A Dialogue Between Computational Thinking And Interdisciplinarity Using Scratch Software

Un Diálogo Entre El Pensamiento Computacional y La Interdisciplinariedad Usando El Software Scratch

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Tipo de Artículo: Reportes de investigación y ensayos inéditos

Doi: 10.17533/udea.unipluri.20.1.06

Cómo citar este artículo:
Zampieri, M. T., & Javaroni, S. L. (2020). A Dialogue Between Computational Thinking and Interdisciplinarity using Scratch Software. *Uni-Pluriversidad, 20*(1), e2020105. doi: 10.17533/udea.unipluri.20.1.06

FACULTAD DE EDUCACIÓN

Recibido: 2020-04-03 • Aprobado: 2020-07-12

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Abstract

In this paper, the purpose is to discuss results of a continuing education action with teachers, linked to the university extension project *Computational Thinking and Interdisciplinarity in the classroom*, developed within the Postgraduate Program in Mathematics Education at Sao Paulo State University (UNESP), Rio Claro (Sao Paulo), Brazil. The development of interdisciplinary activities by teachers using Scratch software is highlighted, pointing out how this is reflected in the classroom, from the development of an interdisciplinary activity in two classes taught by the teacher of Geography, a participant of this formative action. The qualitative approach was adopted, and the methodological procedures used were video recording of the meetings, writing of field diaries, prepared by all the involved proposers, and recording of all the developed activities. Data analysis highlights how important this partnership between university and school was because it contributed to transform the knowledge of teachers, researchers, and students through the development of Computational Thinking.

Keywords: University-school Partnership, Scratch, Interdisciplinary Activities, Mathematics Education.

Abstract

En este documento, el propósito es discutir los resultados de una acción de educación continua con los docentes, vinculada al proyecto de extensión universitaria *Pensamiento computacional e interdisciplinariedad en el aula*, desarrollado dentro del Universidad Estatal de Sao Paulo (UNESP), Rio Claro (Sao Paulo), Brazil. Se destaca el desarrollo de actividades interdisciplinarias por parte de los docentes, utilizando el software Scratch, señalando cómo esto se refleja en el aula, a partir del desarrollo de una actividad interdisciplinaria en dos clases impartidas por la maestra de Geografía, participante de esta acción formativa. Se adoptó el enfoque cualitativo y los procedimientos metodológicos utilizados fueron grabación de video de las reuniones, redacción de diarios de campo preparados por todos los proponentes involucrados y grabación de todas las actividades desarrolladas. A partir del análisis de datos, se destaca la importancia de esta asociación entre la universidad y la escuela, porque contribuyó a transformar el conocimiento de profesores, investigadores y estudiantes a través del desarrollo del pensamiento computacional.

Palabras clave: asociación universidad-escuela, Scratch, actividades interdisciplinarias, educación matemática.

Introduction

Recent researches conclude that the use of Digital Technologies (DT) by teachers linked to the development of exploratory activities, in teaching and learning processes, is still modest in the Basic Education (students between 11 and 14 years old) at the State of Sao Paulo, Brazil. Some reasons are: lack of computers; broken computers; bureaucracies within the "Acessa Escola", whose purpose was to manage the computer rooms of public schools in the State of Sao Paulo; and the fact that teachers did not feel sufficiently prepared to use digital technologies. These studies also show that collaboration between university and school is one of the aspects that contribute to this use, as well as an active participation in collaborative continuing education actions, which enable teachers to produce activities with DT, leaving their comfort zones and advancing to their risk zones (Javaroni & Zampieri, 2019).

From this scenario, a continuing education action is developed with teachers who work in a public school belonging to the Integral Education Program (IEP). They teach within three major areas: Humanities, Language and Codes and Exact and Natural Sciences. The objective was to promote reflections on the development of Computational Thinking (CT) in interdisciplinary approaches, with programming language Scratch, Scratch for Arduíno, with robotic kits, gold material, among other artifacts.

Given this, the purpose of this paper is to discuss the results of this action, highlighting the development of interdisciplinary activities by teachers, using Scratch specifically, to point out how this reflected in the classroom.

Contextualizing the continuing education action

The partnership between UNESP, represented by the authors of this paper, and the Carolina Augusta Seraphim School began in 2017, with the fieldwork of the master's research developed by a master's student, whose purpose was to develop the CT with 9th grade students of this school, in partnership with the teacher Ana, through the programming language present in the Scratch software and the Arduíno Uno robotics kits, besides addressing the content about the rest of the Euclidean division and congruence between two numbers (module n) (Silva, 2018).

