



Historical Evolution of the Use of Digital Technology in Teaching Mathematics in Brazilian Classrooms

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Abstract

Digital technologies are important tools to adapt the teaching of mathematics to students, but even with a wide use there are few studies historically detailing this mode of teaching, so this work aims to historically demonstrate the evolution of the technologies used. To achieve this objective, a bibliographic review was carried out in the SCIELO, SBEM, SBM and PROFMAT databases, obtaining as a result 15 articles that use some resources of digital technology as a tool for teaching mathematics, thus managing to have a timeline that includes the computer, diskette, CD/DVD, webcam, digitizing tablet, video projector, digital whiteboard, and some mathematical software, concluding that teachers already use digital technology in the classroom as a means of improving the teaching-learning process.

Keywords: Digital Technology; Mathematics teaching; digital resources.

1. Introduction

The use of technologies has always been used in the teaching and learning process, these being any type of technology, blackboard, chalk, among others. However, from the 60's, with the invention of another type of technology, digital technology - which had a major milestone in 1976 with the invention of personal computers - that in fact there was a "boom" for the use of technologies in classroom (FELCHER; PINTO; FOLMER, 2021).

According to Ribeiro (2020), Professor at the Department of Language and Technology at the Federal Center for Technological Education of Minas Gerais, Digital Technology (TD) is a set of different technologies that allows the communication of any language in numbers, which are read by miscellaneous appliances. We were able to infer that to be considered a digital technology, it necessarily needs to go through a programming process, already ready in the devices, thus differentiating it from the rest of the technologies, which were already being used in the process of teaching mathematics.

Currently we have many examples of digital technologies that students have easy access to, such as cell phones, computers, tablets. However, how did these technologies begin to be used in the classroom? In what order did they appear in teaching? These are questions that are being answered during this process of evolution, which is still taking place. According to Pessoa and Gouvea (2019) teachers must be aware of the emergence of technologies, so that the student can generate benefits from its use and Batista (2017) complements, stating that traditional mathematics classes must be modified to generate interest to the student, may be through the use of digital technology.

In view of this, as an academic of the Licentiate in Mathematics course, as I already had another training in the area of Information and Communication Technology (ICT) and as a result of this having ease in the use of DT, I recognized myself as adept at the use of technologies as facilitators. and potentiating the teaching of mathematics at all levels of education. In this way, I started to use DT during my experiences in the classroom, realizing a good acceptance by the students, especially in schools, which, because they are already digital natives¹, are able to be better connected to the subjects taught using this tool.

Even though DTs have already been used in the school context since the 19th century, based on my experiences as a monitor and assistant teacher in public, private and free mathematics schools in the metropolitan region of Belém, there is little recognition and technical knowledge of teachers in the use of these in the classroom. As a result, they are not used in a way that can cover all the possible potential of this tool as a means of teaching mathematics.

In order to deepen this analysis of the scenario of the use of technologies in mathematics, a search was carried out in the following databases: Brazilian Society of Mathematics Education - SBEM, Revista do Professor de Matemática, Sociedade Brasileira de Matemática - SBM, Professional Master's in Mathematics Mathematics in National Network - PROFMAT, Revista Perspectivas da Educação Matemática, so that the relevance of this theme could be observed, which corroborates the research found: "Digital media in the teaching of Mathematics" (MOREIRA; FIDALGO; COSTA, 2020), "Teaching of mathematics in the interface with new technologies: teaching perspectives" (SOUSA; FERNANDES, 2021), however Moreira, Fidalgo and Costa only demonstrate possibilities regarding visual resources, not including other technologies as a tool

and Sousa and Fernandes expose the technologies and their uses, but does not organize them in a methodological and chronological way for the reader.

