

## TECHNOLOGICAL TOOLS IN TEACHING AND LEARNING IN BRAZILIAN EDUCATIONAL INSTITUTIONS

*Ferramentas tecnológicas no ensino e aprendizagem nas instituições de educação brasileiras*

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### ABSTRACT

This study aims to reflect on the technological tools that help teaching and learning published at the Brazilian Meeting of Graduate Students in Mathematics Education (EBRAPEM) between 2017 and 2019. Based on the inclusion criteria, 130 were found articles published at the Meeting, however, when analyzing the exclusion criteria, 29 studies remained to be analyzed. Among the results, it is informed that GeoGebra is the most present tool in the articles, having a great flexibility of use, as it serves age groups from Basic Education to Higher Education. The selected studies address with concern the social differences that impede access to learning tools in schools in all regions of Brazil and draw the attention of teachers who are already in the profession to the need to update and seek to know these technologies that are inevitable in today's world. Finally, the study reveals different acceptances of learning tools in Brazilian regions, with less evidence of use of the tools in the North and Northeast regions of Brazil.

**Keywords:** Technological tools. Teaching and Learning. Brazilian Education.

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## FERRAMENTAS TECNOLÓGICAS NO ENSINO E APRENDIZAGEM NAS INSTITUIÇÕES DE EDUCAÇÃO BRASILEIRA

*Technological tools in teaching and learning in brazilian educational institutions*

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### RESUMO

Este estudo tem como objetivo refletir sobre as ferramentas tecnológicas que auxiliam o ensino e a aprendizagem publicadas no Encontro Brasileiro de Pós-Graduandos em Educação Matemática (EBRAPEM) entre 2017 e 2019. Com base nos critérios de inclusão, foram encontrados 130 artigos publicados no Encontro, porém, ao analisar os critérios de exclusão, restaram 29 estudos a serem analisados. Dentre os resultados, informa-se que o GeoGebra é a ferramenta mais presente nos artigos, possuindo uma grande flexibilidade de uso, pois atende faixas etárias desde a Educação Básica até o Ensino Superior. Os estudos selecionados abordam com interesse as diferenças sociais que impedem o acesso às ferramentas de aprendizagem nas escolas de todas as regiões do Brasil. Assim, chamam a atenção dos professores que já exercem a profissão para a necessidade de se atualizar e buscar conhecer essas tecnologias inevitáveis nos tempos atuais. Por fim, o estudo revela diferentes aceitações de ferramentas de aprendizagem nas regiões brasileiras, com menos evidências de uso das ferramentas nas regiões Norte e Nordeste do Brasil.

**Palavras-chave:** Ferramentas Tecnológicas. Ensino e Aprendizagem. Educação Brasileira.

## INTROCDUTION

Technological tools are important for the teaching-learning process, especially when face-to-face activities are not possible. It so happens, however, that such tools require knowledge, willingness, and commitment to the strategies employed in order to facilitate student access to what is being taught. Educational institutions invest in equipment and technologies that, without the preparation and qualification of teachers, have little effect on the teaching methodology. It is worth remembering that many students in Brazil do not have access to the internet, are unable to acquire tools to live with new media, do not have support from public or even private institutions to, through technological learning tools, expand their possibilities of study. Thus, there is a great barrier for education to have quality and be seen as a form of social mobility, that is, as a path for students to follow and achieve professional success.

Education in Brazil is going through critical moments. It is still very common that the tools made available to teachers in the classroom are the blackboard and chalk. Thus, it is also common to find students who do not have a computer, laptop, tablet, or smartphone, which are tools that contribute to the good use of classes. The gap between what these students intend and what they have at their disposal to achieve their goals is large and, in the short or medium term, no changes are seen in this scenario. These difficulties and obstacles presented to educators and students demonstrate how much there is to be done for the benefit of quality education.