Thus, since the development of this research, this partnership has been fruitful as the students demonstrated, to the school management, a progressive improvement in the school performance related to the Mathematics curriculum component, other regular components (that count in the curriculum of the final years of Elementary School, which are compulsory) and electives (which appear in the curriculum as themes different from the regular, optional for students) of the school. It provides evidence of the contributions of Computational Thinking to the development of these curriculum components (Silva, 2018).

In view of this, we developed a university extension project, entitled Computational Thinking and Interdisciplinarity in the classroom, and submitted it to comply with Pro-rectory of university extension of UNESP, public notice number 02/2018. It was approved and effective between May and December 2018, and it was developed at Carolina Augusta Seraphim School, with the support of the research group of which we are members, the Research Group in Informatics, other Media and Mathematics Education (GPIMEM). The purpose of this project was to promote continuing education with teachers, as mentioned earlier (Zampieri, Silva & Javaroni 2019). This formative action was conducted by the authors of this paper and by the master's students Eliel Constantino da Silva, Leandra dos Santos and Pedro Henrique Girardi de Sousa, and by the graduate student Blenda Siqueira, and it was also one of the settings for the development of the first author's postdoctoral activities.

This action took place in 10 meetings of 50 minutes each with 11 teachers in the school's computer lab. Data were produced by videorecording the meetings, field diaries, prepared by all proponents involved. In addition, all activities performed by teachers during the course were recorded by researchers on their personal computers and pen drives. Therefore, it was adopted a qualitative research approach. Regarding the two classes we followed, the methodological procedures were: registration of all activities developed by the students and field diaries of the researchers involved.

Regarding the dynamics of this continuing education action, it was proposed that the teachers work in groups within these three different areas. In the first two meetings we did an exploration of Scratch activities and we also took a robotics kit (Arduino Uno) for them to explore and decide which of these artifacts they would like to work with. They chose Scratch because of its user-friendly interface and because some of their students, particularly the ninth grade, were already familiar with such software.

In one of the activities with Scratch, the teachers were invited to explore some projects developed by the school students, which are attached on the school website. Some teachers were surprised by the creations of their students, which were mostly games that articulate different scenarios and characters, and a very well-structured programming. We realized that there was a greater interest on their part to study Scratch further.

In the third meeting, we discussed the possibilities of the development of Computational Thinking with teachers, from the study of the paper Stimulating Computational Thinking with the project Logicating, by Silva, Miroelli and Kologeski (2018). This discussion made possible for teachers in their respective groups to expound their understanding of CT. From these understandings, other questions about this theme arose, such as the distinction between common thinking and Computational Thinking and the presence of the latter in daily life.

We also suggest that teachers, in developing the next activities of this continuing education action, try to see if their conceptions of the CT made sense throughout this process, and reformulate them if they thought it was necessary (Silva, Zampieri & Javaroni, 2019).

In the following meetings, we proposed each group the creation of an interdisciplinary activity with Scratch to contemplate contents of d ifferent disciplines. Thus, the group of Human Sciences decided to create a game, as a Quiz, addressing the theme of Watersheds. In the Languages and Codes group, the teachers chose to create an activity that involved tourism in world-renowned places through a dialogue between two characters in the English language. The group of Exact and Natural Sciences chose to create a game involving food pyramid and calorie counting of some foods.

Given the above, we present below a dialogue with literature, within the main themes that we want to highlight in this paper: Teacher Education focusing on the partnership between university and school, Interdisciplinarity, Digital Technologies and Computational Thinking.

A dialogue with literature

With the expansion of digital networks there is also a breakdown of the boundaries between cinema, television, writing, computing, telecommunications and press, as predicted by philosopher Pierre Levy in the early 1990s, the consequence of which is the “metamorphosis of interfaces into one cosmopolitan territory” (Levy, 1999, p. 113). We are continually experiencing this metamorphosis of interfaces, which in turn reflects directly on the nature of communication, as predicted by him, and it has indeed materialized, with fast internet access via a mobile device proving this prediction.

For this author, cognition or intelligence is the result of a complex network in which different biological, human and technical actors interact. Thus, in this perspective, there is no intelligent self, but a self with a group of humans, in which this self is an integral part, with its own language, with a baggage of methods, writing, etc. Moreover, according to this philosopher, the intelligent self is fragmented within, so that, based on the assumptions of cognitive psychology, there are a multitude of parts, of different shapes and types, that make up the human cognitive system. With these arguments, Levy (1999) defends the idea that each individual alone is a cosmopolitan society.

