu; Menon, 2012; Dowker; Sarkar; Looi, 2016; Villamizar *et al* 2020; Moura-Silva; Bento-Torres; Gonçalves, 2019; Moura-Silva; Bento-Torres; Gonçalves, 2020). Likewise, our data is also consistent with other evidence when we observe the influence of the school context on academic performance (Yaratan; Kasapoglu, 2012).

In meta-analysis (Hembree, 1990), it was observed that low levels of mathematical performance would be directly related to high levels of MA. In the same perspective, Bezerra and Kassouf (2006), analyzing the factors that affect school performance in urban and rural areas, indicated that the location of the school and the motivation of the students are predominant. Other studies, such as those carried out by Hlalele (2012) found the adverse effects of breastfeeding on the confidence, motivation and performance of students, indicating the school as one of its causes.

Our findings corroborate those found previously, indicating that mathematical performance seems to be influenced by the school context considered. Although in an isolated way, we perceive a clear association of Mathematical Anxiety negatively influencing the mathematical performance in girls who study in urban / suburban contexts, although, we recognize that our evidence is not sufficient to generalize these results to the other contexts investigated.

6 Conclusions

Our study sought to identify relationships between MA and mathematical performance from specific school contexts: urban, rural and suburban. The results indicated significant relationships between MA and school setting, realizing the influence of the school context on the prevalence of MA in relation to gender. The findings that the school context also interferes with mathematical performance. The rural group showed generally inferior performances, in

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v38a210057

relation to the urban and suburban groups. Considering that rural schools were the ones that presented the worst performances, research should be expanded to investigate their causes and establish interventions aimed at remedying these results. Among the limitations that may have an impact on the results of our study, we mention the reduced variables that were considered and that can be expanded and combined in future investigations, such as, the inclusion of factors like metacognition, self-efficacy, socioeconomic conditions and a more accurate analysis of the school structure itself in terms of its infrastructure and technical staff.

Even so, our results contribute to the field of investigation of social and environmental influences on MA, indicating that the school context seems to have an impact on the prevalence of MA when considering different school contexts, especially when evaluating gender. It is an initial overview of the topic, so new verifications are necessary to inform teachers, students and other school professionals about the factors that influence mathematical learning in different Brazilian teaching contexts.

References

ASHCRAFT, M. H. Math anxiety: Personal, educational, and cognitive consequences. **Current Directions in Psychological Science**, Cleveland, v. 11, n. 5, p. 181-185, Oct. 2002.

BALOGLU, M; KOÇAK, R. A multivariate investigation of the diferences in mathematics anxiety. **Personality and Individual Differences**, Washington, v. 40, n.7, p. 1325-1335, 2006.

BEZERRA, M. G; KASSOUF, A. L. Analise dos Fatores que Afetam o Desempenho Escolar nas Escolas das Áreas Urbanas e Rurais do Brasil. *In:* CONGRESSO DA SOCIEDADE BRASILEIRA DE ECONOMIA, ADMINISTRAÇÃO E SOCIOLOGIA RURAL, v. 44., n.1, p. 106-114, Fortaleza. **Anais** Brasília: SOBER, 2006.

BLAIR, RJ. The amygdala and ventromedial prefrontal cortex in morality and psychopathy. **Trends Cogn Sci**, Cambridge, v. 11, n. 9, p. 387-92, 2007.

BRASIL. Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira (INEP). **Microdados do Sistema Nacional de Avaliação da Educação Básica** – **SAEB**. Brasília: INEP, 2011.

BRASIL. Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira (INEP). **Microdados do Sistema Nacional de Avaliação da Educação Básica** – **SAEB.** Brasília: INEP, 2018.

CARMO, J. S; SIMIONATO, A. M. Reversão de ansiedade à Matemática: alguns dados da literatura**. Psicologia em Estudo**, Maringá, v. 17, [s.n], p. 317-327, 2012.

CARMO, J.; MENDES, A.; FASSIS, D. Diferentes graus de ansiedade à matemática e desempenho escolar no ensino fundamental. **Psicologia da Educação**, São Paulo, v. 39, n. 39, p. 47-61, 2014.

