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The learning of mathematics in the final years of elementary school: Studies and realities in the municipal school system of Florianópolis-SC

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ABSTRACT
This article presents a research whose objective was to investigate how the teaching-learning process of mathematics occurs in the final years of elementary school. To achieve this goal, two integrative literature reviews were initially carried out based on data available on the Web of Science, Scopus and Scielo and, in a later phase, a field research was carried out with students and teachers of the final years of elementary education in municipal schools. from Florianópolis - SC. In this research characterized as descriptive in terms of its objectives and qualitative in terms of approach, in addition to the integrative review, participant observations and semi-structured interviews were used. As for the use of TDIC's for learning mathematics, the results of the reviews revealed that the gradual increase in this use has been pointed out as positive. However, in field research with 15 teachers and 50 students, it was identified that, for the majority, at the time the data were collected, the technologies were not yet actively participating in this process. As with other findings at this stage, it should be noted that, for these students, mathematics was mentioned as one of the disciplines with greater "ease" of understanding. In addition, they pointed out "fractions" as the content with the greatest difficulty in understanding. In this way, it is concluded that the analysis and reflection on the relevant aspects of the observed experience, focusing on the use of technologies or, the difficulties pointed out in the teaching of fractions, can greatly contribute to the educational praxis of mathematics.

Keywords: Learning, Mathematics, Elementary school, Educational technology.

1 INTRODUCTION

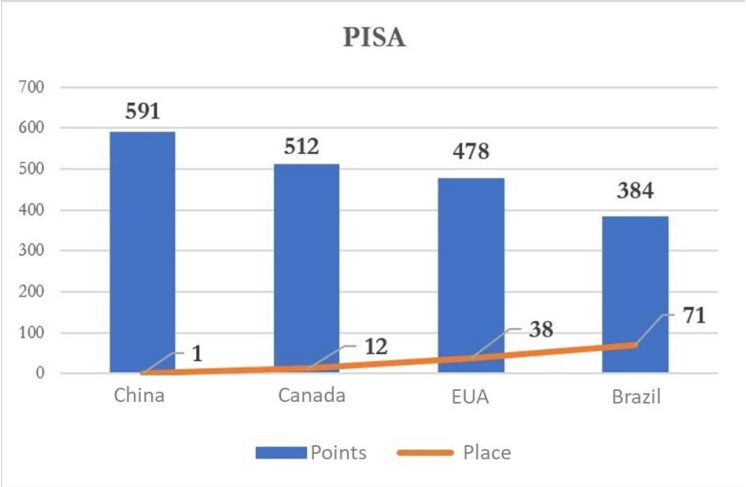
The educational and learning process has been modified and progressed, while accompanying the changes and modernizations that affect society. Over the years and different situations, the teaching tools, learning methodologies and techniques, the roles played by the teacher and student, and even the places where education is effected have changed because, with the pandemic that has affected the world since December 2019, remote teaching has been incorporated into many situations. However, when it comes to the subjects offered in the different cycles, mathematics is indicated as one of the

foundations of the formation of students, being part of a set of disciplines that, by accompanying them throughout basic education, should guarantee them the learning of vital skills for the exercise of citizenship, as well as preparation for the world of work. In 2018, the Ministry of Education concluded the document called National Common Curricular Base (BNCC) with the inclusion of the High School stage, through which experts from all areas of knowledge pointed out the demands in each theme, in order to provide today's students, competencies–knowledge, skills, attitudes and values–to enable them in the transformation of an increasingly human society, socially just and focused on caring for nature (Brasil, 2018).

The BNCC also reinforces that, contrary to what common sense believes, mathematics is not restricted only to counting, measuring objects and quantities, but also creates abstract systems that encompass ideas and objects fundamental to the construction of meaningful representations, fundamental to mathematical literacy. Defined by this basis as the set of competencies and skills capable of favoring in students the establishment of conjectures, formulation of problem solving through concepts, procedures, facts and diversified tools, mathematical literacy is the target of constant evaluation.

In one of the International Student Assessment programmes, the Programme for International Student Assessment (PISA), the OECD (Organisation for Economic Co-operation and Development) investigates students' performance in terms of their reading, math and science knowledge and skills. Due to the pandemic the assessment that would take place in 2021 was moved to 2022. The latest available data from this test are those from 2018, published in December 2019 (PISA, 2018). About mathematics, it is proven the low performance of Brazil that, with only 384 points takes the 71°place, while China is in first place with 591 points, Canada is in 12°place (512 points) and the United States, is in 38°place (478 points). Figure 1 shows these data.

Figure 1. PISA Assessment Data



Source: PISA (2018).

From this context, this article presents an excerpt from a doctoral research that began in May 2019 focusing on identifying the situation of the teaching-learning process of mathematics, in front of teachers and students from the 6th to 9th grades of elementary school. It was also placed as one of the specific objectives: Identify what are and how are used the Digital Information and Communication Technologies (TDIC's).

In order to recognize the different aspects that permeate the learning process, in relation to the discipline of mathematics, the question that drove this research was: How does the learning of mathematics occur in the final years of elementary school in the municipal network of Florianópolis-SC?

The presentation of this study is divided into five sections: this introduction, which, as a first step, puts the reader abreast of the contents that will be addressed in the article, the following section where the theoretical framework will be presented and, subsequently, the third section, where the methodological procedures are. In the fourth section are the presentation, analysis, and discussion of the results. The fifth section closes with the final considerations and recommendations for further research.

2 LEARNING VS. MATHEMATICS

Mathematics is one of the basic disciplines of the formation of students. As Silva (2017) points out, it is through mathematics that knowledge such as counting, measuring, and solving problems is learned, considered fundamental for personal and professional development, and consequent life in society.

According to the National Common Curricular Base (BNCC) the different fields that make up the discipline of mathematics bring together a set of fundamental ideas that, by producing articulations among themselves − such as equivalence, order, proportionality, interdependence, representation, variation and approximation− have a primary role in the development of students' mathematical thinking (Brasil, 2018).