In Mathematics Education, Borba and Villarreal (2005) argue, supported by Pierre Levy’s ideas and also in other literary works, about the possibility of analyzing the role of technologies as actors within this collectivity composed by human and non-human actors. However, this analysis is not about a comparison, in the sense of characterizing what these technologies do best in relation to interaction with other technologies, but rather the search for understanding about the transformations they cause in thinking, and about the types of problems that manifest themselves with their use, particularly in Mathematics Education (Borba & Villarreal, 2005).

However, when working with the computer or other technology, the mathematics teacher may feel the need to deepen with the students some mathematical ideas, and concomitantly, look for other methodological alternatives to address in their classes, according to Borba and Penteado (2010). That is, along with the use of technologies comes the challenge of continually expanding, deepening and revising their mathematical knowledge, because the more teacher propose to make this use, the greater the risk that they will encounter some unfamiliar mathematical situation.

If we add this to the idea that teachers have increasingly felt the need to venture into working with interdisciplinary approaches, the challenge is greatly increased, as it will not only be mathematical knowledge that will require time, depth and review, but also those related to the contents of other curriculum components with which they choose to work. In this sense, Tomaz and David (2017, p.27) highlight that working within an interdisciplinary perspective allows the creation of "new knowledge that is added to each of the disciplines or situated in the intersection zone between them, starting from the interactions of the students in the environment and elements of a communicative practice that they develop " (Tomaz & David, 2017, p.27).

These authors also emphasize that interdisciplinarity is a possibility, through the investigation of concepts or some activity, to foster relationships between practices involving students and teachers, which include two or more subjects in the curriculum. In other words, for them, interdisciplinarity happens when students and teachers participate in school practices during the development of such practices. In this sense, it happens in the action of the people who actively participate in Mathematics teaching and learning processes.

Thus, for them, communication between students and teacher in their own teaching and learning processes characterizes an interdisciplinary work. This argument is also in synergy with what Skovsmose (2000) argues about the importance of dialogue and the role of the teacher in research scenarios. It ceases to be centralizing and teacher assumes the role of mediator.

In this sense, according to this author, it is up to the teacher to create learning opportunities for his students to formulate interesting questions that encourage them to assume an investigative posture. From this perspective, the quality of communication among all those involved in a specific school practice is directly related to the quality of teaching.

According to Skovsmose (2000), a research scenario is one that invites students to ask questions and seek explanations. Questions like "What happens if…?", which may come from the teacher, are interesting questions because they mobilize students to take an investigative stance. And it was this spirit that we sought to foster in the teachers, and later in the classes we participated with them.

One thing that could favor the development of interdisciplinary approaches, in our view, would be to promote the development of Computational Thinking in a way that intertwines with these approaches. The International Society for Technology in Education and the Computer Science Teacher Association presented a definition of Computational Thinking for Primary and Secondary Education, as follows:

Computational Thinking is a problem-solving process that includes (but is not limited to) the following characteristics:

- Formulating problems in a way that enables us to use a computer and other tools to help solve them
- Logically organizing and analyzing data
- Representing data through abstractions, such as models and simulations
- Automating solutions through algorithmic thinking (a series of ordered steps)
- Identifying, analyzing, and implementing possible solutions with the goal of achieving the most efficient and effective combination of steps and resources
- Generalizing and transferring this problem-solving process to a wide variety of problems (ISTE & CSTA, 2011, p.13).

Although these characteristics were thought for the development of the CT with students, in our view, they can also be extended to the development of approaches to continuing education with teachers, since CT has to do with the "computational concepts we use to approach and solve problems, manage our daily lives, communicate and interact with other people" (Wing, 2006, p. 35).

In this sense, according to this author, Computational Thinking is associated with the way humans solve problems and it does not refer to the attempt to make us think like the computer, since our cognitive processes are intrinsic to our human condition. That is, for her, "humans are intelligent and imaginative. We humans have made computers exciting". (Wing, 2006, p. 35). However, the author reiterates that by being equipped with the computer, it is possible to mobilize our intelligence to solve problems that could hardly be glimpsed before the computer age.