In addition, when considering the educational environment, inserting the teaching of Mathematics and other subjects in this technological universe, respecting and taking advantage of the knowledge that the student brings from their own environment, expands the possibilities of teacher-student interaction to successfully achieve their goals, as long as it is possible to allow teachers, training and content. Add to this, that in many regions of the country, those who do not have access to the necessary tools to enter this new technological world, it is important to target investments and digital inclusion policies that are not just on paper, but leave it and go even those who really need it.

In addition to homes, businesses, and other various establishments and institutions, access to technological tools, coupled with information and guidance from a teacher or instructor with a solid base of knowledge, can transform the school into an environment that offers students a new way of living. come to knowledge. This means that the role of teachers from other disciplines can be strengthened and made more attractive, since it will be narrowing, that is, reducing the distance that exists today between the school and the world. The important thing in this regard is that the teacher has mastery of the tool and that all the support is offered to use it properly in the classroom.

It is also necessary to observe the interest that such tools arouse in students; his thirst for knowledge of these resources is undeniable and it is not difficult to find an individual who has self-knowledge simply because he is able to reach these media easily, is willing to learn and does not find this learning in the school environment. (Tardif, 2002)

Given the importance of using technological learning tools for the teaching of Mathematics, this study aims to reflect on the technological tools that help teaching and learning published in the Brazilian Meeting of Graduate Students in Mathematics Education (EBRAPEM) between 2017 and 2019. Thus, at first, the study presents the methodology used in the study, then a theoretical reflection on technological learning tools for Mathematics is carried out, followed by the study results, conclusion, and references. (Ribeiro; Paz, 2013).

## 1 TECHNOLOGICAL TOOLS FOR LEARNING MATHEMATICS

Technological tools facilitate learning by empowering students to make decisions and solve problems. Its use in the school environment and outside it is a stimulus for the continuous search for more and more knowledge. The popularization of computers, laptops, smartphones and tablets demands modernization, or rather, the updating of strategies, resources, materials and, finally, the attitude of teachers, to embrace these updates and get involved with their use for the benefit of these generations that they may not know what a facsimile or fax machine is, but they know and use social media without any problems (King, 2011).

In Brazilian schools there are several ways to promote a class through the use of technologies. There is also all the technology that, whatever the model, can be used with it in order to increase the range of tools for the benefit of learning. Among them are GeoGebra, Scratch, Minecraft, App Inventor, and Robotics.

GeoGebra (a combination of the words Geometry and Algebra) is today the most common and most used software by Mathematics students and teachers in the world. It can be downloaded on a computer, smartphone, tablet, laptop. It is a very dynamic program that supports the use of diverse teaching-learning strategies to enable mathematical knowledge to be achieved. Its use by many Mathematics teachers is due to facts such as the easy-to-use interface and numerous features that allow a wide creation of teaching materials, such as interactive web pages, and, as it is free, it is open source software for users non-commercial.

It is a tool that makes learning Mathematics more interesting and pleasurable for the student who gains autonomy and becomes an agent of their learning, establishing a closer relationship with the object being studied. As a friendly resource, GeoGebra presents itself as an important ally in Mathematics classes so that difficulties, prejudices and deficiencies can be overcome.

Scratch is a software that was not developed specifically for the teaching of Mathematics, but because it addresses mathematical concepts in a context and thus can facilitate the teaching of the subject, stimulate and motivate students, encouraging them to always want more is a tool invaluable and a facilitating component to achieve the goal of teaching in a way that students retain what is taught. Scratch is a programming software that allows the creation of projects focused on Mathematics.

The internet, computers, technologies, in short, are already part of people's daily lives and, even though they learn through these channels, they do not give them this value as learning aids. Scratch offers multimedia resources that allow the creation of virtual environments that encourage creativity and systematic thinking. It is a software that proposes that you create, invent and favor learning in a way that everyone benefits, it can be used on computers, tablets, laptops and smartphones.