It should be noted, however, that learning mathematics has become a challenge for many students who, even before trying to solve the proposed questions, stress "I am not good at mathematics" (Segarra; Julia, 2021; Colomeischi; Colomeischi, 2015). In this regard, Bausela (2018) points out that the risk predisposition to low performance may be associated with anxiety, in combination with several factors still under study such as delay or deficit in neurocognitive processes. Oliveira and Oliveira (2017) go further, stating that this discipline represents a barrier for most students because, between different levels of schooling, the stigma that mathematics is difficult is maintained. For Silva (2006) the difficulties of students in understanding the mathematical contents may be related to factors such as: lack of study habits, decontextualized activities, memorization of fundamental subjects, lack of

activities that develop reasoning, difficulties of abstraction, disinterest of students who cannot learn, or even unmotivated teachers.

In view of the express, it is essential to seek new knowledge about the learning of this discipline. According to Pozo (2002), learning admits a great variety of conditions, processes and results and, for this reason, the different combinations generated will be responsible for diverse situations. Perrenoud (2000) complements, by pointing out that, for students to participate in a collective effort in search of building new competencies, learning must include projects of problem-situations, capable of encouraging them to act in a practical-reflective way.

The role of the teacher is also paramount. According to Oliveira (2014) the teacher can no longer be only a transmitter of contents, but rather, must act as a mediator and manager of knowledge, knowing their students, respecting their differences and limits and, thus, leading them to think, criticize and formulate doubts, capable of helping them in the production of new knowledge. Paula, Ferreira and Torisu (2020) also highlight that, for the success of the learning process, the teacher-student relationship has a fundamental role because both must act as partners, dividing the responsibilities for the educational process.

In addition to the roles assumed by teachers and students, another relevant issue today is the use of Digital Information and Communication Technologies (TDIC's). As Silva (2017) maintains, TDIC's are increasingly present in everyday life and, thus, more accessible in the school context. Its use, in this sense, can enable a quality mathematical education. Molenaar and Campen (2017) reinforce that, when it comes specifically to mathematics, the use of TDIC's becomes elementary, so that students do not feel bored in the classroom, with the use of traditional teaching methods. On this precept, Basso (2003) perfects this opinion by stating that the use of computers for mathematics classes positively influences whereas, in computer-assisted teaching, the teacher ceases to be the holder of knowledge and creates the opportunity to develop student-centered experiences, changing the focus of tasks and responsibilities from the teacher to them and, in this way, modifying the *status* of traditional teaching.

From the above, it is perceived that different factors influence the process of learning mathematics. Thus, this study is justified to investigate how the teaching-learning process of mathematics occurs in classes from 6th to 9th grades of elementary school.

3 METHODOLOGICAL PATH

Focusing on the attempt to achieve the objectives proposed in this research and, following the indications of Lakatos and Marconi (2001) who emphasize the importance of seeking answers to the questions proposed with the use of scientific methods, seeking to know the reality of the field studied, the approach of this research was of a qualitative nature. As Gerhardt and Silveira (2009) point out, the qualitative approach rejects a positivist model of science and deepens in analyzing and

understanding a social group, an organization, and not just a numerical representativeness. Thus, we opted for the use of a qualitative approach in which the researcher has a fundamental role, trying to reduce the path between theory and data, as well as between context and action, making use of his experience to understand the phenomena perceived in this trajectory (Teixeira, 2007). It is also emphasized that, with regard to the objectives, this research can be characterized as descriptive, because it seeks to describe the characteristics of a certain population or phenomenon or even to establish the relationships between the variables found (Gil, 2008).

In order to theoretically support this study, we started with the method called Integrative Literature Review - RIL. As Torres-Carrión *et al. point out*. (2018) this scientific strategy is recognized for synthesizing various studies with related themes, providing research with the opportunity to build new knowledge. Creswell (2010), in turn, points out that this method has as its main characteristic the expansion of the researcher's field of view in relation to the investigation. To carry out the RIL, the model proposed by Botelho, Cunha and Macedo (2011) was used, in which six steps are followed: in the first stage, the theme is identified and the research question is selected; in the second, there is the establishment of inclusion and exclusion criteria; in the third, the identification of pre-selected and selected studies; in the fourth, the categorization of the selected studies; in the fifth, the analysis and interpretation of the results is performed; and, finally, in the sixth stage, the review and synthesis of knowledge is presented.

For this research, two integrative reviews were performed. In both cases, the same databases were consulted: *Web of Science*, *Scopus* and *Scielo*. In the first revision the search *string* used was: "*math*" AND "educational technolog*" AND *"education*", emphasizing that the use of the asterisk in the word *"technolog*" sought to rescue as many studies as possible with this same radical. After applying the inclusion and exclusion criteria, as well as the refinement and analysis of duplicate studies via *Mendeley, the* following resulted: of the 378 articles initially found in the *Web of Science*, only 5; of the 92 *Scopus* articles, only 6; and, of the 366 *in Scielo*, only 3 articles for full reading. In this sense, through this RIL, 14 articles were obtained, which are categorized in Chart 1.

Chart 1 - Articles selected in the first Integrative Literature Review

Title	Authors and Year
1. K-16 Computationally Rich Science Education: A Ten-YearReview of the Journal of Science Education and Technology (1998–2008)	Jennifer Wofford (2009)
2. Improving Teacher's self confidence in LearningTechnology Skills and Math Education through Professional Development	Taralynn Hartsell, Sherry S. Herron, Houbin L. Fang, Avinash Rathod (2010)
3. The attitudes of the prospective mathematics teachers towards instructional technologies and material development course	Sevinç Mert Uyangör, Denizhan Karaca Ece (2010)