Thus, for this author, thinking computationally implies solving a problem algorithmically, or even it implies dividing it into blocks and solving them in stages, and this is not restricted to the use of the computer. Thinking about teaching and learning processes, Computational Thinking can be developed through interaction with different artifacts, such as manipulative materials and digital technologies (Javaroni & Silva, 2019). Among the latter, Scratch software specifically, associated with exploratory approaches, enables the development of this thinking within interdisciplinary approaches, as it allows the creation of games, stories, animations, etc.

However, in order for the teacher to advance to this risk zone, he must first understand that he is not the sole holder of knowledge, as argued by Borba and Penteado (2010). In addition, the authors argue the need for collective action and thinking, because individually it is difficult for anyone to cope with their risk zones.

Collective actions should emphasize, as Tarfid (2000) points out, classroom practice, proposing reflections on different teaching knowledges that can be used in this context, linking them to school guidelines, as we proposed to do in the development of action, discussed here in this paper.

Teaching and classroom mobilizations

As mentioned, there were times in the formative action when teachers were invited to develop interdisciplinary projects. Thus, they formed three groups of agreement, corresponding to the areas of Humanities, Exact and Nature Sciences and Languages and Codes. The choices of the respective themes were negotiated to meet each group member and the specificities of each of these areas, as recommended in the Brazilian curriculum guidelines. Thus, as already pointed out at the beginning of this paper, the group of Human Sciences chose to create a quiz game about watersheds that make up the entire national territory. The Languages and Codes group has chosen to create a story involving a plane ride through world-famous historical places or monuments, such as the Statue of Liberty, the Great Wall of China, among others. The Exact and Nature Sciences group has chosen to create a game involving food pyramid and calorie counting.

Throughout the teachers' involvement in the creation of such projects, we observed the development of Computational Thinking, as advocated by Wing (2006) and ISTE and CSTA (2011). To achieve their goals, they had to break these projects into smaller parts. So, after having had contact with Scratch, in the first meeting, and having already seen their possibilities for the construction of games and storytelling, teachers Cristiane and Josiane, members of Languages and Codes group, opted for this last approach, as we've already mentioned. Thus, they formulated the problem involving a fly by famous places, so that it could be implemented in the Scratch software.

This action was consistent with the first characteristic of Computational Thinking, as defended by ISTE and CSTA (2011), that is "Formulating problems in a way that enables us to use a computer and other tools to help solve them". Then, to achieve that main goal, Cristiane and Josiane delimited at first some of these places, starting with the Statue of Liberty and the Great Wall of China.

Then they started debating and choosing the scenarios on the internet. They chose pictures of a child with his father on the plane, an image of the Statue of Liberty, and planned the dialogue of the history, defining that it would be in the English language. Therefore, at that moment, the teachers collected the illustrations that would be necessary to tell their story and defined what would be the content they would like to convey and in what language the dialogue between the characters would take place, meeting the second characteristic related to the development of CT, according to ISTE and CSTA (2011), that is, "Logically organizing and analyzing data".

They began planning the programming for the first planned tour, which would be a visit to this monument. Initially, this group would like an airplane to pass by the Statue of Liberty image (Figure 1), then change the background of the animation, Scratch stage, to the inside image of the airplane and then start the dialogue between father and daughter. In this first part, that is the airplane movement, the teachers questioned how it would be possible to perform this movement, and, with our help, set up the programming as shown in Figure 1.

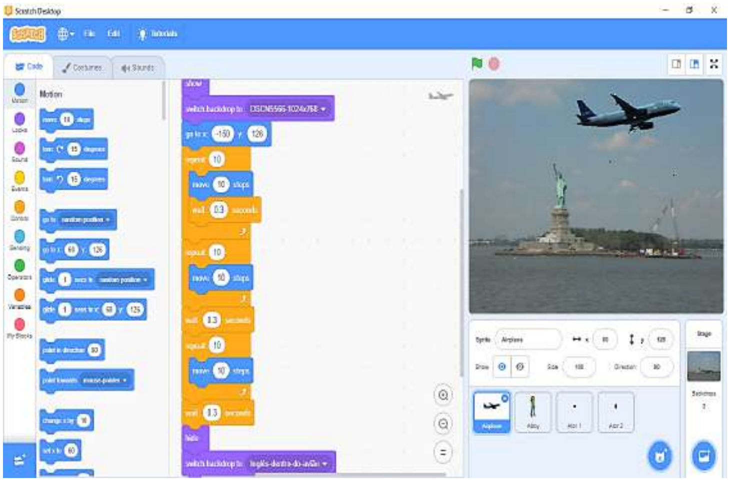

Figure 1. Static image of the airplane programming.
Source: extension project data.