As for the Minecraft game, it is a very useful resource, especially for teachers to help students learn Geometry. The game allows the creation of environments with geometric shapes, with interactivity, which favors socialization, with remote or face-to-face teaching and offers teachers guides and guidance with classes and activities that can be downloaded after logging in with e- school mail. The game allows action in other areas of knowledge, such as Biology, Geography, and others, but for use in Geometry, it is very efficient. The company has an educational model with ongoing assistance for teachers, launching lesson plans in various specialties and answering questions or making suggestions to groups of teachers who are part of the community. It is not free and its value is in dollars, which is an impediment for many students, teachers and IE.

App Inventor is a platform that, being user-friendly, allows even children to create apps for smartphones. Also being an MIT initiative, launched in 2009, it works as a web service administered by teams from the Institute involved not only with technological aspects, but also with learning. (Raminelli et al., 2017).

The objectives of App Inventor, according to its creators, are to train and promote Computer Science Education, as well as to maintain and constantly improve the tool, in addition to building improvements in companies and conducting and supporting community research. Without a doubt, empowering and promoting Computer Science Education is the proposal that most interests this study to, through this objective, allow that, with the knowledge that a good part of students, especially in High School and Higher Education, they create the applications that will help you understand and solve mathematical problems in Statistics, Algebra, Geometry and all other aspects of mathematics.

The use of technology as a way of contributing to learning is already a reality in many Brazilian schools, especially private schools. Public schools, as they do not have the same resources, still find it very difficult to adapt to this urgency. There is, however, a technology that can be developed even with scrap and sustainable materials that have helped many Mathematics teachers with interest and knowledge on this subject without requiring large investment by the institution. The very search for material in their homes already awakens in students the interest and motivation for new discoveries and this can be used by Mathematics teachers, but also by those from other areas of knowledge. It's about Robotics, which is a resource that offers multiple possibilities of use and countless ways to get or produce your own work material.

The use of Educational Robotics allows students to use their mathematical knowledge in activities that involve the construction and operation of robots that, as they involve multidisciplinary, will add meaning to their knowledge.

Educational Robotics, as well as other technologies, still does not have a public policy in Brazil that offers support so that, especially in public schools, there is an opportunity to try to promote social mobility. Robotics kits on the market are not free and public institutions cannot bear their cost so that all their students have access to them, and selecting those who could have this access is exactly the opposite of what you want when it comes to social mobility (Araújo et al., 2020).

## 2 METHODOLOGY

The present study carried out an analysis of studies on Digital Technologies of Information and Communication in the teaching and learning of Mathematics published at the Brazilian Encounter of Graduate Students in Mathematics Education (EBRAPEM) from 2017 to 2019. All studies that referred to this theme in the period were raised.

As inclusion criteria, there are studies published from 2017 to 2019, which addressed issues of technology and focus on Mathematics Teaching.

As exclusion criteria are studies that did not clearly present the use of a technological tool, or that did not reflect on the teaching and learning of Mathematics.

Based on the inclusion criteria, 130 articles published in the Brazilian Meeting of Graduate Students in Mathematics Education were found, however, when analyzing the exclusion criteria, 29 studies remained to be analyzed.

The importance of the meeting is precisely in the fact that the participants who come from various parts of Brazil, bring their experiences, experiences and contributions to the teaching of Mathematics, which is a subject understood as “difficult” by a good part of the student population. In this way, the studies published at the event represent a rich source due to the extensive and intense diversity of opinions and postures that, despite presenting disagreeing points, share a common concern with improving the teaching of Mathematics and awareness that it is necessary act for that to happen.

## 3 RESULTS AND DISCUSSION

The learning tools presented in this work are just a part of those that can be used for teaching Mathematics. GeoGebra is the most widely publicized resource due to its free nature, the support it receives from Institutes that spread across several countries and are accessible in several languages, and mainly because it is easy to apply and allows the student to work in groups or alone creating problems that deal mainly with Algebra, Geometry, Statistics, that is, it is very broad and allows the student to have the freedom to act. What is sought with these tools is exactly this positioning of allowing the student to make their discoveries through their mistakes and successes and, thus, learn.