4. Math attitudes of computer education and instructional technology students	Mehmet Tekerek, Betül Yeniterzi, Orhan Ercan (2011)
5. Adaptively Ubiquitous Learning in Campus Math Path	Shu-chuan Shih, Bor-Chen Kuo, Yu-Lung Liu (2012)
6. Tablet-Based Math Assessment: What Can We Learn from Math Apps?	Xingyu Pan, Gabrielle A. Cayton-Hodges, Gary Feng (2015)
7. Short Serious Games Creation under the Paradigm of Software Process and Competencies as Software Requirements. Case Study: Elementary Math Competencies	Arturo B. Saavedra, Francisco Á. Rodrigues, Ricardo Mendoza-Gonzalez, Ana Cecília O. de Luna (2015)
8. The Pedagogic Role of the Arts and Digital Media in the practice of the Ontario Mathematics Curriculum	Ricardo Scucuglia Rodrigues da Silva (2015)
9. Ipad in Elementary School Math Learning Setting	Ibtesam F. Al-Mashaqbeh (2016)
10. Teaching Math to Deaf/Hard-of-Hearing (DHH) Children Using Mobile Games: Outcomes with Student and Teacher Perspectives	Brett E. Shelton, Mary Ann Parlin (2016)
11. Use of digital applications in the medicament calculation education for nursing	Francisco G. F. Pereira, Joselany A. Caetano, Natasha M. Frota, Maguida G. da Silva (2016)
12. Investigating the Use of the Khan Academy and Mathematics Software with a Flipped Classroom Approach in Mathematics Teaching	Yilmaz Zengin (2017)
13. Exploring In- and Pre-Service Science and Mathematics Teachers' Technology, Pedagogy, and Content Knowledge (TPACK): What Next?	Noha Alrwaished, Ali Alkandari, Fatimah Alhashem (2017)
14. Meerkat Maths – A comprehensive maths learning programme for Grade-R	Eurika J. van Vuuren, Moritz Herzog, Annemarie Fritz (2018)

Source: Prepared by the authors (2023).

In the second RIL, as in the first, the methodological model described by Botelho, Cunha and Macedo (2011) was used. Seeking to increase the search capacity, we also searched the platforms Health Sciences - (DeCS), *Medical Subject Headings* (MeSH) and *European Thesaurus* of Educational Systems to improve the search *string*. In addition, the term "elementary school" was added to the search. Thus, the strategy used was: (*("learning" OR "*apprentice*" OR "learning*" OR "education") AND ("mathematics" OR "mathematics*") AND ("elementary school" OR "primary* education*") AND ("*educational technology" OR "technology in education" OR "educational *technology*" OR *"technology in education*")).

Initially, 224 documents were found in *Scopus*, 72,356 documents in the *Web of Science*, and only 1 in the *Scielo database*. After applying the inclusion and exclusion filters, 11 articles remained for full reading and the *Mendeley* reference manager was used in order to categorize the documents found in this review. The data of the second RIL as well as its themes are presented in Chart 2, in the section of Presentation, analysis and discussion of the results.

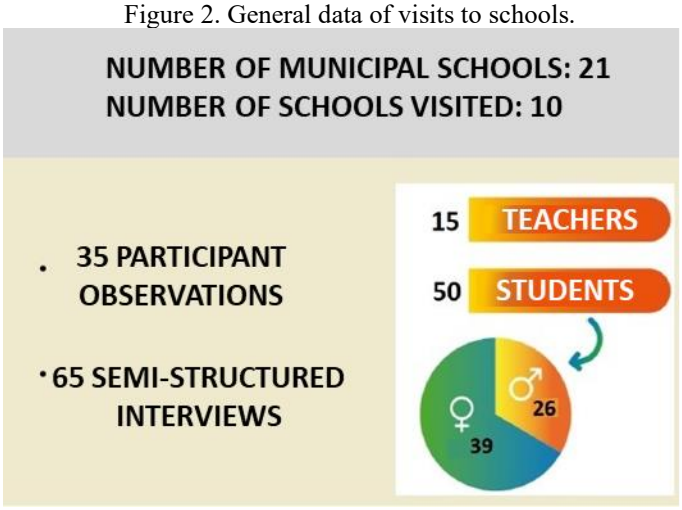
Following the process of effecting the RIL, the selected articles were incorporated into a synthesis matrix, a method through which, after the collection of information, the organization of the sources can assist in the clear and objective writing of the analysis of the results (Garrard, 2011). As Botelho, Cunha and Macedo (2011) point out, a RIL effectively complements a research, while the analysis of different studies on the same theme is configured in a method capable of synthesizing and generating new knowledge. Then, as the sixth and final stage of the RIL, the review and synthesis of the acquired knowledge is generated, through the section of Presentation, Analysis and Discussion of the results, later chapter of this article.

In a next step in search of the proposed goals, from the approval of this study in the Brazil Platform–national and unified database of research records involving human beings under the number 3,296,598, as field research were carried out visits to schools. In view of the location of the university where the doctorate is being studied, this research was carried out in the city of Florianópolis-SC. The visitation order started from the alphabetical sequence of schools, provided on the *website* of the Municipal Department of Education (Education, 2021) and the proximity of location.

The City Hall of Florianópolis / SC has 37 municipal schools in total, however, for the purposes of this study were selected the 21 schools that work with 6th to 9th grade of elementary school. In each of the schools visited, a script was followed: meeting with the direction or pedagogical coordination to present the project, participant observation of a mathematics class, semi-structured interview with all mathematics teachers, semi-structured interview with at least one student from each class of 6th to 9th grade of the school. All participants in the interviews received, read, and signed the Free and Informed Consent Form (ICF). In the case of the students, the ICF was signed by them and by their parents or guardians.

From June 18, 2019 to March 16, 2020, 47.6% of the total number of schools were visited, and initially, semi-structured interviews were conducted with those responsible, that is, principals or pedagogical coordinators. These people authorized the follow-up of the research and signed the letter sent by the Management of Continuing Education (GFC) of the Municipality of Florianópolis/SC, which, in accordance with Municipal Ordinances 116/2012 and 076/2014, authorizes the researcher to carry out his study in the school environment under his jurisdiction. After the interview with the parents/guardians, observations were made and interviews with teachers and students began. A total of 15 teachers and 50 students were interviewed. General data on school visits are shown in Figure 2.

Figure 2. General data of visits to schools.



Source: Prepared by the authors (2023).

As shown in Figure 2, analyzing the total audience of teachers and students, 65 people were interviewed, 26 males (40%) and 39 females (60%). In some of the schools there was only one math teacher for all classes, in others two or more teachers, which generated a total of 15 teachers interviewed. In most schools, 2 students per school year were interviewed, resulting in 50 interviews with students.

In the following section will be presented the data, as well as the analysis and discussion of the results.