Teachers Cristiane and Josiane would like the plane to pass near the Statue, but in a way that was not so fast and not so slow, that is, to simulate the movement of an aircraft about to land. To do this, they made different experiments on Scratch, using the commands "repeat" and "move-steps". So, they experimented with the number of steps and repetitions better to represent the situation they would like, until they arrived at the configuration shown in Figure 1.

Then other programming challenges arose. One of them was the change to the next scenario, which would already be on the plane, where the dialogue between father and daughter should take place. After several attempts to create the balloon with the dialogue, along with one of the members of the proposing team, came up the idea of creating a new actor, which would be a point, which should be hidden (located on top of the girl's hair), implying that she was the one who spoke. This idea arose to circumvent the fact that dialogue would only be possible if it were linked to an actor in Scratch, that is, it would not be enough to have only the stage. And then, the next scene was configured as shown in Figure 2.

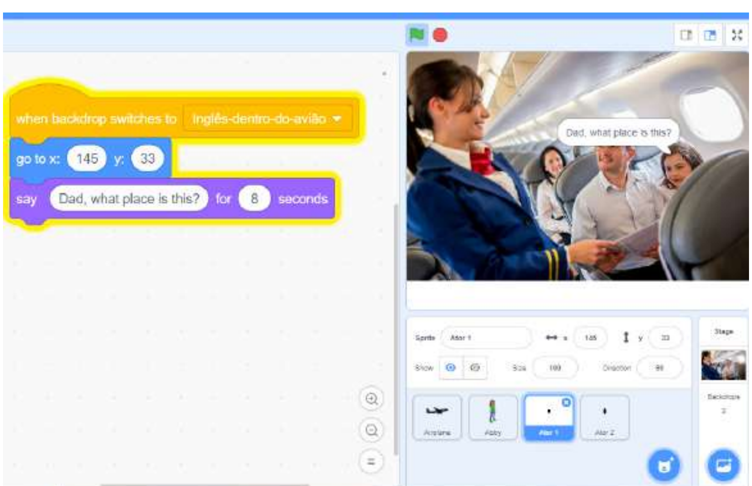

Figure 2. Static image of the dialogue programming.
Source: extension project data.

In those moments, teachers Cristiane and Josiane focused on the essential aspects of the context in which their story was going, first, seeking through simulations of the Scratch software motion and control blocks, to accurately simulate the movement of the aircraft. Then, through our mediation as formators, they refined the programming, creating the desired dialogue. These actions are consistent with the third characteristic and the fourth, on the development of CT, according to ISTE and CSTA (2011) which are: "Representing data through abstractions, such as models and simulations" and "Automating solutions through algorithmic thinking (a series of ordered steps) ".

Although it was a relatively simple programming, the teachers tried to make a combination of steps efficiently, that is to create an algorithm that do what was desired when it was executed, with a minimum number of steps, which is close of the fifth characteristic for the development of the CT, according to ISTE and CSTA (2011): "Identifying, analyzing, and implementing possible solutions with the goal of achieving the most efficient and effective combination of steps and resources".

The development of these projects is considered as one of the main moments of this continuing education action, because it has enabled teachers to create something that intertwines the content of the disciplines of all members of each group and culminates in the manifestation of different ideas loaded with imagination and creativity. It is defended by Wing (2006), by emphasizing the human essence of Computational Thinking. It also fostered ideas for them to apply such activities in the classroom, which was something that happened at the very end of this action.

That was when we suggested that teachers draw up lesson plans. So, they explored the development of Computational Thinking using Scratch. The idea arose because we realized that the teachers were making little progress in the development of their projects, arguing that they were unable to understand Scratch functionalities and did not feel sufficiently prepared to work with such activities in the classroom.

As the big problem would be facing the risk zone (Borba & Penteado, 2010), we suggested that they think of something more practical, more classroom oriented. From this dialogue emerged the following idea: the elaboration of a lesson plan, addressing one or more content that they deemed convenient through the development of Computational Thinking, using Scratch.

So, we suggested that, with our help, they finalize their projects and begin immediately to draw up their individual lesson plans. We were also available for providing ideas as well as for applying these plans if they so wish. We cannot say that there was a generalization and transfer of these programs to solve a variety of problems, as reported by the sixth characteristic for the development of Computational Thinking, as advocated by ISTE and CSTA (2011). However, there was a reflective process for the planning of these classes, to create activities with interdisciplinary approaches, through the development of the CT with the Scratch software, as we go into more detail below.

