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The use of Scratch as a pedagogical tool in the perception of who will teach mathematics

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ABSTRACT

This paper presents a research on the use of the Scratch block programming language as a possible tool in the process of teaching and learning mathematical concepts in initial teacher education. For the study, we used the virtual space of the Scratch, which in addition to developing the computational thinking, allows the teacher to work in the schools the mathematical contents through their games, animations and various other activities. The empirical data were constructed with four Mathematics undergraduate students of a Federal Public Institution of the Midwest, through questionnaires, socialized at the end of two workshops to create games with the Scratch. To compose the results, we opted for Bardin's Content Analysis (2016). The categories were work and interaction. The results suggest, in the students' perception, that the use of Scratch can improve the teaching and learning process of Mathematics, making this experience meaningful, creative and playful.

KEYWORDS: Teaching. Learning. Scratch. Mathematics.

INTRODUCTION

There is a growing interest in the use of technologies in the teaching of Mathematics, through dynamic software, virtual environments, games, animations and other resources. Among these, we highlight Scratch, which is a block programming language, developed by Lifelong Kindergarten, a group at the Massachusetts Institute of Technology (MIT) . The Scratch project was funded by the National Science Foundation, the Intel Foundation, Microsoft, the MacArthur Foundation, the LEGO Foundation, Google, Dell, Inversoft and the MIT Media Lab research consortia and has as its concept the idea of teaching programming logic, for the development of games and animations, which facilitates the creation of interactive stories, games and animations with individual learning and the possibility of sharing user creations with others on the web.

As the school is the environment conducive to reflections and concerns related to the teaching and learning process, we note that the use of digital technologies, whether to overcome educational problems or to provide more opportunities for learning and assessment, offers possibilities, through resources, for the development of different contents, including Mathematics. For Dawley and Dede (2012, p. 1), virtual worlds are "an engaging and engaging collaborative and participatory experience for the student", with a variety of features that are not possible in the real world and that serve to improve engagement and student learning.

> Nor can it be ignored that human activities are being transformed with each technological renewal, which will make obsolete much of the skills acquired at the beginning of professional training. Therefore, thinking about education through educational technologies goes beyond having these materials only as resources that enhance teaching and learning. But, rethinking the entire educational process brings new meanings to it (CURCI, 2017, p. 43).

As an educational tool, Scratch can provide the learning of a programming language in blocks, the creation of games and a sharing network for those who use it. The choice of this programming language is due to its great ability to enable its users to learn while playing, through simulations and game creations within a virtual environment.

> These factors justify the use of Scratch [MIT 2014] as a tool to be used in the proposed course, as in addition to encouraging young people to maintain positive attitudes about Computer Science [Meerbaum-Salant et al. 2013], this environment brings a language that contributes to the learning of programming through an innovative concept of project-oriented code development, which privileges Creative Computing, an expression that is used to recognize that the knowledge and practices that young people need acquire to create software must come from their personal interests [Scaico 2013] (AONO *et al*., 2017, p. 2171).

In this context, we are interested in promoting access to this language for future mathematics teachers, as well as understanding their perceptions about its use as a pedagogical tool for teaching and learning mathematics in basic education. It is notorious that we currently live in schools with the first generations of children and young people, raised in technological environments, called by Prensky (2001) as digital natives.

> What should we call these "new" students of today? Some refer to them as the N-[for Net]-gen or D-[for digital]-gen. But the most useful designation I have found for them is Digital Natives. Our students today are all "native speakers" of the digital language of computers, video games and the Internet (PRENSKY, 2001, p. 1).

It is observed that their relationship "with technology is spontaneous and intuitive, a fact that can be used to bring benefits and support the practice of learning in various fields, including logical thinking used in programming languages" (AONO *et al.*, 2017, p. 2169). In this sense, it will demand that the teacher is increasingly prepared and updated.

> Therefore, the initial training of mathematics teachers must provide the future teacher with all the necessary support for their practice in the profession, offering them the necessary skills to start. But, also, to develop the conscience of the search for a continued formation throughout the career, being always updated in relation to new teaching methodologies and technological innovations, because the present social scene, with all the technological advance and dissemination of ICT, increases the educational challenges, so that the professionalization of teaching practice must be focused on the formation of a training teacher for social demands (CURCI, 2017, p. 51).