4 PRESENTATION, ANALYSIS AND DISCUSSION OF RESULTS

In this topic we will discuss the results obtained from the reading of the articles selected in the integrative reviews and, subsequently, the observance of the data collected in the visits to the schools.

In the first RIL, after data analysis, among the main aspects observed in the reading of these studies, it can be emphasized that:

- the use of technology for educational purposes was pointed out by all studies as positive as an aid in the learning process;
- Some of the ways in which technology was used for educational purposes in the studies in question were spreadsheets, databases, and educational software programs;
- In the studies under analysis, the use of technology occurred in the different educational levels - preschool, elementary school and high school, through devices such as *Ipad, tablet*, computers and cell phones and, use of different methodologies, such as inverted classroom and games.

The results of this RIL, in full, are published in the journal Educação Matemática Pesquisa (PUC-SP), in the article entitled "The Digital Technologies of Information and Communication and the Teaching-learning of Mathematics: an integrative review" (Pillon *et al.*, 2021).

In addition to these topics present in the resulting RIL articles, one of the terms that drew attention was "mathematical anxiety" presented and discussed in the study *"The relationship between middle school students mathematics anxiety and their mathematical understanding"* (Kaba & Şengül, 2018). By quantitatively researching the relationship between anxiety and math comprehension with 466 high school students, the authors found that those who demonstrated a high degree of comprehension had high levels of anxiety. At this moment, it was taken for the first time, contact with this important subject concerning the learning of mathematics.

In the second RIL, after analysis of the inclusion and exclusion filters and also the use of the *Mendeley* reference manager, 11 articles were selected for full reading. They are categorized and their scopes are listed in Chart 2.

Chart 2 – Articles and themes addressed in the second Integrative Literature Review

Article	**Authors and Year**	**Topic of the article**
1.Education in Programming and Mathematical Learning: Functionality of a Programming Language in Educational Processes	Ramón García-Perales, Ascensión Palomares-Ruiz (2020)	The authors compared the result of an *online* version of the Mathematical Competency Assessment Battery (BECOMA On) between two groups of students. They concluded that the students who participated in this study demonstrated to have developed their mathematical skills more than the students who learned mathematics through other activities.
2.Teacher Dashboards in Practice: Usage and Impact	Inge Molenaar, Carolien K-V Campen (2017)	In this study, the authors researched the adaptive educational technology used through teacher panels. The results showed that the learning analyses obtained through these panels influence their pedagogical actions in the daily activities in the classroom and can initiate behavioral changes in teaching practices.
3. Teaching Basic Mathematics by Using TuxMath in Primary Education	Megavarnan Jagadesan (2013)	In the third article, we sought to examine the usefulness of a video game called TuxMath, in the role of assistant primary education teachers in the teaching and learning of mathematics. The results showed that TuxMath had a significant positive impact among teachers and students, with students preferring TuxMath over using the traditional method of teaching basic mathematics.
4.Using educational technology to develop early literacy skills in Sub-Saharan Africa	Philip C. Abrami, C. Anne Wade, Larysa Lysenko, Jonathon Marsh, Anthony Gioko (2016)	This article shows a study on the impact of an interactive multimedia literacy software called ABRACADABRA (ABRA, for short) on the reading skills of students in elementary school. After 13 weeks of intervention, it was observed that ABRA students outperformed their peers in control classes on the end-of-year basic exams, including English, math, science, and social studies.
5.Analysis of the construction of the concepts of proportionality with the use of the *virtual geoplane* software	Leandra Anversa Fioreze, Dante Barone, Marcus Basso, Sílvia Isaia (2013)	These authors carried out a research based on the Theory of Conceptual Fields of Gérard Vergnaud, with the objective of relating the use of digital resources and the learning of the concepts of proportionality. After the stages of the study, the authors concluded that the results obtained proved that the involvement of the students in the process was determinant for the final evaluation to be positive.

6.Accessible mathematics videos for non-disabled students in primary education	Alejandro Rodriguez-Ascaso, Emilio Leton, Jaime Muñoz-Carenas, Cecile Finat (2018)	In this study, the authors analyzed the Universal *Design* criteria used to produce and use math videos for visually impaired elementary school students, which may also affect students without disabilities. The essay was designed to assess the quality of learning achieved with two types of videos (A and B) and, in the end, the authors concluded that inclusive education shows neutral to positive effects in students with and without disabilities.
7. An Exploratory Analysis of the Implementation and Use of an Intelligent Platform for Learning in Primary Education	Natalia L. Nieto-Márquez, Alejandro Baldomino, Alejandro C. Martínez, MiguelÁngel Pérez Nieto (2020)	In article 7, the authors conducted an exploratory analysis on the use *of Smile and Learn's*, an educational and multi-dimensional platform. At the end of this study, it can be concluded that such results can contribute to improvements in educational platforms, especially regarding the *design* of materials and digital activities.
8.Comparative evaluation of virtual and augmented reality for teaching mathematics in primary education	Eleni Demitriadou, Kalliopi-Evangelia Stavroulia, Andreas Lanitis (2019)	In this research the authors compared the use of Virtual Reality (VR) and Augmented Reality (AR) technologies as opposed to traditional teaching methods, specifically in the discipline of mathematics, during a course on solids in primary education. From the results it was concluded that the implementation of new technologies in virtual and augmented reality education improves interactivity and students' interest in mathematics education.
9. Development of a video game and its dance board, for learning basic mathematics	Ismael Martínez Oviedo, Guadalupe T Toledo, Eduardo Martínez Mendoza (2021)	Here is a research in which a video game was developed with Unity 3D™ technology and its board, designed for elementary school children, early grades, where they would learn the four basic operations, called AppNdomimbas. At the end of this study, or authors concluded that the goal was achieved because the game was created to be a tool for learning mathematics and stimulating physical activity simultaneously and achieved both goals.
10.Interactive White Boards in Preschool and Primary Education	Athanasios S. Drigas, George Papanastasiou (2014)	This study shows a research in which interactive whiteboards (IWB's) were used in preschool and primary education, from 2004 to 2013. At the end of the research it was possible to realize that the IWB's are able to keep students engaged, and also promote their attention in each aspect of the curriculum, more easily than without it.
11. Is changing teaching practice the mission impossible? A case study of continuing professional development for primary school teachers in Senegal	Takeshi Miyazaki (2015)	The article reports on a continuous professional development project called *Projet de Renforcement de l'Enseignement des Mathématiques, des Sciences et de la Technologie* (PREMST). At the end of the research, it was found that the teachers participating in PREMST changed their practices in terms of teaching methods used in the classroom, however, the change in pedagogy remained minimal.