One of the groups, the Humanities, had already finalized their project, and their members started thinking about their lesson plans. In particular, the Geography teacher (teacher Andreza) not only started writing her plan, but also pre-scheduled a possible date to apply it, in partnership with us. The purpose was to deepen with students the concepts that involve the types of Migrations, intertwined with the approach of mathematical concepts, such as Positioning in the Cartesian Plane.

Specifically, the lesson plan was prepared to take place in two consecutive classes, and it ended as follows:

- Students were asked to split into small groups (doubles or threes), and to study the types of migrations: pendulum, seasonal, permanent, rural exodus, internal migration, permanent, temporary, spontaneous, and forced. Then, they were asked to program in Scratch a quiz with ten questions, one about each content, for another group to answer later. The group with the most points would be in first place. If students were unaware of Scratch, the teachers would briefly focus on the basic functionality of a quiz. Students should pay attention to some rules to create their games:

    1. Questions should be asked so that the answers are simple, or "yes" or "no", or the names of each migration, so that Scratch recognizes the answers, so that the game is fair to everyone.

    2. When answering the quiz created by another group, the programming should be hidden, and with each answer given (right or wrong), students should write down on a sheet what they observed in relation to the answer given and the score they obtained with it.

When everyone finished, the students would be asked as follows: What was the final score for each group and why? (The idea is for them to talk in detail about what they would have noted in the notebook, for example: "In the first question, we missed a point because we answered commuting, and in fact it was seasonal, in the second question…" [simulation of a possible student response]). From these answers, teacher Andreza could intervene in order to direct students to learn about migrations taking account the mistakes and successes of each group. And as we would be working in partnership, we could also direct them to investigate the mathematical concepts involved (addition operations involving negative numbers and positioning in the Cartesian Plane). The classroom environment we intended to create resembled a research scenario, as advocated by Skovsmose (2000), and it was permeated by the dialogue and encouragement of the investigative spirit.

- We would also question students' choices regarding programming, or what was the scoring system, how would the final score be calculated, how did their games increase, what moves were made by the game's characters, what concepts on Migrations were better deepened?

- Then each group would be asked to report on the reasoning and strategies they used while developing the quiz, orally and in writing: "why would you choose certain features for programming over others, why did you choose those questions?" This would be done to identify if Computational Thinking was developed during the quiz preparation process and how this development contributed to the understanding of the ten types of migration and the understanding of the mathematical concepts involved. Remembering that students should save their activities on the computer after completion. Thus, the data from these classes consist of researchers' field diaries, student-created games in Scratch, and the grade sheets they provided at the end of the classes.

Throughout the development of these classes at school, the students would call us to answer their questions, and when we realized that the first class was over, we began to worry if we could actually comply with the idea of the proposal, which would be to change their computers between the groups so that they could answer each other's questions. We suggested that they ask as many questions as they could (and not necessarily the ten questions as planned) so that they have time to answer quiz questions from other groups. And it happened.

However, we realized that when they went to play the game created by another group, because some games were incomplete, it was not possible to define the group that had won, so we decided not to do any kind of competition and invest in the debate after the activities. Students highlighted the aspects that most caught their attention. At this time, many said they liked the class because it provided a different, more dynamic way of studying, besides the fact that they enjoyed working with the software because its features allow the creation of different types of activities, and change scenarios and characters.

An important thing highlighted by teacher Andreza, about these classes, and which we are giving greater attention to in our analysis, was in relation to the process of building the quiz by each group. There was a different mobilization in the classroom than traditionally happens. That is, instead of students thinking about answering questions (which is the most common in the classroom), they had to look at strategies to create meaningful questions to put in the quiz in order to have a simple answer, yes or not, true or false, or even the names of each migration type. At the same time, although they had simple answers, the questions could not be so "easy" because other groups would have to answer them, and until then it was a competition.

In these moments, the students felt challenged, first, to elaborate questions seeking to meet these mentioned specificities, second, to create a programming that would return some feedback to the group that was going to play the game, according to the answer given in each question. This is in line with the first characteristic for the development of the CT: "Formulating problems in a way that enables us to use a computer and other tools to help solve them" (ISTE & CSTA, 2011).