Thus, the present work returns to the academic community and to the teachers who are working in teaching networks, demonstrating the context of the historical advance of technology in teaching, since the research will historically show the digital technologies already used and those used more recently. , serving as a basis for teachers to be able to understand the historical context of technological advances in teaching and, thus, understand the possibilities of using this mechanism to be able to cover the formation of knowledge in students. In view of what has been exposed, in the writing process of the work he seeks to answer "How does the advancement of digital technology used in mathematics teaching in Brazilian schools occur?", "How digital technology has been used in the history of mathematics teaching resulting from the technological advance in the teaching-learning process?". Finding results that discuss with authors during the work, about how digital technology can be allied and dynamic in the teaching and learning process.

For the construction and detailing of this research, the general objective was chosen to demonstrate historically the advancement of digital technology used in the teaching of mathematics, precisely so that this understanding of the academic community, teachers in action and other researchers in the area have this access. With that, as specific objectives of this work is to understand the definition of digital technology and how it is used in the teaching of mathematics and to present historically the digital technologies applied in the mathematics education, in order to finally be able to present as results and discussion a detailed timeline with the application of the use of these technologies in the teaching-learning process of mathematics.

2. Theoretical Fundamentals

For this research, the bibliographic review was used as a method, which is understood as a summary of published scientific articles in a particular area of study. Understanding this concept, we will use it for the production of that work, which will be a data collection through already published materials, articles, books and magazines, which will make classifications on the digital technologies that were/are being used in mathematics teaching.

Using the literature review, this research aims to put the researcher in direct contact with the DTs used in mathematics teaching, in order to catalog and understand the technological advance in that area. According to Taylor and Procter (2007), the literature review is like an account of what has been published on a specific topic, it is not just a repetition of something that has already been worked on, as it can generate greater recognition about the subject. the theme.

For the search, databases were used where scientific research is found, guided by rigorous, valid and relevant methodologies for society, which were: SCIELO, SBEM, SBM and PROFMAT. Data collection was carried out from July to September of the year 2021, using as descriptors "mathematics" "digital technology" "teaching of mathematics through technology" only in Portuguese, from 2017, except for some classics. Being raised 15 articles, the analysis of their relevance for the research was made, being organized in the results the use of these technologies in chronological order, discussing with the authors who have their research based on this type of technology.

TITLE	TYPE	YEAR	AUTHOR
The use of information technologies and communication in mathematics teaching	Dissertation of Master's degree	2017	DAMASCENA
Possibilities for teaching and math learning	Expanded Abstract I EPTM	2018	KANLINKE ET AL.
Interactive digital whiteboard: your contributions and challenges for professionals education	Didactic production pedagogical	2014	MARTINS E KLIEMANN
Stages of digital technologies in the mathematical exploration in the classroom: from graphing calculators for cell phones smart	Article published in magazine	2018	FARIA; ROMANELLO; DOMINGUES
Digital media in mathematics teaching	Article published in magazine	2020	MOREIRA; FIDALGO; COSTA
Uso de softwares educativos como objeto de aprendizagem no ensino da matemática	Publication in conference proceedings	2017	LAURENTINO; FREITAS; ALVES

The GeoGebra software in teaching mathematics: reports from theses and dissertations	Publication in conference proceedings	2019	JUNIOR; BERTOL
The use of MatLab software, to assist in the teaching function of the 1st degree in the 1st year of the high school	Dissertation of Master's degree	2017	ALMEIDA
O estudo de funções no ensino médio: uma abordagem sobre as contribuições do Software Graphmatica como recurso metodológico para a prática do professor	Dissertation of Master's degree	2020	NUNES
The importance of technologies communication and information (ICT) as pedagogical tool in education Kindergarten and in the early grades of Education Fundamental	Article published in magazine	2017	SOUZA ET AL

The evolution of devices data storage from the perspective of story	Completion work of course	2017	COSTA; PINTO
The use of games as a strategy learning for 1st cycle students basic education: the case of the cd Room "Escola Digital"	Completion work of course	2006	ABRANTES
Distance learning	Completion work of course	2020	MEIRA; ROCHA
Use of cell phone in teaching 1st grade functions degree: a literature review	Article published in magazine	2017	SILVA; RODRIGO
Mathematics teaching in the interface with the new technologies: teaching perspectives	Article published in magazine	2021	SOUSA; FERNANDES

Source: authors

3 Data and Discussion

Over the years of teaching mathematics, several digital technologies have been used, since the use of a resource as a catalyst for learning is an approach used since the beginning, such as the abacus, Tangram and Tower of Hanoi. Digital technology in mathematics teaching today is an irreversible strategy and the use of technological resources is something routine in the school environment, but to reach this scenario - even if in glimpse - that we have today, a great process of evolution of technological instruments was necessary. necessary, as well as the reinvention and differential of the teacher in using each one of them.