Source: Prepared by the authors (2023).

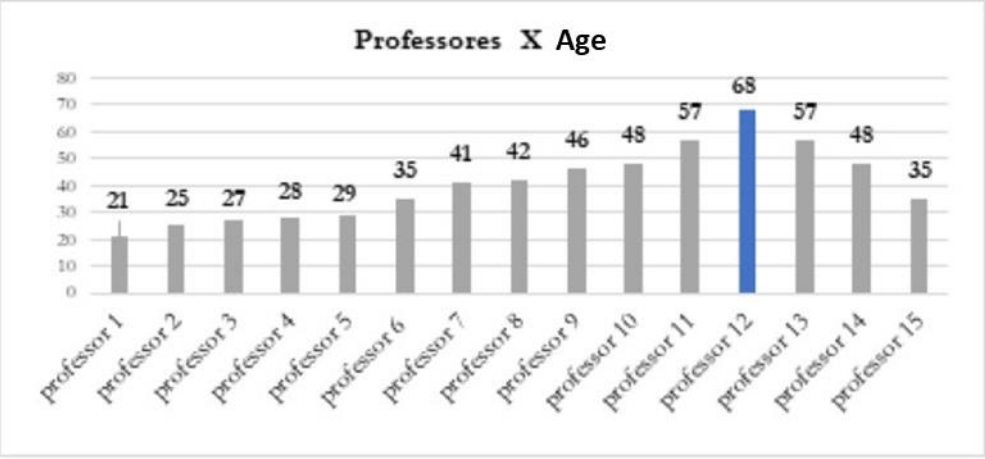
In order to achieve the general objective of this research−to investigate how the learning of mathematics occurs−in the second stage visits were made to the schools of this municipality (from August 2019 to March 2020) and this activity was only interrupted due to the pandemic.

Regarding the theme under consideration, it is worth mentioning that studying the process through which learning is actually effective means paying attention to something that may not yet have been incorporated into the behavior of this student and, therefore, can both produce lasting changes and can be used in different contexts (Nérici, 1993). Thus, for this specific study, it is emphasized that any and all aspects that were observed *in loco* can be considered a relevant factor.

The target audience of this research was composed of teachers and students from 6th to 9th grade of elementary school. Thus, in each school, after the interviews with the guardians, the observations of the mathematics classes were carried out. In total, 35 classes were observed: 8 classes of 6th grade; 9 classes of 7th grade; 9 classes of 8th grade; and 9 9th grade classes. Ninety-nine percent of the classes were expository-dialogued and, in its great majority, the methodology used was presentation and explanation of the content followed by resolution of exercises and subsequent correction in the chart. Only one of the teachers used, during the observed class, gamification as a strategy of active methodologies, applying in their classes *the game Mind Lab*, made available by the city hall. In addition to this, only one of the schools visited mentioned that it also uses *the Mind Lab*, but in this second school, there was no opportunity to observe the classes in which the game was used by the students.

In the visits to these schools, a total of 15 mathematics teachers were interviewed, 7 females (53.3%) and 8 males (46.7%). The sample showed great diversity regarding the age of the teachers. Figure 3 shows these data.

Figure 3. Age of the teachers interviewed.



Source: Prepared by the authors (2023).

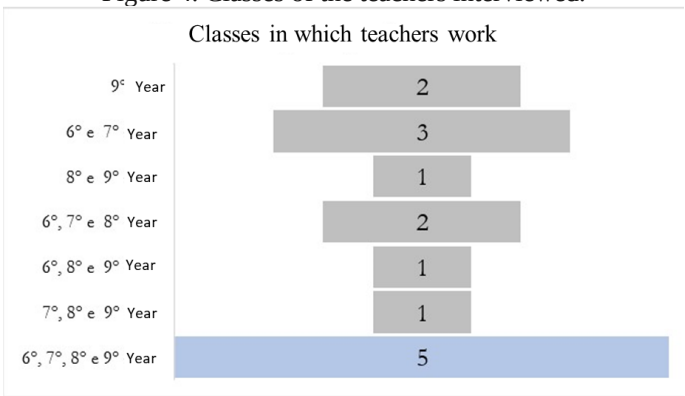
As shown in Figure 3, of the total of 15 teachers, 5 were interviewed aged 20 to 30 years (33%), 2 teachers aged between 30 and 40 years (13.3%), 5 teachers between 40 and 50 years (33.3%), 2 teachers aged 50 to 60 years (13.3%) and only 1 teacher in the range of 60 to 70 years (6.66%). Another

factor to be observed was the mean age, which was between 40 and 50 years (40-46), corresponding to mature adult professionals.

In addition to age, another aspect analyzed was the academic training of teachers. the vast majority of the teachers interviewed (14 of the 15 teachers, 93.3%) have a Bachelor's Degree in Mathematics and one of the teachers (6.66%) is still attending (Undergraduate Degree in Mathematics - Incomplete). As for the occurrence of two degrees, only one of the professors, in addition to the Degree in Mathematics, has a Bachelor's Degree in Oceanography (6.66%); another professor who, in addition to this degree, has a Bachelor's Degree in Law (6.66%); and a third who also has a Bachelor's Degree in Physics (6.66%), but they do not work in this second formation. Of the total of 15 teachers, only 3 have specialization and only 1 has a master's degree, and this course was not held in the area of mathematics.