With the growing increase in technologies and information (whether in use by society, at work or in the school environment), it is necessary to discuss a new work organization in which, depending on the teaching performance, it is essential to search for new knowledge and / or technological knowledge, in order to place this professional closer to the context experienced by their students. The teacher or the future teacher, in this changing reality, needs to guide students on how to collect one or more information, how to separate it, treat it and use it.

> Conducting the process of integrating computer technology, today so accessible to educational environments and, consequently, to the students, in order to provide a differentiated pedagogical approach is not an easy task. Despite efforts on the part of educators, preparation and subtlety are necessary. Although its use has grown substantially in recent years, there is still a feeling of lack of certain directions in order to better use it in the educational context (CRUZ; QUARTIERI, 2018, p. 1).

When thinking about the technological education of the teacher, knowledge combined with practice is necessary. There are authors who discuss theory linked to practice, such as Floriani (2000, p. 14) when reflecting that "the union between theory and practice is perhaps one of the best ways to overcome mediocrity in school education". For Gama and Fiorentini:

> From the perspective of knowledge "of" practice, the researchers suggest, to favor professional development, opportunities for teachers to explore and question their (and others') ideologies, their interpretations and their practices. This means that teachers learn: by challenging their own assumptions; by identifying important practice issues; when proposing problems; when studying its own students, classrooms and schools; in constructing and reconstructing the curriculum; and by assuming roles of leadership and protagonism in the search for the transformation of classroom practice and, consequently, of school and social practices [authors' emphasis] (GAMA; FIORENTINI, 2009, p. 444).

For the investigation described in this article, the path followed was qualitative research, focused on action research. References and strategies were defined based on studies by authors such as Marconi and Lakatos (1999), Gil (2002), and Fiorentini and Lorenzato (2009). For this purpose, a Scratch workshop was developed, with two meetings, planned for Math undergraduate students, considering their theoretical and technological training.

Thinking of that, the workshop was planned in dialogue with professionals who already work in the area of initial and continuing education of Mathematics teachers for the use of Scratch as a pedagogical tool. Thus, there was the participation of an educator from the Secretary of State and Education of the Federal District (SEEDF) and another educator from the University of Brasília Mathematics Department (UnB).

After two meetings, the participants were invited to answer an online questionnaire, which addressed their perceptions regarding the use of the Scratch program as a pedagogical tool for teaching Mathematics in Basic Education. Therefore, an investigation was outlined based on the following general objective: To understand the perceptions of Mathematics degree students regarding the use of Scratch in the teaching and learning process of Mathematics in Basic Education. And as specific objectives:

- Identify the educational potential of Scratch for teaching and learning Mathematics in Basic Education.
- Understand aspects of the use and presence of Information and Communication Technologies, in the initial training of participants.

THE USE OF PROGRAMMING LANGUAGES AS A RESOURCE FOR THE MATHEMATICS TEACHING AND LEARNING PROCESS

The use of programming languages in education can contribute to the improvement of the teaching and learning process, considering that there has been a considering increase in time children and young people spend in front of a computer, tablet, smartphone, or video game console. Therefore, it is possible to observe that there is a vast field for the use of some programs as a teaching and learning tool with which students can learn school content. “With these technologies, difficult-to-understand concepts can be visualized when appropriate modeling and simulation software are associated with teaching” (CRUZ; QUARTIERI, 2018, p. 4).

An educational approach with software can facilitate the exposure of certain content in a practical context for students. For Cruz and Quartieri (2018), the use of digital software in the classroom can lead the student to have access to different areas of knowledge, such as Science, Mathematics, History, Arts and others, contributing to their development and facilitating the learning of Mathematics.

The national curriculum (Base Nacional Comum Curricular - BNCC) talks about the use of technologies as a competence that must cross the entire curriculum of a school, with the proposal of a social intervention that contextualizes the use of the content to be studied.

> It should also be considered that digital culture has promoted significant social changes in contemporary societies. As a result of the advancement and

> multiplication of information and communication technologies and the increasing access to them due to the greater availability of computers, cellphones, tablets etc, students are dynamically inserted in this culture, not only as consumers (BRASIL, 2018, p. 59).

The BNCC also encourages the modernization of resources and pedagogical practices, aiming to form the general skills and competencies mentioned in the document. We believe that, in this case, when using the Scratch programming language, we will be contemplating the development of one of the ten general competencies.