Thus, with the results found, for didactic purposes, digital technologies will be listed in topics, containing their beginning in the timeline of mathematics teaching, as well as their function and contribution,

being discussed with authors found in the databases searched for in the work. . We have as main references the following TD.

3.1 Computer

The 1980s were largely responsible for bringing the use of computers to the classroom, helping in the teaching-learning process, which even caused major clashes related to the use of this technology, opposing the use of the computer to the cost it presented and even to the risk that the need for a teacher in the classroom was presented, aligning even with a possible dehumanization and lack of sensitivity to the student, which was easily retorted with the educational community that believed that the use of computers in the classroom they were the solution to major obstacles for teachers and students in the teaching-learning process (FARIA; ROMANELLO; DOMINGUES, 2018).

This glimpse of the use of the computer in the classroom in Brazil, more specifically in the teaching of mathematics - the subject of greatest dropout in high school - provides the student precisely with the view that mathematics may not be this set of rules and numbers that is adapted. Then, the computer stands out in the classroom, as a source of knowledge and assistance in the process of building knowledge in a more palpable way, being more intense than a drawing on the board (MOREIRA; FIDALGO; COSTA, 2020). 12² It can be understood as any computer program capable of commanding the operation of a computer-based system, performing specific tasks (AMORIM, 2015)

From the studies carried out and the students' experience with the computer device, law n° 7,232, of October 29, 1984, Law of Informatics (1984) was created; National Information Technology Policy Law. Which defined how the federal government should interfere in the industrial sector of equipment related to information technology, taking computers to public schools, making the use of the computer in the teaching of mathematics even more evolved, being used for all audiences within the classroom, offering this experience to public school students.

With this advancement in computer use, other resources were created and adapted, helping and covering more and more classroom demands, such as the devices listed below:

3.1.1 Educational Software

With the use of computers for teaching, it was necessary to create software² for teaching, since the utilities that were already on the computer limited the use for specific subjects of the discipline.

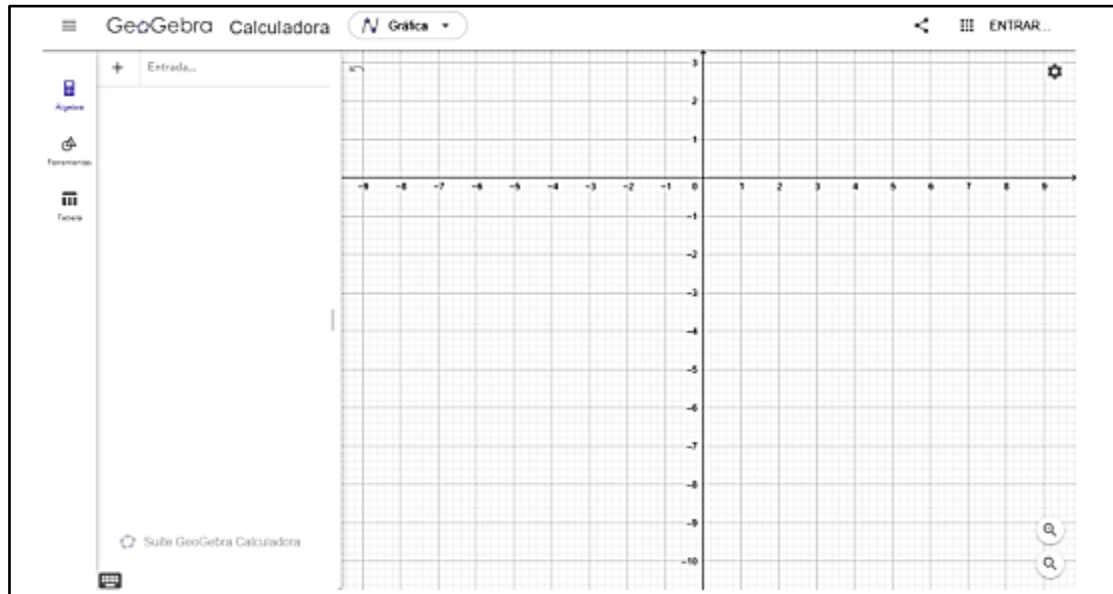
The intervention of pedagogical software to aid in the teaching of mathematics allied to teaching in the classroom, make up a tool of great influence, especially for students, making them able to change the vision they hold, acting as a facilitator. (LAURENTINO; FREITAS; ALVES, 2017)