The performance of the teachers with the school was the item addressed later. Of the total of 15 teachers, only 5 work in the 4 years of elementary school studied in this research−6th, 7th, 8th and 9th grades, which represents 33.3%. Three teachers (20%) work in 6th and 7th grade; 2 teachers (13.3%) are in the 6th, 7th and 8th grade classes; and, 2 teachers (13.3%) are in the 9th grade classes. In addition, there is 1 teacher (6.66%) who works with classes of 7th, 8th and 9th grades; 1 teacher (6.66%) who accompanies the classes of 6th, 8th and 9th grades; and, 1 teacher (6.66%) who has the classes of 8th and 9th grades. Figure 4 shows the classes in which the teachers work, teaching mathematics classes.

Figure 4. Classes of the teachers interviewed.



Source: Prepared by the authors (2023).

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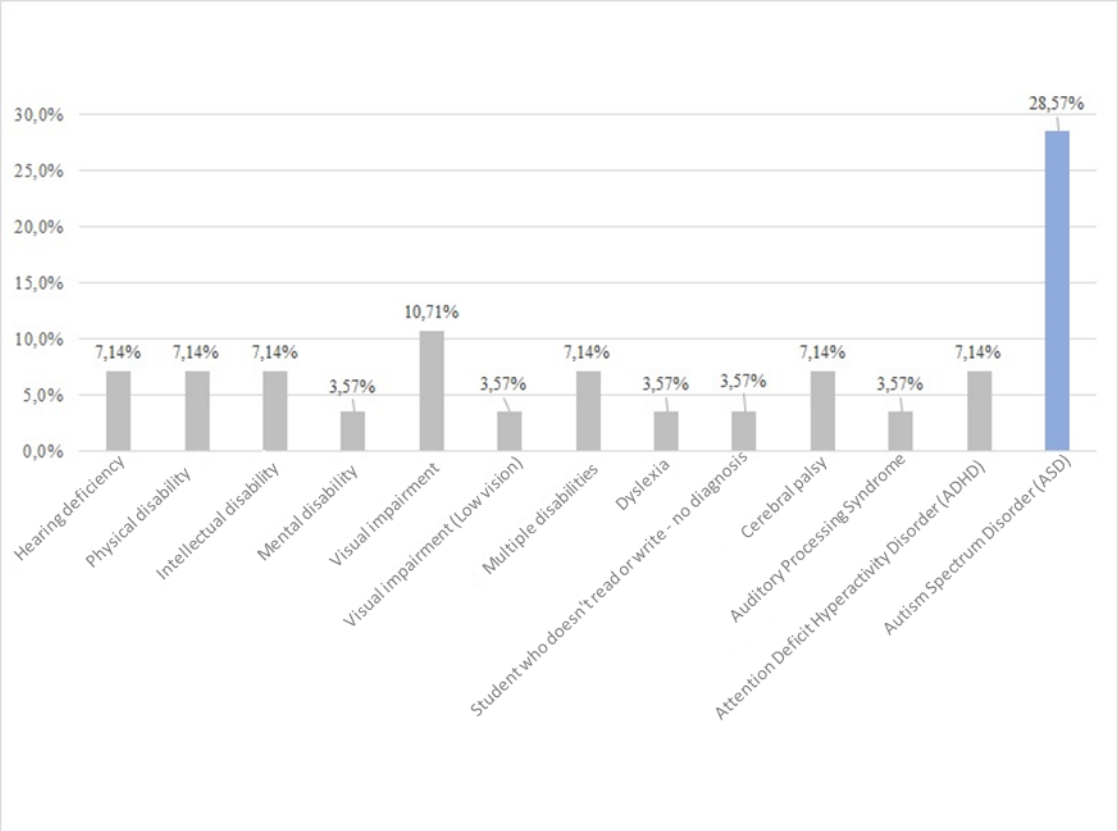
When asked about the participation of students with some type of disability in their classes, the teachers, in their majority, answered that they have, at least, 1 student with some type of disability in each of their classes. The 15 teachers interviewed mentioned a total of 28 students with some type of disability. Figure 5 shows the types of disabilities mentioned.

Figure 5. *Types of disabilities in the classes.*



Source: Prepared by the authors (2023).

As shown in Figure 5, the type of disability most cited among teachers was Autism Spectrum Disorder (ASD) with an incidence rate of 28.57% (8 students), followed by Visual Impairment with 10.71% (3 students). In third place, with 7.14% of the cases are: Physical disability, Multiple disabilities, Intellectual disability, Cerebral palsy, Hearing impairment, Attention Deficit Hyperactivity Disorder (ADHD) – representing 2 students. With 3.57% of the set (1 student) there was the mention of disabilities: Auditory Processing Syndrome, student who does not read and does not write (without diagnosis), Dyslexia, Visual impairment (Low vision), Mental disability.

Subsequently, interviews were conducted with the students. The fifty students interviewed were selected intentionally and non-probabilisticly. As an initial proposal, the goal was to interview two students per class−of 6th, 7th, 8th and 9th grades, however, in many cases the students took the document (ICF) to collect the signature of those responsible, but forgot to bring back signed, or, still, the responsible were with doubts about the research and did not authorize their participation. So in some schools, only one student was interviewed in certain classes. A total of 50 interviews with

students were completed. Table 1 presents the demographic data of the interviews, the number of students interviewed by age, separated by gender, and the number of students distinguished by gender, according to their respective class, is highlighted.

Table 1. Demographic characteristics of the students interviewed.

Variable	***Female***		***Male***		***Total***	
Gender	n = 31	62%	n = 19	38%	n = 50	
Age		**%**		**%**		**%**
10 years	n = 1	3,20%	n = 0	0%	n = 1	2%
11 years	n = 3	9,70%	n = 1	5,30%	n = 4	8%
12 years	n = 10	32,20%	n = 3	15,80%	n = 13	26%
13 years	n = 6	19,30%	n = 7	36,80%	n = 13	26%
14 years	n = 7	22,60%	n = 3	15,80%	n = 10	20%
15 years	n = 3	9,70%	n = 5	26,30%	n = 8	16%
16 years	n = 1	3,20%	n = 0	0%	n = 1	2%
Year of Elementary School		**%**		**%**		**%**
6th year	n = 8	25,80%	n = 3	15,80%	n = 11	22%
Year 7	n = 9	29%	n = 2	10,50%	n = 11	22%
8th grade	n = 5	16,10%	n = 9	47,30%	n = 14	28%
9th grade	n = 9	29%	n = 5	26,30%	n = 14	28%

