

# Journal of Engineering Research

ISSN 2764-1317

vol. 6, n. 2, 2026

## ... ARTICLE 4

Acceptance date: 24/02/2026

# CREATIVE COMPUTING FROM THE STUDENT'S PERSPECTIVE: LEARNING EXPERIENCES AND DIGITAL INCLUSION IN BASIC EDUCATION

Cris Elena Padilha da Silva

Tiago Thompsen Primo



All content published in this journal is licensed under the Creative Commons Attribution 4.0 International License (CC BY 4.0).



**Abstract:** The National Common Core Curriculum (BNCC) establishes Computing as an essential component of Basic Education, requiring pedagogical practices that promote student leadership and digital inclusion. This article analyzes the perceptions and learning of students participating in Robotics and Creative Computing Clubs, developed in the context of a training proposal based on teacher training methodology. The research was conducted in the public school system and is based on the principles of Constructionism, Computational Thinking, and Creative Learning. Data were collected through questionnaires, observations, and student productions, and were analyzed qualitatively. The results show student engagement, the development of computing-related skills as outlined in the BNCC, and the strengthening of creativity, collaboration, and leadership. An increase in digital literacy was also observed. In this context, Creative Computing practices contributed significantly to digital inclusion and the construction of more meaningful learning experiences in Basic Education.

**Keywords:** Creative Computing, Teacher Training, Digital Inclusion, Basic Education, Educational Media, Computational Thinking.

## INTRODUCTION

The incorporation of Computing in Basic Education, as established by the National Common Core Curriculum (BNCC), represents a significant advance in the recognition of computational thinking, digital culture, and the digital world as essential skills for the comprehensive training of students. This movement

requires not only curricular reorganization, but also the implementation of pedagogical practices that promote student leadership, creativity, and digital inclusion, especially in school contexts marked by inequalities in access to technology.

This scenario becomes even more relevant in light of the recent legal framework for digital education in Brazil, established by Law No. 14,533/2023, which institutes the National Digital Education Policy (PNED) and guides actions aimed at digital literacy, inclusion, and the development of digital skills in Basic Education. At the same time, Computing has been integrated into the National Common Core Curriculum through specific regulations from the National Education Council, defining the skills and competencies to be developed by students.

Considering that students are central subjects in the educational process, it is essential to understand how they experience Creative Computing proposals and what learning they construct from these experiences, especially in contexts that promote digital inclusion.

This study focuses on analyzing the views of students participating in Robotics and Creative Computing Clubs (CRCC)<sup>1</sup>, investigating their perceptions, levels of engagement, and evidence of learning related to Creative Computing.

The objective of this article is to understand how students experience Creative Computing practices and what contributions these experiences offer to the development of computational thinking, creativity, collaboration, and digital literacy.

---

1. Robotics and Creative Computing Club (CRCC) takes place outside of school hours, developing computing and creative learning skills.

To this end, data collected through questionnaires, observations, and student productions are analyzed, seeking to highlight the pedagogical and formative impacts of these practices. The data were collected in accordance with the ethical principles that guide research with human beings, ensuring respect for the dignity, privacy, and autonomy of the participants<sup>2</sup>.

## THEORETICAL REFERENCE

This chapter presents the theoretical foundations that underpin the study, addressing the inclusion of Computing in Basic Education, computational thinking, the principles of Constructionism and Creative Learning, as well as student protagonism and digital inclusion as central axes of analysis.

### Computing in Basic Education and Computational Thinking.

The inclusion of computing in basic education consolidates an international movement that recognizes computational thinking as a fundamental skill for citizenship training in the 21st century.

According to Jeannette Wing (2006), computational thinking involves cognitive processes used in problem formulation and solution expression in a way that can be executed by humans or machines, going beyond the limits of programming and extending to different areas of knowledge.

---

2. Student participation was subject to prior authorization from legal guardians, through a Free and Informed Consent Form, ensuring the voluntary nature of the collaboration. To preserve the identity of participants, anonymization procedures were adopted, and no information that could enable their individual identification was disclosed.

In the Brazilian context, José Armando Valente emphasizes that the integration of computing into basic education must be associated with active methodologies, in which students take on a central role in the construction of knowledge, overcoming instruction-based approaches. For the author, the use of digital technologies needs to favor investigative, authorial, and reflective processes, aligning with the principles of computational thinking and the critical training of students (VALENTE, 2020).

The National Common Core Curriculum (BNCC) incorporates computing linked to the dimensions of computational thinking, digital culture, and the digital world, guiding the development of skills such as abstraction, decomposition, pattern recognition, and algorithm design. This integration requires pedagogical practices that go beyond the instrumental use of technologies, promoting meaningful, contextualized, and student-centered learning experiences.