> However, it is also essential that the school understands and incorporates more new languages and their modes of operation, unveiling possibilities of communication (and also manipulation), in order to promote education for more democratic uses of technologies and for more conscious participation in digital culture. By taking advantage of the communication potential of the digital universe, the school can institute new ways of promoting learning, interaction, and sharing of meanings between teachers and students (BRASIL, 2018, p. 59).

We emphasize that the Curriculum in Motion of the Secretary of State and Education of the Federal District (DISTRITO FEDERAL, 2018) presents the need for "practices mediated by digital technologies", which work with students "investigative practices". Thus, the computer lab environment at the universities, in partnership with a programming language in education, can contribute and give new meaning to the use of technology as a resource in teaching practice. It is noteworthy that information technology, as an aid resource in classes and in the development of mental and psychic abilities, can enable students to learn from their experience, socialization, and living, because, for Bittar (2000, p. 93), "when the teacher uses the computer lab resource, there is an intention to teach, however, this does not guarantee that the computer is acting in the student's learning process".

When using Scratch in school activities, it is important to emphasize that the use of this program does not guarantee that the teaching and learning objectives will be achieved, but we believe that good planning and specific direction can help the teacher to achieve these goals.

THE METHODOLOGICAL OUTLINE

This study has a qualitative approach, typified in an action research. Considering this, according to Fiorentini and Lorenzato (2009, p. 112):

> The researcher enters the environment to be studied not only to observe and understand it but, above all, to change it in directions that allow for the improvement of practices and more freedom of action and learning for the participants (FIORENTINI; LORENZATO, 2009, p. 112).

For the authors, this process of investigation and intervention moves towards an "investigative practice, reflective and educational practice", (FIORENTINI; LORENZATO, 2009, p. 112-113). Gil (2002), when explaining action research, points out that:

> [...] it is a type of empirically-based research that is conceived and carried out in close association with an action or with the resolution of a collective problem and in which researchers and participants representing the situation or problem are involved in a cooperative or participatory way (THIOLLENT, 1985, p.14, *apud* GIL, 2002).

The research proposed to do a workshop, in two meetings, to undergraduate Mathematics students, of a public institution of education in the Federal District. For the development of the workshop, the computer resource was used and the Computer Laboratory as a space. The meetings were held on November 1 and 8, 2018. A didactic material aimed at beginners was planned, which included Scratch tools. After planning, a call for registration was made in a form link on the Google platform, directed to the undergraduate students.

The workshop was organized in two stages: 1) Presentation, history, the concept of Scratch programming language, and game programming of "Vamos salvar a Mônica da chuva?" (Let's save Monica from the rain), lasting two hours; 2) Feedback from the previous workshop, game programming of "O jogo do gato" (The cat game), socialization and information about completing the online questionnaire, lasting two hours and twenty minutes (2h20). For Marconi and Lakatos (1999), the questionnaire is a scientific instrument, composed of a set of questions with a predetermined criterion, to be answered without the presence of the interviewer, as it aims to collect data from a group.

The analysis of the data constructed in the research was based on Bardin (2016), verifying whether the units of analysis corresponded to an interpretation that guaranteed homogeneity, "that is, they must comply with precise criteria of choice and not present too much uniqueness outside these criteria" (BARDIN, 2016, p. 128). Thus, our aim was to search the data for reflections and considerations in relation to the stated research question.

THE PARTICIPANTS

Seven undergraduate Math students and one student from the Department of Design collaborated with this research. For the purpose of analysis and preservation of the participants' identities, the students were identified by the capital letter of the alphabet "E" and discriminated by Arabic numerals, namely: E1, E2, E3, E4, E5, E6, E7 and E8.

WORKSHOP DEVELOPMENT WITH *SCRATCH*

The objective of the workshop was to work on the introduction of the Scratch block programming language, through the dynamic construction of practical games, using mathematical concepts. Initially, a computer connected to the internet was used for each student, through which they accessed the Scratch website at https://scratch.mit.edu. In this access, each student created their logins and access passwords. About Scratch, it was summarized as:

> [...] a programming language that enables the creation of interactive stories, animations, games, music and arts. It was developed by the Massachusetts Institute of Technology - MIT, led by Resnick, heir to Seymour Papert, creator of Logo. Scratch was inspired by Logo language, which was used in Brazil in