App Inventor and Scratch are initiatives from the same company with similar proposals, but the first is a resource aimed at smartphones, which is a great advantage, since practically the entire school population can have access to one. Both allow the creation of programs that can have any theme linked to the mathematical disciplines. They are also free tools and even if the user has no programming experience, he will be able to develop a program because they are very self-explanatory. Once again, it is possible to observe the presence of Meaningful Learning that proposes exactly that the student discovers from a knowledge he already has (Ferreira; Brito, 2020) and, at a time when children, teenagers, young people and adults are closer to digital tools due to the imposition of social isolation, it cannot be said with guarantees that programming is something completely ignored by a part of the population whom these technologies want to reach in a positive way.

A resource that originally had no educational purposes but can be turned into one, Minecraft is aimed at teaching Mathematics to children in the first years of school and contributes to the creation of programs that allow them to learn different aspects of mathematical subjects. It serves as an important strategy for teachers to give classes, considered rigid and cold, with a playful air that facilitates learning and conquers a space then

reserved for other areas of knowledge that are not socially and culturally labeled as rigid and with determined and infallible results. As it is a game, it allows students to have independence to create their own game where they learn mathematical concepts and make decisions to solve the problems presented during the development of the game they created themselves.

In relation to Robotics, what can be observed is, in addition to its playful character, the possibility of integration with the environment in which one lives and the interaction between students and communities. It is a resource that proposes the teaching of mathematical subjects from the construction of other technological tools involving the student with values such as teamwork and a view of Mathematics as a subject that allows creativity, inventiveness and freedom. Although countless sustainable materials are accessible, kits are needed so that student creation can work and, for this, mathematical knowledge is necessary and makes the presence of the teacher as a facilitator, an advisor who does not impose limits on creation and allows the students make their discoveries and look for the solution to the problems that may arise during the construction with the kits. (Barbosa; Fernandes 2017).

The articles presented at Freire (EBRAPEM) in the years 2017 to 2019 selected for this study indicate a prevalence of the use of Robotics as one of the most widespread tools in the school environment, especially in the South and Southeast regions of Brazil. The use of GeoGebra in the Midwest region of Brazil also stands out. Other tools with the potential to contribute to the teaching-learning process still need to go a long way before becoming popular in the school environment. Because some are not free or, perhaps, have not come to the knowledge of teachers, it may be a justification, which shows that institutions need to commit to the use of learning tools in teacher training courses so that they become familiarized and enjoy all the advantages of its use in the classroom.

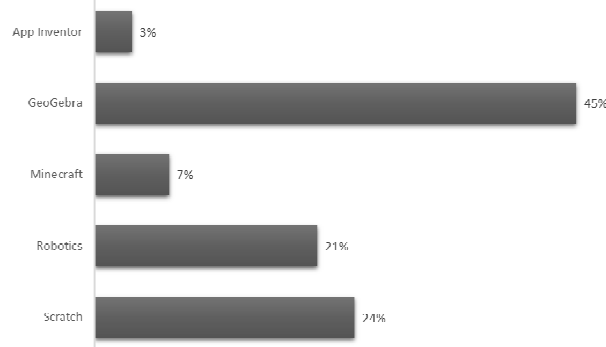
The studies that show more commitment to learning tools in 2017 and the consequent care to improve the quality of education are from the South and Southeast regions of Brazil, which may be linked to being more densely inhabited and more industrialized regions. These regions also have a large number of articles published in EBRAPEM.

In 2018, publications from the Southeast region of Brazil stand out, accompanied by the South and Midwest, which is also evidenced during 2019. Although much still needs to be done so that the learning tools are incorporated into the routine of teachers and students, interest in them has grown, albeit slowly. The years studied indicate an encouraging growth in the number of papers presented dealing with technologies in 2019. (Rodrigues, 2018).

EBRAPEM publications from 2017 to 2019 reveal a growing concern with the paths of education with regard to the use of learning tools and the preparation of teachers in undergraduate courses to adapt to the 21st century school. Some experiments have been carried out in Elementary School, more by the teacher's own initiative, who understands the difficulties that students have with mathematical subjects, than by initiatives from the official bodies responsible for offering support for the improvement of teaching-learning conditions in the parents. Although these studies are not sufficient to demonstrate the degree of infiltration of learning tools in schools, they are a sampling of all the possibilities that these technologies offer and contribute to improving the quality of teaching and the understanding that students have as agents. of their own learning.