### Constructionism and Creative Computing

Creative Computing is based on the principles of Constructionism, proposed by Seymour Papert (1993), according to which learning occurs most effectively when subjects construct meaningful artifacts and share their productions. For Papert, knowledge is actively constructed by the learner, in interaction with concrete or digital objects, encouraging reflection on the learning process itself.

These principles underpin Creative Learning, formulated by Mitch Resnick, which is organized around four pillars known as the “4Ps”: projects, peers, passion, and playful thinking. According to Resnick (2017),

learning environments based on these principles stimulate creativity, collaboration, and autonomy, which are essential elements for developing skills in the contemporary world.

By integrating programming, robotics, and digital media into activities, Creative Computing expands students' possibilities for expression and strengthens their active participation in the educational process, promoting experiences in which creating, experimenting, making mistakes, and re-doing are fundamental parts of learning.

According to Paulo Blikstein, constructionist approaches combined with maker culture enhance creative learning by promoting spaces for experimentation, in which students develop critical thinking, creativity, and authorship, expanding the educational meaning of the use of digital technologies (BLIKSTEIN, 2013).

## Student Leadership and Digital Inclusion

Student protagonism is a central axis of contemporary educational approaches, especially when linked to the pedagogical use of digital technologies. In Constructivism, proposed by Seymour Papert (1993), students are understood as active subjects in the learning process, constructing knowledge through the creation of meaningful artifacts and reflection on their own productions.

In proposals based on Creative Computing, students cease to occupy a passive position and begin to act as authors of their projects, developing autonomy, critical thinking, and the ability to collaborate. This perspective is reinforced by Mitch Resnick (2017), who states that learning by creating

promotes engagement and enables students to become producers, not just consumers, of technology.

## METHODOLOGY

This study is characterized as qualitative research with descriptive quantitative elements, constituting a section of a broader investigation developed using the MERCI methodology (SILVA, 2026). While the original research focused on the continuing education of teachers working in CRCC, this article focuses on analyzing the perceptions and learning of students participating in these activities.

### Context of application

The research was conducted in public schools, in the context of CRCC, involving 31 elementary school students, from third to ninth grade. The students regularly participated in the proposed activities, which integrate programming, robotics, and the use of educational media, throughout the project implementation period.

### Data collection procedures

Data were collected through questionnaires administered to students, observation records of activities, and analysis of the work produced during the meetings over the course of one year of participation in the CRCC. The instruments sought to identify perceptions about engagement, difficulties, learning outcomes, and experiences during Creative Computing practices.

### Analysis procedures

Qualitative data were analyzed using content analysis, according to the principles

of Bardin (2016), with thematic categorization of responses and identification of discursive recurrences. Quantitative data were treated using simple descriptive statistics, allowing us to visualize trends related to student engagement and perceptions.

The categories of analysis were defined based on the study's objective, covering: (i) student engagement and experiences in Creative Computing practices; (ii) development of computational thinking; (iii) creativity and authorship; (iv) collaboration and interaction among peers; and (v) digital literacy and inclusion. These categories guided the organization of the data and the discussion of the results, articulating the different collection instruments.

## RESULTS AND DISCUSSIONS

The results are presented based on the categories defined in the methodology, seeking to understand how students experience Creative Computing practices and what contributions these experiences offer to the development of computational thinking, creativity, collaboration, and digital literacy.

### Engagement and Experiences in Practices

Thirty-one students from the 3rd to 9th grades of elementary school participated in the study, with the majority reporting high interest in the activities of the Robotics and Creative Computing Club. On a scale of 1 to 5, 98% of students predominantly assigned values between 4 and 5 to their interest in the activities, indicating engagement in the activities.

Regarding the initial motivation for participation, responses related to fun, the

desire to learn to program, and the creation of games stood out, showing that the playful and creative aspects were relevant factors for participation.

The level of satisfaction with the Club also showed positive results, with a predominance of ratings between 3 and 5, with a percentage of 96%. In addition, most students said they would like CRCCs to be integrated into regular school subjects, reinforcing the perception of the pedagogical value of the activities.

Comments included statements such as: "I would like to participate again this year," "I would like to continue because I learned a lot," "I love the club, I learned many new things there," and "It would be good to have more classes."

These reports highlight a formative experience marked by emotional involvement and a desire for continuity, aspects associated with student leadership and meaningful learning.

### Development of computational thinking

The activities carried out mainly involved the use of Scratch, with a focus on creating games and interactive projects. Students reported learning related to programming, logic, and problem solving, indicating advances in the development of computational thinking.