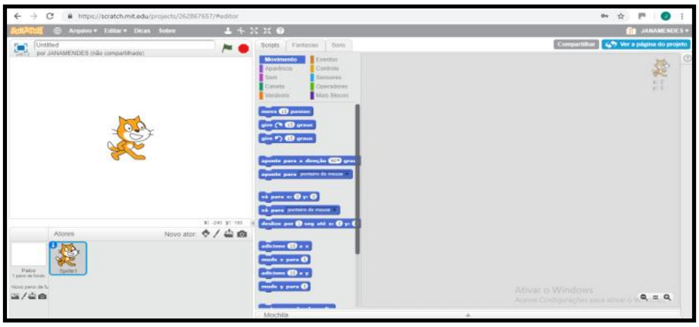
> the 1980s as an educational tool, but the reality of that time did not allow the tool to advance. Resnick was fascinated by the interest children had in the Lego game, thus developing Scratch based on Logo and Lego (OLIVEIRA; CORDEIRO, 2016, p. 3).

Before the first meeting, the Scratch program was installed on the laboratory's computers and a file folder was created on the work area, with images for the construction of the game "Let's save Monica from the rain?" Soon after, the proposal to perform the research was presented and the Scratch programming language was introduced, addressing its history, creators, concept, use, structure, basic applications, as well as the philosophy that supports its development, such as Resnick's "four Ps of Creative Learning":

> Our approach is based on four core elements, which we sometimes call the Four P's of Creative Learning: • Projects. People learn best when they are actively working on meaningful projects – generating new ideas, designing prototypes, refining iteratively. • Peers. Learning flourishes as a social activity, with people sharing ideas, collaborating on projects, and building on one another's work. • Passion. When people work on projects they care about, they work longer and harder, persist in the face of challenges, and learn more in the process. • Play. Learning involves playful experimentation – trying new things, tinkering with materials, testing boundaries, taking risks, iterating again and again (RESNICK, 2014, p. 1).

In this approach, Resnick (2014) highlights the four pillars for creative learning as strategies to work with content or themes, whether schooled or not, in order to place students at the center of the educational process, in a motivating way, with conditions for them to plan, create and test the most diverse situations proposed. After the introduction, we presented the initial screen of Scratch, represented by Figure 1, in which we highlight the area for programming.

Figure 1 – Initial screen



Source: The authors' file.

Next, in Figure 2, the functionalities of each field of the Scratch screen were presented.

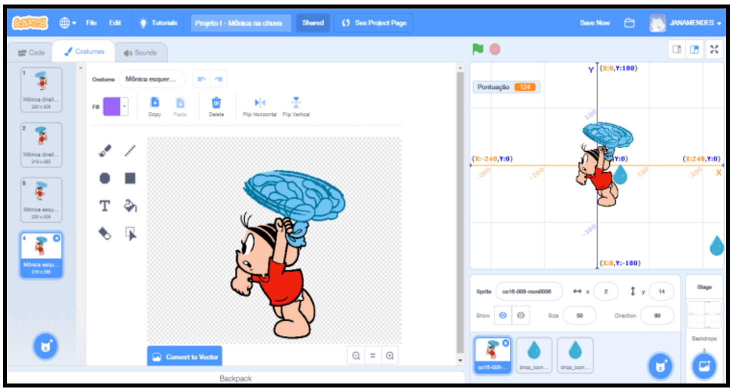
Figure 2 – Initial screen

Source: The authors' file.

In Figure 2, the initial fields were also observed: object editing; start/stop buttons; stage; area and objects created; editing area and script connection; options for the scripts area (costumes, costumes and sounds); command blocks and command categories.

In Figure 3, the "Cartesian Plan" scenario was used to present the Scratch area.

Figure 3 – Initial screen

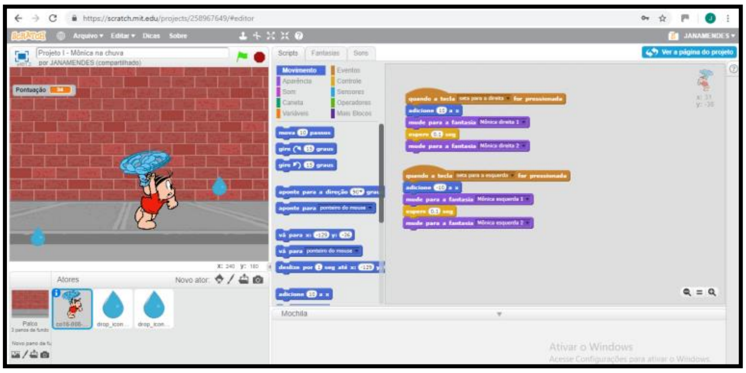


Source: The authors' file.