Like this, there was the creation and use of several educational software, having as main examples:

- a) Geogebra, created in 2001 by Prof. Dr. Markus Hohenwarter for his doctoral thesis at the University of Salzburg, Austria. Having as main utilities the creation of graphs, algebra and tables are interconnected and have dynamic characteristics, as well as a friendly interface, with several sophisticated resources and a tool for producing interactive applications on WEB pages,

being also available in several languages for millions of users. around the world (JÚNIOR; BERTOL, 2019).

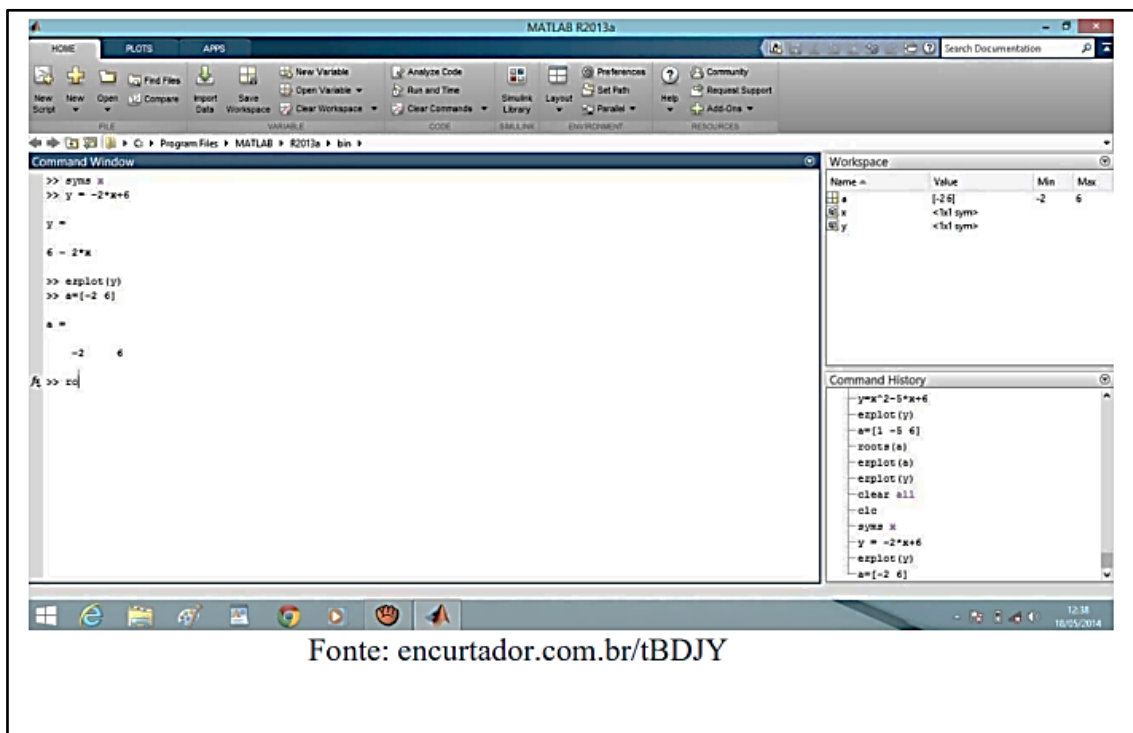
Figure 1: Geogebra software home page



Source: authors

- b) MatLab - Software created in the late 1970s by Cleve Moler, then chairman of the computer science department at the University of New Mexico. It is marked by being very interactive, facilitating the use by students and also high performance, focused on numerical calculation. It integrates numerical analysis, matrix calculation, signal processing and graph construction (ALMEIDA, 2017).