When asked about the contribution of the activities to their overall school performance, most rated them between 4 and 5 on a scale of 1 to 5, suggesting a perceived positive impact on learning.

The production of games and digital projects promoted the understanding of

sequences, commands, and strategies, bringing students closer to computational practices in a contextualized and meaningful way.

## Creativity and Protagonism

Creativity appears as an important element in the students' responses, especially in questions related to the projects developed. Game creation was pointed out as the most appreciated activity, being described as a space for expressing imagination and protagonism.

Comments such as "creating games using creativity" and "making my game" highlight the sense of belonging to the productions created, reinforcing the role of Creative Computing in valuing protagonism.

These results are in line with the Creative Learning approach, in which projects where students are protagonists favor engagement and the development of creative skills. In Figure 1, we see the creation of a game on the Scratch platform by CRCC students.

## Collaboration and Interaction among Peers

With regard to interpersonal relationships, 93% of students positively evaluated the statement that the Club enabled them to make new friends, giving scores between 4 and 5 on a scale of 1 to 5. This data points to the strengthening of social bonds and collaborative learning.

Among the most appreciated aspects of the activities were the weekly meetings and participation in events such as Robopel, highlighting the importance of collective spaces for learning and socialization. The

robotic cat project, shown in Figure 2, was carried out at CRCC and presented at MOTIC<sup>3</sup>.

## Literacy and Digital Inclusion

All students stated that CRCC activities contributed to learning more about technology, recognizing positive impacts on their education.

These results indicate advances in digital literacy, understood not only as the use of tools, but also as increased confidence, autonomy, and critical understanding of technologies.

In this sense, Creative Computing practices proved to be relevant in promoting inclusive experiences, especially in the context of public schools, expanding students' access to meaningful digital learning.

## FINAL CONSIDERATIONS

This article aimed to understand how students experience Creative Computing practices and what contributions these experiences offer to the development of computational thinking, creativity, collaboration, and digital literacy in the context of Robotics and Creative Computing Clubs in public schools.

The results showed student engagement, with expressions of interest, satisfaction, and desire to continue the activities. The students' work and reports indicate advances in computational thinking, especially in problem solving, logic, and the creation of digital projects, as well as the strengthening of creativity and leadership.

---

3. MOTIC - Technology and Innovation Exhibition with a focus on scientific research and sustainability.

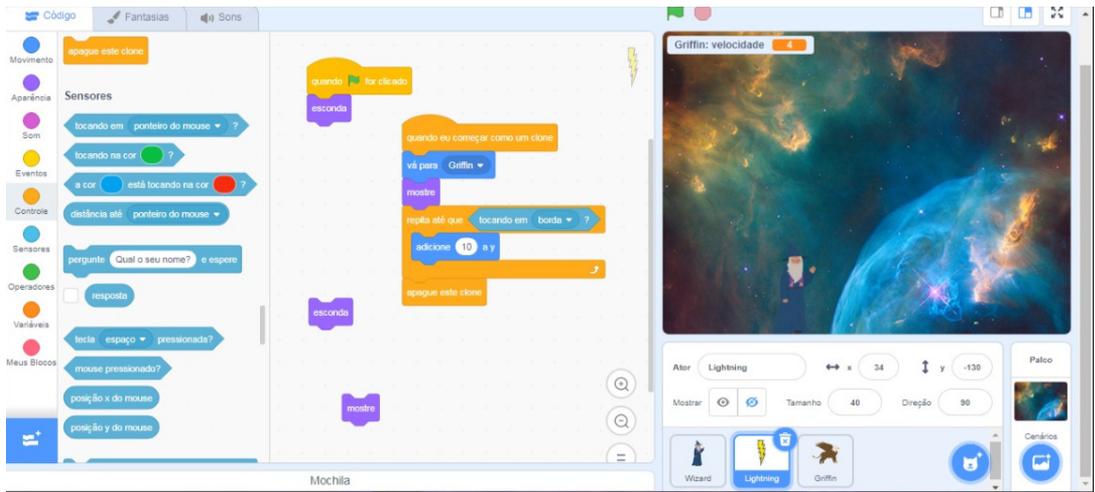


Figure 1 - Game created by CRCC students

Source: author's own.