We also emphasize that before starting the game programming concepts, the notions of the Cartesian plane, coordinates of points and movements were approached and explored, based on the figures and objects to be used (actors).

We emphasize that, for the programming of the game, the character chosen was Mônica, who is part of the characters developed by the Brazilian cartoonist Maurício de Souza, who authorized the use of some images for educational applications, as shown in the following figure:

Figure 4 – Game programming screen

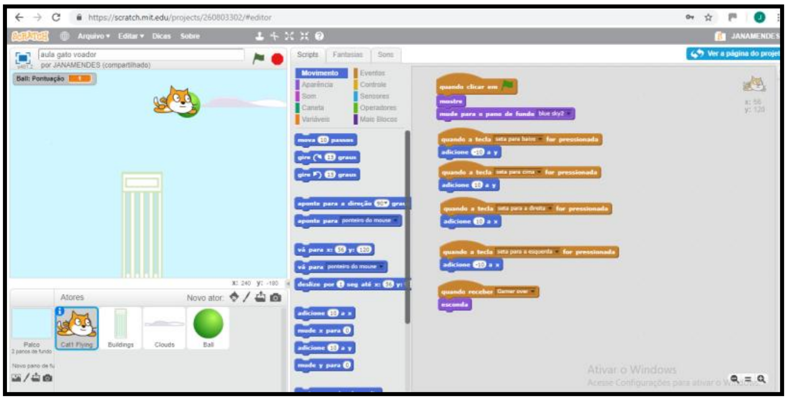


Source: The authors' file.

Figure 4 presents the image of the game with the programming finished. It is possible to observe a stage (as a background), three actors (Monica and two drops) and the programming in the editing area.

For the second meeting, we started with some feedback from the previous meeting and continued with contents from the Cartesian plane to start the creation of the activity "The game of the cat". Doubts and collective learning were shared when thinking about solutions, strategies and resolutions for the challenges of game programming. In Figure 5, we present the result of the game "The flying cat" built in the second meeting:

Figure 5 – Game programming screen



Source: The authors' file.

The actions were continued with some other challenges to enrich the programming for this game, such as: scenographic effects (change the scenery), hide characters, get points when picking up a certain object, use of time, score, among others.

ANALISYS AND DISCUSSION

The analysis and discussions are based on ten questions that come from the research question. From this perspective, the participants' responses were searched for evidence of how they (future teachers) see Scratch as a pedagogical tool and their perceptions about the contribution of this resource to the teaching and learning process of Mathematics. The questionnaire items were built from the observations made at the two meetings and from the possible contributions of Scratch as a tool for teaching Mathematics.

During the analysis, the following categories were constituted: teaching work and interaction.

> Thus, the understanding of teaching work at the beginning of the career, permeates the formation of being a teacher and the change in the social subject that performs the teaching action, the study of the object of its practices, the techniques to do it, the different projects, the pedagogical intentions and proposals for the realization of the educational project, the conditions to perform the work (SILVA, 2018, p. 18).

The interaction category is understood as an action that occurs between the action of mathematical content and the use of Scratch as a pedagogical tool, either in the introduction or in the validation of the knowledge taught. Brait (2001) states that:

> [...] interaction is a component of the process of communication, of signification, of construction of meaning and that is part of every act of language. It is a sociocultural phenomenon, with linguistic and discursive characteristics that can be observed, described, analyzed and interpreted (BRAIT, 2001, p. 194).

In the educational context, in the classroom space or in the computer lab, following the lesson plan, doubts and difficulties on the mathematical contents are considered, as they provoke and allow rearrangements that allow the subjects to interact, introduce, review and the expansion of concepts, which contributes to the teaching and learning process.

Thereby, it is possible to think about teaching practice from the point of view of communication when teaching and interaction, in this case the teaching work, through which it is possible to continue and develop a scenary in which the subjects involved relate to the social environment that surrounds them, in the construction of meanings. With the use of Scratch in this teaching and learning process, teacher, student and content interact with the use of tools, and there are constructions that are modified or adapted through the evolution of these interactions. Below, we detail the analysis of the responses.