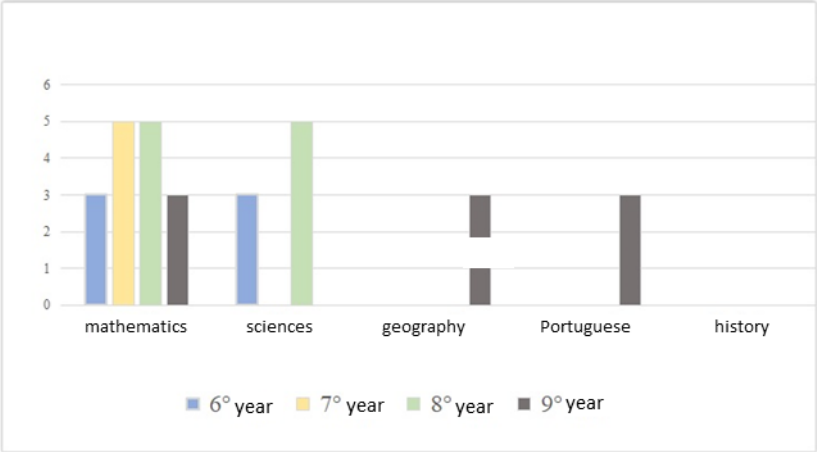
Source: Prepared by the authors (2023).

According to Table 1, a total of 50 interviews with students were completed. The analyzed classes had varied ages because in most of them, 6th, 8th and 9th years, there were four different ages and only in the 7th year there was the occurrence of only two different ages (12 and 13 years). In the 6th grade there were students from 10 to 13 years old; in the 8th, from 12 to 15 years; and, in the 9th, from 13 to 16 years. It is also observed that, in almost all classes–6th, 7th and 9th grades, most students are female, because only in one of the classes (8th year), the number of male students was higher than that of female students. This fact coincides with the result of the interviews with the teachers, who had most of the female participation, with 53.3% of the total.

After collecting the profile of the students interviewed, we moved on to the open questions to identify the current situation of the process of learning mathematics for this target audience. The semi-structured interviews were conducted in a room provided by the direction of the schools, always during the mathematics classes. The participants were individually allocated in an empty, quiet room with comfortable chairs and answered a questionnaire with twelve questions used as a script. The content analysis technique proposed by Bardin (2011) was used to evaluate the responses of the participants in order to verify the quantitative indicators or not present in the messages obtained.

Initially, students were asked, "What subjects do you have the greatest ease of understanding this school year?" Figure 6 shows the students' responses.

Figure 6 - Disciplines with greater "ease"

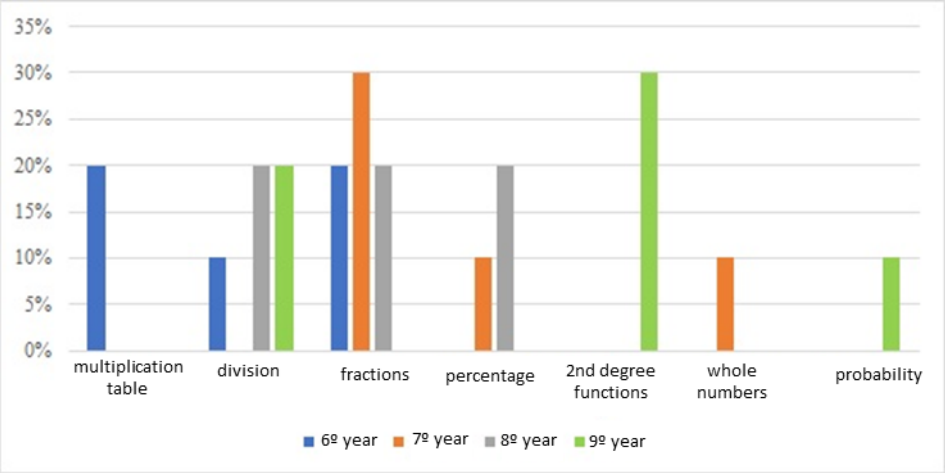


Source: Prepared by the authors (2023).

For the analysis of this stage, the answers were classified in first, second place and third place, obeying the order of response of the students. As shown in Figure 6 in the 6th grade, as the first discipline cited, there was a tie between mathematics and science. In the 7th grade, the discipline of mathematics took first place. In the 8th grade, there was a tie between the subjects mathematics and science. Finally, in the 9th grade, the discipline mentioned in first place had identical voting and the subjects Portuguese, mathematics and geography occupied this position. The discipline of history was not indicated as the first option of discipline of greater ease of comprehension by any of the four classes under analysis −6th, 7th, 8th and 9th grades.

Subsequently, focusing on the mathematical discipline, the students were asked which contents they had greater difficulty to understand, as shown in Figure 7.

Figure 7 - Contents of mathematics with greater "difficulty"



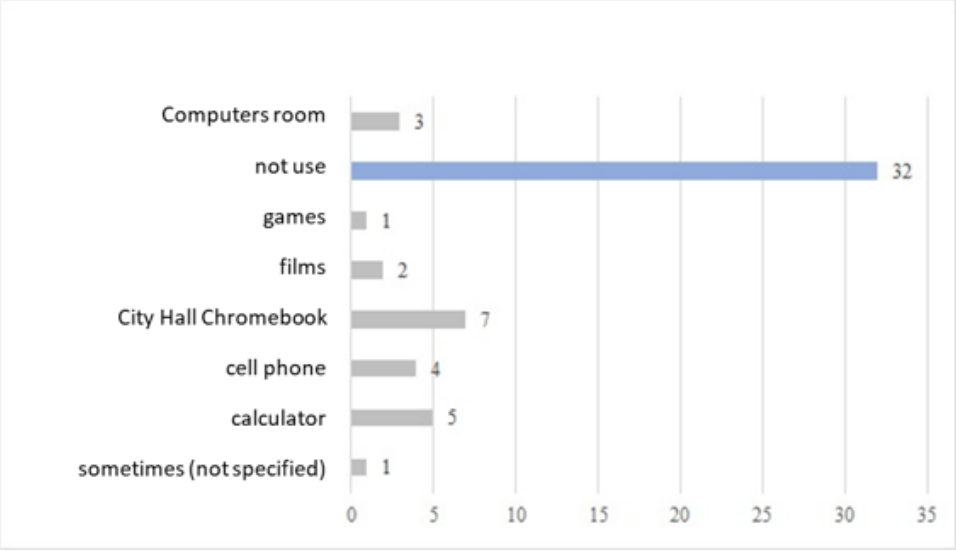
Source: Prepared by the authors (2023).