For example, students could ask any question they wanted about the topic of Migration, as long as the answers were simpler, so that the software would recognize the answers. Thus, we realized that there was a lot of creativity in the elaboration of these questions by the students, not being tied to their formal definitions, as they studied in the didactic materials, before creating the games.

From the moment they studied the types of migrations in their materials, and started to create the questions at the same time that they structured the program, they were doing something similar to the second characteristic for the development of the CT: "Logically organizing and analyzing data" (ISTE & CSTA, 2011).

An interesting example can be seen in Figure 3 below. To talk about Pendular Migration, a group students integrated by Bruna and Ana decided to create the following problem: “Adalto leaves in the morning to work and returns in the afternoon, what kind of migration does Adalto do?” The excerpt with this problem is highlighted in the Portuguese language since it happened in Brazil.

Figure 3. Static image of the Quiz programming by one group of students.
Source: extension project data.

In this sense, the interdisciplinarity was developed since, in line with Tomaz and David (2008), interdisciplinarity happens through the active participation of students and teachers in school practices. And this active participation takes place in research scenarios (Skovsmose, 2000), as these are permeated by dialogue, and the quality of communication is closely related to the quality of learning.

Dialogue was part of every moment of the class, from the beginning, when students began to study the types of migration - with the mediation of teacher Andreza and through communication with colleagues throughout their readings on this topic -, until the moment they created their games with Scratch. In addition, the dialogue was also present when they debated ideas to answer the questions, both in writing and orally, and to argue in the debate we promoted at the end of the classes.

It is important to emphasize that the groups defended their ideas and positions, in an environment permeated by dialogue. It contributed to manifest the knowledge produced, both about programming and about mathematics and geography, led by questions made by us and by the teacher, seeking to foster in students an investigative posture, in synergy with Skovsmose (2000).

Regarding programming, from the students’ speeches and the programming evidenced in the games created, we noticed that the students made different experiments, asking for our help a few times. They were creative both in choosing different scenarios and different characters, but also in using

Scratch codes, skillfully, articulating blocks of motion, appearance, sound, events, control, sensors, operators, and variables. It converges to the ideas presented in the third, fourth and fifth characteristics of the development of the CT, as ISTE and CSTA (2011): “Representing data through abstractions, such as models and simulations”; “Automating solutions through algorithmic thinking (series of ordered steps)”; “Identifying, analyzing, and implementing possible solutions with the goal of achieving the most efficient and effective combination of steps and resources”.

Knowledge about types of migration was mobilized by students both in the study conducted at the beginning of classes, mediated by teacher Andreza, and at the times when they were programming their games, being modeled on the dialogue with colleagues in order to decide which questions could propose for other groups to respond to. An example of this process was shown in Figure 3 above.

Mathematical knowledge was also mobilized throughout this process, mainly about location in the Cartesian Plane, since the students needed to position and reposition the characters in the chosen scenarios. Something that caught our attention was that in one of the groups (studentes Lia, Daniela and Carina), they wanted to give the game a motivational character, because in addition to presenting funny and positive messages with each hit or mistake, they made the character slide up from the third question, as if it were an invitation not to give up on the game. The group had to do experiments using different coordinates until they were able to position the character in the location of the scenario that they thought was most appropriate, so that they could get the message they wanted. The programming performed by this group can be seen in Figure 4 below.

Figure 4. Static image of the Quiz programming by one of the group of students.
Source: extension project data.

Although students have not generalized and transformed their programs to solve another variety of problems, as stated in the sixth characteristic presented by ISTE and CSTA (2011), they created and refined their algorithms, easily articulating blocks of movement, control, operations, variables, etc., while mobilizing knowledge of Geography and Mathematics, as discussed.

Therefore, during classes, we noticed the development of Computational Thinking (Wing, 2006) by students, because they had to divide their work in stages to solve them, and they had to structure everything they were planning algorithmically, so that the commands could be executed by Scratch. So first they had to resume studies on the types of migrations, using their notebooks, or freely accessible materials on the internet. Then they had to think about the layout of the game, what the scenario would be, who the characters would be, if there would be dialogue between the characters, if with each wrong question they would lose a point or would get the same score they were, if after a right answer, would there be any character in the game that congratulated the player (same thing after a wrong answer), if there would be any speech of that character, how would it be synchronized with the appearance of such character, what position would that speech appear in the cartesian plane, and so on. In addition, they had to think about formulating the questions so that they fit the two rules outlined above, as they had to be simple questions, but they should not be so easy.