SURVEY OF PRIOR KNOWLEDGE ON PROGRAMMING LANGUAGES

In the responses, we found that most participants already knew programming language, but only one said they knew Scratch.

What did you think of Scratch?

> *[E1] It is an **interactive program** that activates creativity. I found the program easy to understand the commands.*
> *[E2] A **practical**, didactic and **interactive** program. It can be used even by children with a little computer knowledge.*
> *[E3] **Interesting**, dynamic, simple and **practical**.*
> *[E4] An **interesting** tool that facilitates the organization of programming through blocks.*
> *[E5] Very simple, easy to learn how to use.*
> *[E6] I really liked the proposal of the program and it should be one of the*

> ***practical*** *contents in schools as a way of helping.*
> *[E7] It is very good. And as it is something interactive, only provides programming logic without charging a complex language.*
> *[E8] Very* ***interesting*** *and* ***intuitive****.*

The programming language of Scratch is defined with the sockets of the command blocks, which allows to reduce or even eliminate the errors of syntax present in some languages. Participants' responses demonstrate that Scratch is easy to access, interactive, practical, didactic and also easy to understand and understand. The words *interactive program, practical, interactive* and *interesting* stand out as parameters.

> [...] Scratch, a programming software aimed at creating interactive projects with multimedia resources and with great potential for learning mathematical concepts in a contextualized and motivating way, as well as contributing to technological fluency, an essential skill to be developed in the formation of the contemporary citizen (CURCI, 2017, p. 54).

Potential of Scratch for teaching, according to the perception of some teachers who will teach Mathematics

The responses point to the contents: set of whole numbers, Cartesian plane, functions, graphs, problem situations and mathematical logic.

> *[E1]* ***Graphs, Functions, Integers****... Students* ***would learn*** *the mathematical language of "if...then", in addition to others that appear in the program, which is not seen in school. They would have a better sense of the* ***functionality*** *of a* ***Cartesian plane****. They could see more clearly the idea of ordered pairs.*
> *[E2] Any content can be* ***worked on****. Just create a context and insert it in the codes.*
> *[E3] Mainly contents that involve* ***problem situations****.*
> *[E4] Any content that* ***works with language or computational logic****.*
> *[E5] We can* ***work*** *knowing the* ***elements of the graph*** *and related things.*
> *[E6] Mathematics.*
> *[E7]* ***Geometry, Measurement system, functions, probability and statistics, logic, speed****, etc.*
> *[E8]* ***Cartesian plane, notions of direction****, etc.*

According to the participants, Scratch is a pedagogical tool with great potential to promote the teaching and learning process. They are also able to visualize great possibilities of application for the teaching of Mathematics, and the teacher only needs adequate planning and contextualized the content to be worked on.

Mathematical contents present in activities with Scratch

In the game "Let's save Monica from the rain", participants were invited to identify mathematical concepts in their programming.

For Curci (2017, p. 125), Scratch "provides the development of cognitive processes through the interaction of the individual with the tool, enhancing multiple learning skills, such as logical reasoning and systematic thinking". Therefore, the following parameters stand out in the participants' reports: the Cartesian plane and logical reasoning.

> *[E1] I* ***imagine*** *it would be a game to start the idea of "what is* ***the axis of the abscissa****". With the* ***score going negative****, we work with* ***whole numbers****.*
> *[E2] Yes. The* ***Cartesian plane*** *is one of the main ones. Paying attention to the* ***x and y positions*** *of each element, do the calculations. In addition it can also*

be noticed a logical structure behind everything.
*[E3] The **logical reasoning**.*
*[E4] **Logical Reasoning**.*
[E5] We didn't make this game.
*[E6] Yes, the **vertices x and y**.*
*[E7] **Space orientation, metric system, plane geometry, function, mathematical logic, probability and statistics**, etc.*
*[E8] **Positive and negative numbers, Cartesian plane**, orientation.*

Difficulties for using Scratch in building games and possible solutions

Participants presented reports of some difficulties, which are summarized in thinking beyond commands, developing dynamic proposals and programming with an approach in intuitive blocks. There is also a report on the importance of a workshop teacher to guide the construction of the program to be developed, as they emphasize that without a workshop it would be very difficult to follow the activities.