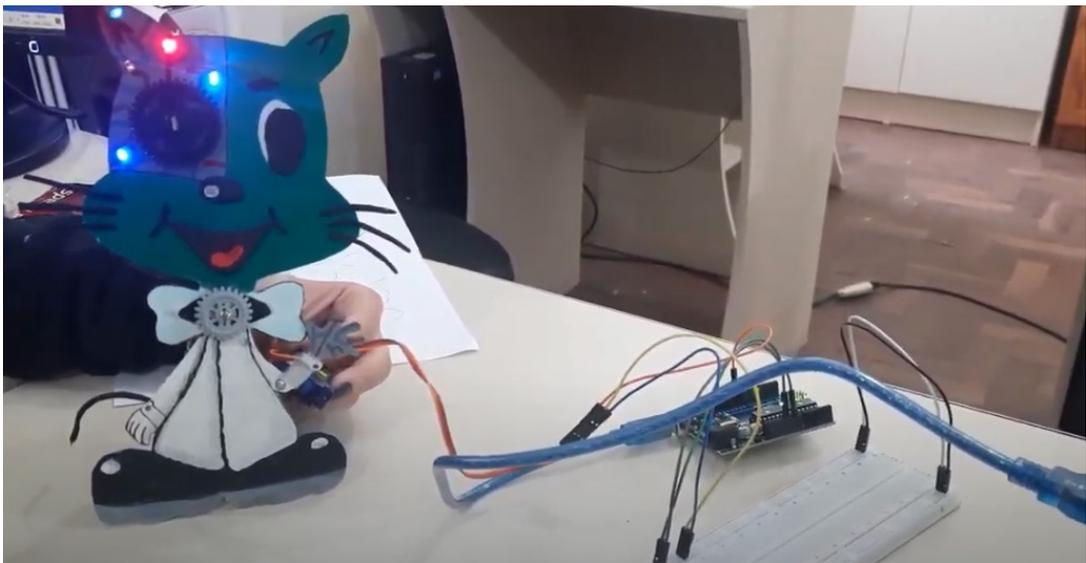


Figure 2 - Robotic Cat Project carried out at the C RCC.

Source: author's own

There was also an increase in peer interactions, favoring collaborative practices and shared learning, as well as significant contributions to digital literacy, reflected in students' increased confidence in the use of technologies and positive perceptions of their education.

These findings reinforce the potential of Creative Computing as a pedagogical approach capable of promoting more meaningful learning experiences, aligned with the BNCC guidelines and the principles of Creative Learning, while contributing to digital inclusion processes in the context of Basic Education.

The limitations of the study include the small number of participants and the localized nature of the research, which does not allow for broad generalizations. Nevertheless, the results offer relevant evidence about the formative impacts of these practices, especially from the students' perspective, an aspect that has been little explored in the literature.

As future perspectives, we suggest expanding the research to other school contexts, as well as studies that monitor the development of computational skills over time. We also recommend further analysis of the relationship between teacher training and student experiences, strengthening pedagogical proposals that systematically integrate Creative Computing into the school curriculum.

## REFERENCES

BLIKSTEIN, Paulo. Digital fabrication and “making” in education: the democratization of invention. In: WALTER-HERRMANN, Julia; BÜCHING, Corinne (org.). *FabLabs: of machines, makers and inventors*. Bielefeld: Transcript Publishers, 2013.

BRASIL. *Base Nacional Comum Curricular*. Brasília: Ministério da Educação, 2018.

BRASIL. Lei nº 14.533, de 11 de janeiro de 2023. Institui a Política Nacional de Educação Digital. Diário Oficial da União: seção 1, Brasília, DF, 12 jan. 2023.

PAPERT, Seymour. *Mindstorms: children, computers, and powerful ideas*. New York: Basic Books, 1980.

RAABE, André. A computação na educação básica brasileira: desafios e oportunidades. In: RAABE, André; ZORZO, A. F.; BLIKSTEIN, Paulo (org.). *Computação na Educação Básica: fundamentos e práticas*. Porto Alegre: Penso, 2020.

RAABE, André; ZORZO, A. F.; BLIKSTEIN, Paulo (org.). *Computação na Educação Básica: fundamentos e práticas*. Porto Alegre: Penso, 2020.

RESNICK, Mitch. *Lifelong Kindergarten: cultivating creativity through projects, passion, peers, and play*. Cambridge, MA: MIT Press, 2017.

SILVA, Cris Elena P. Metodologia MERCI: uma proposta para formação em Computação voltada para professores da Educação Básica. Tese (Doutorado em Computação) – Universidade Federal de Pelotas, Pelotas, em andamento.

VALENTE, José Armando. Integração do pensamento computacional no currículo da educação básica. In: RAABE, André; ZORZO, A. F.; BLIKSTEIN, Paulo (org.). *Computação na Educação Básica: fundamentos e práticas*. Porto Alegre: Penso, 2020.

WING, Jeannette M. Computational thinking. *Communications of the ACM*, New York, v. 49, n. 3, p. 33–35, 2006.