DAMÁSIO, A. R. **O erro de descartes:** emoção, razão e o cérebro humano. Tradução de Dora Vicente, Georgina Segurado. 3. ed. São Paulo: Companhia das Letras, 2012.

DEVINE, A.; FAWCETT, K.; SZÜCS, D; DOWKER, N. Gender differences in mathematics anxiety

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v38a210057

and the relation to mathematics performance while controlling for test anxiety. **Behavioral and Brain Functions**, London, v. 8, n. 33, p. 2-9, 2012.

DOWKER, A.; BENNETT, K.; SMITH, L. Attitudes to Mathematics in Primary School Children**. Child Development Research**, Londres, v. 2012, n. 124939, p. 1-8, 2012. Available in: https://onlinelibrary.wiley.com/doi/10.1155/2012/124939 . Access: 18 July of 2024.

DOWKER, A.; SARKAR, A.; LOOI, C. Y. Mathematics Anxiety: What Have We Learned in 60 Years? **Frontiers in Psychology,** Washington, v. 7, n. 508, p. 1-16, 2016. doi:10.3389/fpsyg.2016.00508. Available in: https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2016.00508/full . Access: 18 jul. 2024.

GAMBOA, S.S. Quantidade-qualidade: para além de um dualismo técnico e de uma dicotomia epistemológica. *In:* SANTOS FILHO, J.C. GAMBOA, S. S. (org.). **Pesquisa educacional:** quantidade-qualidade. 8. ed. São Paulo: Cortez, 2013 (Coleção Questões de Nossa Época, Vol. 46)

HARARI, R., VUKOVIC, R. K. E BAILEY, S. P. Mathematics Anxiety in Young Children: An Exploratory Study. **The journal of experimental education**, Londres, v. 81, n. 4, p. 538-555, 2013.

HEMBREE, R. The nature, effect, and relief of mathematics anxiety. **Journal for Research in Mathematics Education**, Reston, v. 21, n. 1, p. 33-46, 1990.

HLALELE, D. Exploring rural high school learners' experience of mathematics anxiety in academic settings. **South African Journal of Education**, Joannesburgo, v. 32, n. 3, p. 267-278, 2012. doi:10.15700/saje. Available in: https://www.ajol.info/index.php/saje/article/view/79393 . Access: 18 july 2024.

HO, H.-Z., SENTURK, D., LAM, A. G., ZIMMER, J. M., HONG, S., OKAMOTO, Y., WANG, C. P. The Affective and Cognitive Dimensions of Math Anxiety: A Cross-National Study. **Journal for Research in Mathematics Education**, Reston, v. 31, n. 3, p. 362, 2000. doi:10.2307/749811. Available in: https://www.jstor.org/stable/749811 . Access: 18 july 2024.

HO J, TUMKAYA T, ARYAL S, CHOI H, CLARIDGE-CHANG A. Moving beyond P values: data analysis with estimation graphics. **Nat Methods.** New York, v. 16 n. 7 p:565-566, 2019.

JOHNSON-BROWN, S. L**. Location, location, location: do school size, family socioeconomic status, and levels of rurality affect the outcome of westest scores**? 2014. 200 sheets. Dissertation (Master's degree in Education) - Capella University, Minneapolis, 2014.

MALONEY, E. A., & BEILOCK, S. L. Math anxiety: who has it, why it develops, and how to guard against it. **Trends in Cognitive Sciences**, Cambridge, v. 16, n. 8, p. 404-406, 2012. doi: 10.1016/j.tics. Available in: https://www.sciencedirect.com/science/article/pii/S1364661312001465 . Access: 18 july 2024.

MILLER, H; BICHSEL, J. Anxiety, Working memory, gender, and math performance. **Personality and individual Differences**, Canadá, v. 37, n. 3, p. 591-606, 2004.

MOURA-SILVA, M. G; BENTO-TORRES, J; GONÇALVES, T.O . **Manifestações subjacentes da ansiedade matemática no sistema nervoso autônomo: uma análise da Variabilidade da Frequência Cardíaca, Desempenho Matemático e Função Executiva em Crianças Escolares.** 2019. 113 folhas. Tese (Doutorado em Educação em Ciências e Matemática) - Instituto de Educação Matemática e Científica, Universidade Federal Pará, Belém, 2019.