[E1] Yes. How to make a command for two different objects with different keys being pressed simultaneously?
*[E2] Yes. As I know other code-based languages, it was a little strange to be **working** with blocks.*
*[E3] Yes, at first for not understanding the dynamics of the game. Then everything became more **intuitive**.*
[E4] Scratch is very vast, so without instructions from the workshop, it is very difficult to organize the programming because it has many commands.
[E7] I just had a little problem for not paying attention, where I ended up missing a process in the programming logic.

According to the participants, the workshop proposal was short. During the data collection stage, they argued about solving some difficulties pointed out in the previous problem. In this perspective, they reported that:

*[E1] A course with a **longer duration** so that we could share doubts and research them.*
*[E2] Have a **small introduction** on how they work and what relation each one has with the written code.*
[E3] None.
*[E4] Make some **handouts** so that the student can do some programming at home.*
[E5] I think the commands are self-explanatory, it's already simple enough.
[E6] Have a tutorial on how to use the program.
[E7] The teacher takes it easy and explains the process, step by step, of the programming logic and the already structured codes to facilitate.
[E8] I had no difficulty.

Potential of Scratch for teaching, in the perception of future Mathematics teachers

From the participants' reports, it is clear that they realized the possibilities of using Scratch to address mathematical content. During the data collection stage, the students argued that the use can provide the formalization of interactive and playful classes, which facilitate teaching and learning through the creation of games.

*[E1] Yes. I could use it to **explain** any content, as the platform is open to free **creation**. I could create games related to a certain topic with an introductory idea, and I could ask students to **put together** more in-depth games.*

> *[E2] The program can be used both in system **construction** classes and as an **interactive** way for the student to perceive the algorithm. And it can also be used as **a playful way, creating** a game that facilitates the understanding of certain content.*
> *[E3] Yes, applying together with the pragmatic contents.*
> *[E4] I could use this program to **work on** concepts of **logical reasoning**, even if it is aimed at programming.*
> *[E5] Yes. I think it works well with elementary school students, who like games and creative things.*
> *[E6] Yes, I would use it to **reinforce the content**.*
> *[E7] Yes, this program is a wonderful resource, opening up a range of opportunities for the professor, even more for **being easy to use** by both students and teachers, which makes it even better. I would think about using it, but my intentions would be around something that **would enhance new skills** in students, as it is something simpler to produce. For me as a teacher, having knowledge of other more complex languages, Scratch is something limited in terms of the possibilities I can do, but it is a very good initial thing for students, because the programming is interactive and with the codes already predetermined.*
> *[E8] Yes. This program would make the class more dynamic and fun.*

Also according to the participants, the use of the Scratch programming language can "add to classes", playing an important role in the teaching and learning process.

> *[E1] I could initially ask the students to replicate the games shown in the tips to understand the **functionality** of the program and then they would have complete freedom **to create** their own and share them with the class.*
> *[E2] **Teaching** with few students to solve doubts.*
> *[E3] To be a tool that adds to the classes, bringing **dynamics** and **motivation**.*
> *[E4] Use in examples of **logical reasoning** applied to computing.*
> *[E5] Make a game where the character has to pick up items and **perform mathematical operations** and get the correct result, if possible. I haven't explored Scratch enough yet, but I think it's possible to make a game like this for elementary students.*
> *[E6] To teach the aspects x and y in a **fun way**.*
> *[E7] Start in the classroom, but allocating more time for the students to finish, thus enabling **a more creative production** so that it is not just learning the content, but how it relates to the students' personal lives.*
> *[E8] To combine it with the **teaching of contents** as a Cartesian plan.*

Creative Learning and the use of Scratch in Mathematics teaching

During the workshop, Resnick's concept of Creative Learning (2014) was worked on. According to the participants, the concepts of the 4P's give meaning to mathematical activities, helping to develop students' creative potential. They also emphasized that these concepts also help the teaching work, as a creative teacher tends to produce creative classes, capable of motivating students for the pleasure of learning Mathematics.