Some learning tools have become more popular than others. To make popularization more visible, a graph was constructed (Figure 1) with the percentage of learning tools evidenced in the selected studies.

**Figura 1 - Percentage of learning tools evidenced in selected studies. in EBRAPEM publications from 2017 to 2019**



Fonte: By the authors.

Through figure 1, it is possible to infer that GeoGebra is the most present tool in the articles, possibly because it is free, available in several languages, in addition to having headquarters in several countries to support teachers and students, making it very attractive for schools. Its characteristic of serving all age groups and being used in both Basic and Higher Education also contributes.

Learning tools have a considerable diversity of use in mathematical disciplines taught especially with the creation of games that require mathematical programming and logical thinking. The involvement of students and teachers is a demonstration of the ability to promote the interaction that these technologies present. The themes of the articles and their objectives and purposes go beyond the limits of the classroom when they enter the environment in which the student lives in search of products and solutions that may arise in solving problems. This is the case of robotics, which encourages the sustainable use of materials that can be transformed into technological objects with the use of kits and teacher guidance.

The selected articles demonstrate an interest in programming tools to contribute to teacher education and, through this strategy, encourage them to identify the student's preferred learning style. The content to be taught to students undoubtedly has as much or more value than the dynamics employed in the classroom, for this reason there are several articles that deal with learning tools as support for the teacher who is in conditions and with the necessary skills to develop the projects (Silva; Brito, 2020). It is also observed that these projects, in some cases, start from the initiative of interaction between students and teachers who, in this case, are seen more as a member of the team.

The interaction, motivation, encouragement and the view that the difficulties that students have to achieve the average passing rate in Mathematics subjects are aspects that can be facilitated with the inclusion of learning tools in the routine of classes, although this subject not deserved the necessary attention and the creation of public policies that include learning tools in the curriculum of schools. There are few official initiatives that address this issue, as can also be seen in the scarce number of articles that mention such initiatives.

An initiative without didactic-pedagogical purposes that has been used by teachers is Minecraft, from Xbox. Its creation was originally intended to entertain children and pre-teens using equipment that can be installed, but as it stimulates the game through the creation of geometric shapes and notions of space and perspective, it has been used in Mathematics classes and aroused interest of teachers. The increase in demand ended up changing the company's position so that today there is a Minecraft Educator version that can be installed on any computer, tablet, smartphone or laptop. The selected articles addressing this tool highlight the relevance of the creativity and independence gained by students through the creation of scenarios where the game takes place. Publications present the price of Minecraft as an impediment to wider use in schools.

In general, the selected articles believe that the learning tools used in a conscious and responsible way improve the quality of Mathematics teaching, and it is important that undergraduate courses devote more space to this subject to prepare future teachers.

The selected studies address with concern the social differences that impede access to learning tools in schools in all regions of Brazil and draw the attention of teachers who are already in the profession to the need to update and seek to know these technologies that are inevitable in today's world.

## CONCLUSION

At the end of this study, it can be seen that investment in technology by schools needs to go hand in hand with investment in significant content, with investment in the teaching staff, enabling them and offering them conditions to acquire skills and abilities, the security and support necessary so that its performance and its constant search for improvement in the quality of Education is not hampered by other interests outside the educational environment.

Valuing the teacher and his practice in the classroom are essential conditions for the teaching-learning process to take place in degrees of excellence in the search for the best he can do so that the student and their needs are fully met in relation to their academic concerns. It is important that the teacher has access not only to curricular knowledge, but also to practice in the classroom. The concern with the use of learning tools in Mathematics degree courses has not been promising and does not give recent graduates access to knowledge that can influence and even determine their practice.

The study reveals different acceptances of learning tools in Brazilian regions in selected articles from EBRAPEM, there is less evidence of use of the tools in the North and Northeast regions of Brazil.

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