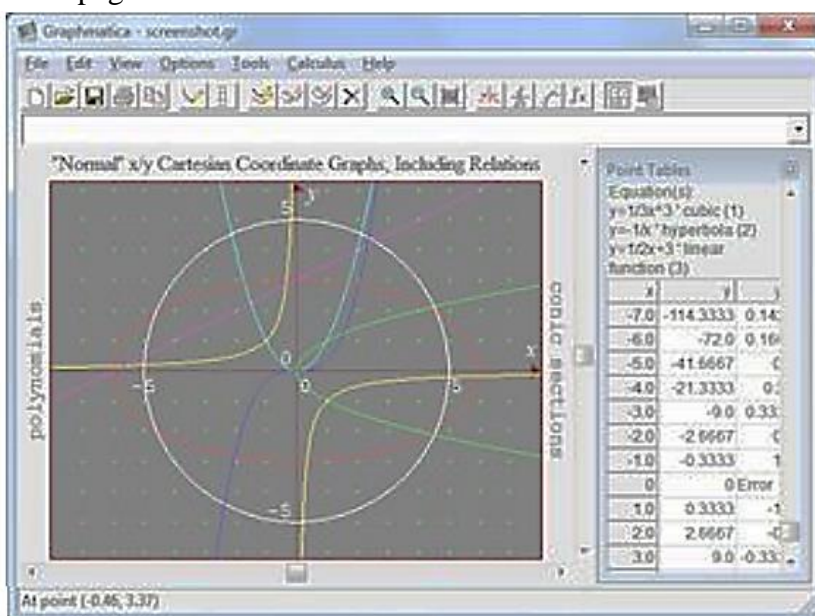
Figure 2: MatLab software home page



Source: encurtador.com.br/tBDJY

- c) Graphmatica – It had its first version, according to the program's website, in 1999, it currently has versions available for use on computers and cell phones. Used to assist in solutions to equations and intersections between Cartesian functions, managing to generate graphs of various types of functions (NUNES, 2020).

Figure 3: Graphmatica home page



Source: <http://www.graphmatica.com/>

3.2 Communication Technologies (TC)

Communication technology (CT) can be defined as a set of technological resources, used in an integrated manner, with a common goal of communication between digital media (SOUZA et al, 2017). We have as main references in the teaching and learning process the following TC:

3.2.1 Disquete

Created in 1970 by Alan Shugart, at the time a researcher at the company International Business Machines Corporation - IBM, used as a reading disk, which facilitated the transport of files and programs between computers. The same was used in education to transport handouts and works made from utility programs (COSTA; PINTO, 2017).

3.2.2 CD/DVD

Launched in 1960, but commercialized from 1982, in Japan and Europe, the Compact Discs - CD, came to revolutionize the floppy disk, which had the main problem the little space available, this new technology had been providing greater storage capacity, durability and sound clarity of CDs, causing floppy disks to become obsolete (ABRANTES, 2006).

In education, they began to be used in the mid-1990s, not having a specific year for their use, considering the CD/DVD as one of the five forms of content for virtual readers, enabling interactivity between the student and the student. content through questions, animations, videos, texts and images (ABRANTES, 2006).

We realized that the use of this means of technology was not only restricted in the classroom, as a means of transporting files, but used containing programs, recorded classes, animations, which allowed students, in addition to using in the classroom, to continue the teaching process in their own home.