All their strategies were reported at the end of the classes in a debate. After these classes, the last meeting of the formative action took place, and teacher Andreza gave the following report to all present:

> I loved this learning strategy, I also found it important because in addition to working with technology through play, I saw joy, determination, persistence, focus, enthusiasm, achieved goals, demonstrated empathy, maintained positive relationships and made responsible decisions, that is, they developed in practice socio-emotional skills and worked the four pillars of education [learning to know; learn to do; learn to live with others; learn to be]. I loved to test the elaboration of new pedagogical practices and you were responsible for inspiring me. Thank you again (Teacher Andreza, December 5, 2018).

This argument of the teacher and the discussion of the data presented here, both of the moments of the formative action with the teachers and the classes taught by teacher Andreza and us, show how important this partnership between university and school is, seeking to transform together the knowledge of teachers, researchers and also students, as advocated by Tardif (2000).

Final considerations

This paper had the purpose of discussing the results of a continuing education action - which was part of the university extension project *Computational Thinking and Interdisciplinarity in the classroom* - highlighting the development of interdisciplinary activities by teachers using this software, and pointing out how this reflected in the classroom.

To this end, we presented how this action was conducted, and the place and the methodological procedures that were adopted by the researchers involved in this project. In addition, we dialogued with the literature within the theme in which this action was inserted, namely: Knowledge Production with Digital Technologies, Interdisciplinarity, Comfort and Risk Zones, Computational Thinking, Teacher Education. Next, we discussed a section of this action, involving the development of an interdisciplinary activity by the Language and Codes group, and, finally, we highlight a mobilization in the classroom, through the development of an interdisciplinary activity, articulating Geography and Mathematics, through the development of Computational Thinking with Scratch software.

Importantly, as simple as the activities may seem, given that we only mobilize basic knowledge of Scratch, without delving into more sophisticated programming, this is a major advance if we consider the difficulties encountered in using technologies in public schools of the State of Sao Paulo, as mentioned at the beginning of this paper. However, we emphasize that many teachers were unaware of this software and some were unfamiliar with the computer. Therefore, this action was a first opportunity for them to get used to an idea of what programming would be like. It was also a first chance for some of the 7th grade students. In addition, the development of this extension project has been mobilizing other studies and actions.

After this action, our partnership with this school was strengthened, in order to foster the development of other research, such as the one being conducted by Master's student Leandra dos Santos, whose purpose is to investigate possible contributions of Computational Thinking to the teaching of mathematical content, being linked to the pedagogical practice of mathematics teachers. This research is being guided by the second author of this paper, who is also coordinator of the extension project discussed here.

In addition, this partnership has helped us engage in new partnerships to foster the development of Computational Thinking through Scratch, among other artifacts, in other scenarios. Reflections promoted by this continuing education action also affected the beginning of the trajectory of the first author, as a teacher in the initial education of mathematics teachers, at the Federal University of São Carlos. These influences were made in order to promote a dialogue among the future teachers in order to face their risk zones, to articulate the use of digital technologies in interdisciplinary approaches, in the development of their classes in the Supervised Internship and in the Pedagogical Residence Program, in which the first author was mathematics area coordinator during the academic year 2019.

Given the above, we hope to foster new reflections on this theme, as well as on the need for more partnerships between university and school, based not only on theoretical contributions consistent with the teaching and learning processes, but especially on ethics, respect, commitment and collaboration among all involved, in order to mobilize the classroom through such initiatives that are the result of partnerships with these characteristics.

Notes

1. https://scratch.mit.edu/. Last accessed on 08.28.2019.

2. http://s4a.cat/. Last accessed on 08.28.2019.

3. More details about the functioning of schools belonging to the Integral Education Program (PEI), of the State of São Paulo, are discussed in Silva, Zampieri and Javaroni (2019).

4. https://scratch.mit.edu/users/Escola_Carolina/. Access on: 07.13.2020.

5. Cristiane is an English language teacher and Josiane is an Arts teacher.

6. The names of the students to be mentioned in this paper are fcitional to preserve their identities, as they are minors.

7. The Pedagogical Residence Program is one of the actions that are part of the National Teacher Education Policy (Brazil) and aims to induce the improvement of practical experiences in undergraduate courses, promoting the immersion of the student in the basic education school, from the second half of the course. More details are available in: https://capes.gov.br/educacao-basica/programa-residencia-pedagogica Accessed in: 01.23.2020.

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