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v38a210057

MOURA-SILVA, M. G; BENTO-TORRES, J; GONÇALVES, T.O. Bases Neurais da Ansiedade Matemática: implicações para o processo de ensino-aprendizagem. **Bolema**, Rio Claro, v. 34, n. 66, p. 246-267, jan. abr. 2020. https://doi.org/10.1590/1980-4415v34n66a12. Disponível em: https://www.scielo.br/j/bolema/a/jrVBryXPH6TWH5X6tt94HZq/?format=pdf&lang=pt. Acesso em: 25 mai. 2024.

PEKRUN, R., LICHTENFELD, S., MARSH, H. W., MURAYAMA, K., & GOETZ, T. Achievement Emotions and Academic Performance: Longitudinal Models of Reciprocal Effects. **Child Development**, Washington, v. 88, n. 5, p. 1653-1670, 2017. doi:10.1111/cdev.12704. Available in: https://srcd.onlinelibrary.wiley.com/doi/full/10.1111/cdev.12704 Access: 18 jul 2024.

RAO, R., CHATURVEDI, A., Study the Academic Anxiety of Secondary School Students in Relation to Gender and Locality. **International Journal of Research in Humanities, Arts and Literature,** Tamil Nadu**,** v. 5, n.12, p. 59-62, 2017.

RICHARDSON, F. C.; SUINN, R. M. The Mathematics Anxiety Rating Scale: Psychometric data. **Journal of Counseling Psychology**, Texas EUA, v. 19, n. 6, p. 551-554, 1972.

STIPEK, D.; GRALINSKI, J. H. Gender differences in children's achievement-related beliefs and emotional responses to success and failure in mathematics. **Journal of Educational Psychology,** EUA, v. 83, n. 3 p. 361-371, 1991.

SULTAN, I., BHAT, S., Academic anxiety of rural urban secondary school students. **International Journal of Research and Analytical Reviews (IJRAR)**, Rajkot, v. 6, n. 1, p. 676-678, 2019.

VAN DER BEEK, J. P. J., VAN DER VEN, S. H. G., KROESBERGEN, E. H., LESEMAN, P. P. M. Self-concept mediates the relation between achievement and emotions in mathematics. **British Journal of Educational Psychology**, London, v. 8, n. 3, p. 478-495, 2017. doi:10.1111/bjep.12160. Available in: https://pubmed.ncbi.nlm.nih.gov/28440010/ . Access: 18 jul 2024.

VILLAMIZAR A.; GUSTAVO, A.; TAMMI Y.; TRUJILLO C.; WENDDY J. Relación entre ansiedad matemática y rendimiento académico en matemáticas en estudiantes de secundaria. **Ciencias Psicológicas**, Montevideo, v. 14, n. 1, p. e-2174, en./jun. 2020. https://dx.doi.org/10.22235/cp.v14i1.2174 Available in: https://revistas.ucu.edu.uy/index.php/cienciaspsicologicas/article/view/2174/2081. Access: 25 mai. 2024.

WU SS, BARTH M, AMIN H, MALCARNE V; Menon V. Math anxiety in second and third graders and its relation to mathematics achievement. **Front. Psychology** v 3 n. 162. P. 1-11, 2012.

YARATAN, H.; KASAPOĞLU, L. Eighth Grade Students' Attitude, Anxiety, and Achievement Pertaining to Mathematics Lessons. **Procedia - Social and Behavioral Sciences,** London, v. 46, n. 1 , p. 162-171, 2012. doi:10.1016/j.sbspro.2012.05.087 Available in: https://www.sciencedirect.com/science/article/pii/S1877042812012165 . Access: 18 jul 2024.

YOUNG, C. B., WU, S. S.; MENON, V. The neurodevelopmental basis of math anxiety. **Psychological Science**, Washington, D.C., EUA, v. 23, n. 5, p. 492-501, 2012.

Submetido em 16 de Abril de 2021.
Aprovado em 15 de Março de 2024.