3.2.3 Webcam

The first Webcam was created in 1991, in the computer laboratory of the University of Cambridge, by researcher Quentin Stafford-Fraser, used primarily as an online security camera, allowing the customers of a coffee shop to check the interior of the same. , to find out if there was a vacancy available at the place, before going there (MEIRA; ROCHA, 2020).

It didn't take long for the Webcam to be used in the classroom, at the end of the 90's faculties were already using it when they partnered with other institutions to advance their teaching, through use in laboratories, classes, presentations, among others. In schools, it was initially used as a camera in computer labs to record projects and school fairs. According to Meira and Rocha (2020), the use of the webcam enhanced Distance Learning - EAD, so that it could offer live meetings, teleconferences, further improving a teaching model that was primarily based on letters, CD/DVD.

Currently, this technology has been widely used in this type of teaching modality, gaining even more strength after the COVID-19 pandemic, being used through video classes available on various platforms, whether free or paid.

3.3 Digital Resources (RD)

The RD are components that are used from the DT, so that they support the teaching and learning process and serve for students to create and develop new skills. Selecting the main resources that appeared in this research, we have the following RD:

3.3.1 Video projector

Launched worldwide in the 90s, the video projector, known as Datashow, came to innovate the current projection because it related the computer with the possibility of projecting static, moving or hypermedia images³. Thus, covering more possibilities of use in the classroom and in the teaching of mathematics.

According to Damascena (2017), the use of this equipment can be very useful in the teaching of Mathematics, through the exposure of figures, videos, educational software, mathematical games, among other methodologies, in the multimedia format connected directly to the computer, thus making the use of several different programs as possible without wasting too much time.

In addition, we found that the use of the projector can be very diversified, and if well used, it can be a facilitator in the learning of mathematical content.

3.3.2 Digital whiteboard (LD)

According to Revista Fator Brasil, the first digital whiteboard was launched in 1991 by a Canadian company, it took time to establish itself in the area of education because its cost was relatively high compared to other technologies already used.

Martins and Kliemann (2015) claim that the use of this technology, using the necessary pedagogical techniques, facilitates the interaction between teacher and student, causing students to leave the passive way of teaching and begin to explore their creativity and thus, participating actively. of classes.

According to Kalinke et al (2018), who surveyed academic work on the use of textbooks in mathematics teaching. It was found that the tools provided by LD enhance the participation of students when solving problems, suggesting, instigating other possibilities with their colleagues and teachers. Even though it is rarely used today, LD allows students to participate in the content in a different way, characterizing itself as a good digital resource that can be used.

Figure 4: Image of using a digital whiteboard



Source: <http://profarosedec.blogspot.com/2012/12/aulas-de-matematica-na-lousa-digital.html>

3.3.3 Digitizing tablet (MD)

Invented in 1893, it was created to send handwritten messages, becoming primarily popular in banks and doctors' offices, however, after several updates in the modes of use, it fell into the use of designers, who use it to this day, as this technology allows make drawings directly on the computer, facilitating the creative process (HASSTENTEUFEL; PERTILE, 2021)

DM took a while to be used in the classroom, gaining popularity during the COVID-19 pandemic that was adhered to during online classes, being used as a board through programs such as DrawBoard, Google Whiteboard, which allow writing directly on the screen. from the computer in handwritten form.

Figure 5: Image of using a graphics tablet



Source: <https://rollingstone.uol.com.br/noticia/mesa-digitalizadora-8-modelos-que-voce-precisa-conhecer/>

3.4 Smartphone and Tablets

The use of tablets and smartphones, over the years, becomes very similar, diversifying in few aspects, due to the technology available for each model. The invention of the tablet dates back to 1989, by the company Grid Systems, gaining popularity after the launch of the iPad in 2010 (SILVA; OLIVEIRA, 2021).