As shown in Figure 7, in the 6th grade, the students mentioned the "table" and the "fractions" the same number of times. In the 7th grade, the content "fractions" was the most cited. In the 8th grade, it is noticed that the three contents mentioned were tied: "division", "fractions" and "percentage". In the 9th grade, the "functions of the 2nd degree" had the highest number of citations. It is noteworthy that, among the contents cited by the students as being the most "difficult", the item "fractions" was presented for three of the four years under analysis–6th, 7th and 8th, being considered, in this way, the content with the highest difficulty index for the target audience of this research.

At the end of the interview with the students, the next question was asked: "Do your teachers use Digital Information and Communication Technologies (TDIC's) in their mathematics classes?".

The answers were transcribed in Figure 8.

Figure 8 - Use of TDIC's in mathematics classes



Source: Prepared by the authors (2023).

In view of the data presented in Figure 8, it is identified that more than half of the students (64%) answered that their mathematics teachers do not use the TDIC's in their classes. In the moments when the use was mentioned, the students referred to the classes in the computer room (and use of the school computers), playing games, enjoying movies, or even using the cell phone, calculator or Chromebook provided by the city hall.

5 FINAL CONSIDERATIONS

Although mathematics is considered an important pillar of the personal and professional formation of students, offering them vital knowledge for their autonomy and preparation for life in society, many people consider it a "difficult" discipline and others, without even trying to carry out their activities, use the phrase "I am not good at mathematics" to justify their low performance. This difficulty has been presented in the data collected in PISA since the year 2000 and the low performance of Brazil in relation to other countries remains worrying.

Focusing on this scope, this research sought to identify the situation of the teaching-learning process of mathematics in the final years of elementary school and, for this, two integrative literature reviews were carried out and, in the later stage, field research in schools in the city of Florianópolis.

In the first RIL it was observed the use of TDIC's for the teaching-learning process of mathematics in the different educational levels. In addition, the uses of different methodologies were pointed out, such as the inverted classroom and/or games, as well as various devices, such as computer, iPad, *tablet* or others. Regarding the means used, this review presented as results: problem solving, use of Khan Academy, free open source *software*, mathematics learning program for Grade-R, mathematics game GeePerS, among others.

In the second review, in turn, the instruments used to improve the process of learning mathematics were: interactive whiteboards (IWB's), video game with Unity 3D™ technology, Virtual Reality (VR) and Augmented Reality (AR) technologies, multidispositive educational platform, mathematics videos, *virtual Geoplane software*, software interactive multimedia literacy, video game Tux of Math Command, adaptive educational technology used through teacher panels, and, Scratch 3. In this sense, it is observed that there was a significant increase in different ways used to improve the educational process in this area, which corroborates the conclusions of these studies that highlight as positive the incorporation of TDIC's or differentiated methodologies to the traditional learning model, reinforcing that they make this process more pleasurable and stimulating on the part of students, as well as supporting teachers in the evolution of their teaching practice.

At a later stage, with the visits made, it is possible to know the educational reality of the day to day in schools regarding the process of teaching mathematics. The age of the teachers was between 21 and 68 years, and 53% were female. The vast majority have a Bachelor's Degree in Mathematics as

training and only one of these teachers has a Master's degree, but in a different area. Of the set of teachers interviewed, 33.3% teach classes in the final four years of elementary school (6th, 7th, 8th and 9th), the others are allocated in different combinations, such as only 6th, 6th and 7th, 8th and 9th, or only 9th grade. Another item asked to the teachers was about the existence of students with some type of disability in their classes. According to the teachers, about 28.57% of the students in their classes have Autism Spectrum Disorder (ASD).

A total of 50 students were interviewed, most of whom were female (62%) and aged between 10 and 16 years. Participants were asked which disciplines they had the greatest ease of understanding. For most classes, from 6th to 9th, mathematics was mentioned among these subjects. In response to the question about which contents of mathematics they had the greatest "difficulty" to understand, the content "fractions" was the most cited. Regarding the use of the TDIC's, according to the data collected in the visits to the schools it was proven that, for the target audience researched in the period in which the interviews took place, the inclusion of technologies was still in the initial process in relation to mathematics. It is noteworthy that this period can be considered pre-pandemic and, therefore, the use of technologies for education was changed considerably with the occurrence of the pandemic, certainly modifying the data collected and recorded here.

Due to what was mentioned, all the objectives of this research were achieved while, in the course of its stages, new nuances were revealed on the topics pertinent to the learning of mathematics, such as its actors (students and teachers), realities in the classroom and findings of significant importance in the different researches analyzed. It is appropriate to emphasize, therefore, that the results of this study can be considered valuable contributions to the scientific community, considering that it presented relevant and pertinent aspects to the learning process that can become auxiliaries in the improvement of pedagogical praxis in mathematics.

As limitations found in the course of the research, we cite the beginning of the pandemic which, due to the government's determination of social isolation, caused field research to be suspended indefinitely. Although teaching in municipal schools has been resumed in a semi-face-to-face manner, for the purposes of this research, it was believed that it would not be feasible to resume the interviews because the teaching situation was no longer the same as before, which would greatly modify the results collected from this date on.

For future research, two distinct studies are indicated: in the first, a new research could seek to identify how the learning of mathematics occurs for the next cycle, high school, a later phase of the educational trajectory researched here. A second study, in turn, could analyze whether and how the uses of TDIC's for the learning of mathematics occurred and how they were incorporated, in view of the changes in the way of teaching that were implemented with the beginning of the pandemic. It should also be noted that even though two literature reviews were conducted, no research was found

with total similarity of the items theme, objective or even target audience, proving the novelty and relevance of this study.

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