> *[E1] Yes, I **believe** that Mathematics is directly related to creativity. I **believe** that we, as educators, should encourage students to think creatively and not just leave them with shallow thoughts that are often transformed into a refusal **to learn** Mathematics.*
> *[E2] Yes. In Mathematics, above all, we need to have passion. **Learning** mathematics is not so easy, as it involves breaking down barriers created by society. It is not enough to teach mathematics, you also need to love **learning** Mathematics.*
> *[E3] Yes. I **believe** that they are interrelated and it is up to the teacher to make the effort to want to apply them.*

> *[E4] For content that can be divided into projects, this approach is totally adequate, as it makes the content more tangible and fun in a first contact.*
> *[E6] Yes, because if you have all these 4p's you can make that student who is not so into math end up falling in love.*
> *[E7] Not only do I believe it, but what should be done. Learning must be something rewarding for students, otherwise it will become something frustrating, becoming a negative variable in the teaching and learning process.*

In general, through the responses of the participants, favorable conditions are verified in relation to the possible actions with the use of Scratch, allied to the approach of Resnick's 4P's (2014), in the teaching of Mathematics. The speeches showed that future teachers believe that the resource facilitates the understanding of mathematical content and, in a playful way, allows the learning of concepts and develops the creative potential of students.

Thus, it is believed that the interaction with Scratch led the participants to reflect on the possibility of working with some mathematical concepts, allied to the tools of the Scratch programming language, with the aim of promoting the teaching and learning process and developing students' creative potential.

FINAL CONSIDERATIONS

For this research, it is observed that the training of the future Math teacher must go beyond understanding the concepts, making calculations and knowing how to teach. We live in a world surrounded by technologies and we can insert these resources into our actions in order to enrich our pedagogical practice, making the teaching of Mathematics more interactive and dynamic, in addition to bringing us closer to the technological reality experienced by our students, in order to promote meaningful learning for the learner (BITTAR, 2000; BITTAR, 2018).

We emphasize that computer use is part of our daily lives and also of the schools in which we work or in which we will, in the near future, work. Therefore, it is not enough just to know how to use the computer, or even a certain programming language. To achieve our goals, we need an adequate planning, which aims to motivate students to learn mathematical concepts, through a resource that has the potential to motivate and facilitate the student's learning process.

With the realization of the workshop, the focus of the research of this work, it was possible to take the students, future Mathematics teachers, to know the Scratch programming language and, from this knowledge, they were able to reflect that it is not enough to have only technical knowledge about some technological resource to be applied in a Math class, but it is necessary to know how to use it in practice, through a theoretical-methodological approach that supports it (NOGUEIRA, 2021).

In the case of this research, the theoretical-methodological approach presented was based on the 4P's of Creative Learning, in order to give a special emphasis to the teaching of Mathematics through: Projects, Partnerships, Passion and Thinking (Projetos, Parcerias, Paixão e Pensar, in Portuguese) while playing. According to the participants, this approach presented itself as an important support for the teaching of mathematics using Scratch. Participants also identified the potential of Scratch and its use in teaching Basic Education content and felt encouraged to undertake the search for teaching strategies using other virtual spaces.

Finally, we emphasize that the workshop achieved the objectives proposed for this research and the results suggest that the use of this programming language can be an important ally for the improvement of the teaching and learning process of Mathematics, making it more meaningful, interactive, playful and creative.

A UTILIZAÇÃO DO SCRATCH COMO FERRAMENTA PEDAGÓGICA NA PERCEPÇÃO DE QUEM ENSINARÁ MATEMÁTICA

RESUMO

Este artigo apresenta uma pesquisa sobre o uso da linguagem de programação Scratch, como possível ferramenta no processo de ensino e de aprendizagem de conceitos matemáticos na formação inicial de professores. Para o estudo, utilizou-se o Scratch que, além de desenvolver o pensamento computacional, possibilita ao professor trabalhar os conteúdos matemáticos por meio de seus jogos, animações e diversas outras atividades. Os dados empíricos foram construídos com quatro estudantes da licenciatura em Matemática de uma Instituição Pública Federal do Centro-Oeste, por meio de questionários, que foram socializados ao final de duas oficinas de construção de jogos com o Scratch. Para compor os resultados, optou-se pela Análise de Conteúdo de Bardin (2016). Constituíram-se como categorias: o trabalho e a interação. Os resultados sugerem, na percepção dos licenciandos, que o uso do Scratch pode melhorar o processo de ensino e de aprendizagem da Matemática, tornando essa experiência significativa, criativa e lúdica.

PALAVRAS-CHAVE: Ensino. Aprendizagem. Scratch. Matemática.

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