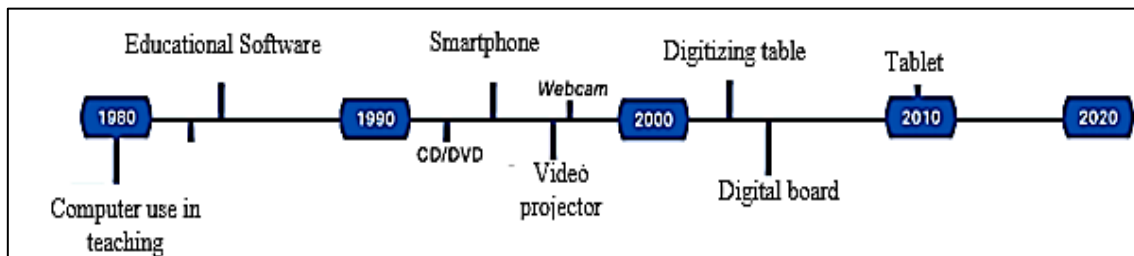
Replacing the cell phone came the smartphone, created in 1992 by the IBM company, which has the difference of being considered a smart cell phone, as it has an operating system running on its system that, because of this, is able to use several applications, which allow that the user uses the smartphone as a tool for numerous purposes (SILVA; OLIVEIRA, 2021).

Both technologies can only be distinguished from each other by the proportion of the device, that is, both have an operating system in their programming, allowing the use of programs, some of these apps available for use, are developed specifically for teaching, opening a range possibilities for teachers and students.

3.5 Timeline

In general and as a result of the research carried out for the formation of this work, it was possible to organize in a chronological way the creation of the DTs presented in this research, aiming at a greater understanding of the order of these resources that are of use to us as an education professional.

Figure 6: Timeline image of digital Technologies Advancement of digital technology



Source: authors

The timeline was made in chronological order of creation of each DT, because during the research we verified that there is no specific date when each DT started to be used in classrooms in Brazil. With the timeline we can check the creation of each TD in chronological order, thus helping to organize our thoughts, helping to aggregate and compare the practices that we use today in the classroom and also generate interest to know the history of the resources we know in the classroom. current days.

It is known that the National Curricular Common Base - BNCC, has as one of its general competences of basic education the use of technology, in order to understand, use and create TD of information and communication in a critical, meaningful, reflective and ethical way in various social practices to communicate, access and disseminate information, produce knowledge, solve problems and exercise protagonism and authorship in personal and collective life. As well, understanding the chronological order of creation of the available DTs is of great importance, not only for teachers, but also for students.

4. Final Considerations

With the course of writing, it was possible to observe the evolution of DT, highlighting the importance of this development, not only for the population in general in its occasional use or for entertainment, but also in the classroom. Making it clear that these resources, even when not created with the teacher in mind, in the hands of an education professional, can transform teaching and consequently the life of an individual.

It is worth mentioning that the use of any of these available DTs does not guarantee that the teaching of content will be of quality. Second, Silva and Rodrigo (2017), the teacher is the main agent for this mediation between the classroom and technology to work, as he will be the one who will make the plans with all the available uses. It is even more necessary that this professional has knowledge, constant training and is motivated to use these resources in their classes. The way that this teacher will be motivated and convinced is precisely from the knowledge and reading of works, articles, experiences of how digital resources are able to transform the classroom environment.

Thus, it is verified how digital technologies began to be used in the teaching of mathematics in Brazilian classrooms and their different uses in teaching, as it was placed on the Timeline and throughout the body of the work.

Having as a reference Basniak, Silva and Gaulovisk (2017) who review the publications from 2010 to 2017 on digital technologies in Brazil in the teaching of mathematics, they put on the acceptance of students, bringing motivation, confidence and enthusiasm, precisely because the process of TDs are on the rise. Today, with this timeline and bringing references beyond the year 2017, we saw that in addition to this power for students, the use of DT has been a great ally of the mathematics teacher in teaching, as an approximation to the student and a resource that facilitates the practice.

A highlight is also the use that was necessary during the years - which we are still experiencing - of the COVID-19 pandemic, where classes were resumed, so it was an "obligation" to use Digital Technologies for the teaching of mathematics. , recognizing the importance of digital resources for teacher practice.

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Historical Evolution of the Use of Digital Technology in Teaching Mathematics in Brazilian Classrooms

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