

Unplugged Computing for Teaching Computational Thinking to Students with Disabilities in Brazilian Context: A Systematic Mapping Study

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Abstract. *This paper presents a Systematic Mapping Study on the use of Unplugged Computing as a methodology for teaching Computational Thinking to students with disabilities in Brazilian context. The study followed the guidelines proposed by Kitchenham and Charters and analyzed papers published in SBIE and EduComp from 2020 to 2025, retrieved through a manual search in the SBC OpenLib platform. From an initial set of 1,145 publications, 7 studies were selected for final analysis. The results indicate that the topic is still emerging, with few studies explicitly addressing accessibility adaptations, evaluation methods, and challenges faced by students with disabilities.*

Keywords. *Unplugged Computing, Computational Thinking, Special Education, Systematic Mapping Study.*

1. Introduction

The teaching of Computing and Computational Thinking (CT) has gained increasing attention as an essential competence for the education of citizens in contemporary society. In Brazil, the National Common Curricular Base (BNCC - Base Nacional Curricular Comum) establishes the competencies and skills that all students in basic education should develop, including aspects related to technology and logical reasoning [Brasil. Ministério da Educação 2018]. The Complement to the BNCC for Computing, consolidated in the Annex to Legal Opinion CNE/CEB No. 2/2022, presents CT as a structuring axis and details how computing competencies should be addressed at each school level. This document suggests, for example, the use of Unplugged Computing (UC) activities in the classroom [Brasil. Ministério da Educação 2022]. More recently, the National Policy for Digital Education (PNDE - Política Nacional de Educação Digital), established by Law No. 14,533/2023, was enacted, defining guidelines to ensure digital literacy, CT, and digital inclusion as rights of all students, including students with disabilities [Brasil 2023].

Unplugged Computing (UC) is a teaching approach that uses resources and activities without the direct use of computers. It represents an inclusive and low-cost alternative for introducing computing concepts, especially in contexts with limited technological infrastructure. Brackmann (2017) reinforces the relevance of this approach by highlighting that UC consists of a set of kinesthetic activities compatible with constructionist methodology, which values active learning and the construction of knowledge by students. From this perspective, UC can support the introduction of CT in an accessible, creative, and meaningful way, while also expanding its potential application in inclusive contexts.

According to IBGE (2022), approximately 63.07% of people with disabilities in Brazil have no formal education or have not completed elementary education. In addition, data from Instituto Rodrigo Mendes (2021) indicate that, in special education, dropout, grade repetition, and migration rates to Youth and Adult Education (EJA) are higher than in regular education. These data show that special education still faces challenges regarding both access to school and the permanence of special education students. In the context of computing education, this discussion is relevant considering the inclusion of CT in the curricular guidelines for basic education, since these competencies should be developed by all students, including those with disabilities.

Therefore, the general objective of this paper is to analyze and characterize initiatives that use UC in computing education and in the development of CT for special education students. More specifically, this paper presents a Systematic Mapping Study (SMS) seeks to identify which approaches have been used, which audiences have been addressed, which adaptations have been made, as well as the challenges and results reported in the literature.

The study followed the guidelines proposed by Kitchenham and Charters and analyzed papers published in SBIE and EduComp from 2020 to 2025, retrieved through a manual search in the SBC OpenLib (SOL) platform. From an initial set of 1,145 publications, 7 studies were selected for final analysis. The results indicate that the topic is still emerging, with few studies explicitly addressing accessibility adaptations, evaluation methods, and challenges faced by students with disabilities.

2. Related Work

Filho et al. (2024) conducted a Systematic Literature Review (SLR) with the objective of understanding the research scenario related to the use of UC in basic education. This SLR was conducted using Google Scholar, IEEE Xplore, the Association for Computing Machinery (ACM) Digital Library, and the Brazilian Symposium on Informatics in Education (Simpósio Brasileiro de Informática na Educação - SBIE). From a total of 256 papers returned in the initial search, 12 studies aligned with the scope of the research were selected. The results indicate that UC has been used as a promising strategy to introduce CT in basic education students. The identified activities include logic games, algorithm-based challenges, and dynamics inspired by classical materials, such as the book *Computer Science Unplugged* [Bell et al. 1998]. These activities create interactive learning environments favoring the development of CT skills. The SLR also identifies relevant challenges, such as the need for greater teacher training, the lack of adequate teaching materials, and the absence of broader public policies aimed at the integration of computing into the school curriculum.

Grebogy et al. (2024) also conducted a Systematic Mapping Study (SMS) with the objective of analyzing how UC has been used to promote CT in the early years of elementary school. The study covered several databases, including SBC OpenLib (SOL), Brazilian Congress on Informatics in Education (Congresso Brasileiro de Informática na Educação - CBIE), the Brazilian Digital Library of Theses and Dissertations (Biblioteca Digital Brasileira de Teses e Dissertações - BDTD), CAPES Periodicals Portal, Revista Novas Tecnologias na Educação (RENOTE), Brazilian Journal of Informatics in Education (Revista Brasileira de Informática na Educação - RBIE), Brazilian Journal of Sci-

ence and Technology Education (Revista Brasileira de Ensino de Ciência e Tecnologia - RBECT), Revista Educação e Tecnologia (RevEduTec), Educ@, Educação, Formação & Tecnologias (EFT), Revista Informática na Educação: Teoria & Prática, SciELO, ACM Digital Library, Springer Link, Scopus, ScienceDirect, and IEEE Xplore. The initial search returned 2355 studies, of which 17 were selected for the final portfolio. The results evidence a recent growth of research in the area, and it is observed that the identified activities are, to a large extent, adaptations or replications of already consolidated approaches, in addition to the absence of consensus regarding the evaluation methods of the initiatives. The authors also highlight that the approach can help reduce the impact of structural barriers, contributing to the democratization of CT education.

Araújo and Andrade (2020) conducted an SMS with the objective of identifying how the teaching of programming to people with disabilities has been investigated. The study was conducted using IEEE Xplore, the ACM Digital Library, and Springer Link. The initial search resulted in 1844 papers, of which 29 were selected for final analysis. The results indicate that most research is concentrated on technological adaptations to enable the teaching of programming, especially through what is called adapted programming, present in 16 of the 29 analyzed studies. This approach involves adaptations to the traditional programming environment, such as the use of screen readers for people with visual impairments or the translation of content into sign language for deaf students. The study points out a predominance of research directed toward students with visual impairments and the absence of a standardized methodology for teaching programming to different types of disabilities. Only 2 of the 29 studies explore activities with an unplugged approach, indicating that this strategy is still little investigated.

Robe et al. (2020) conducted an SLR with the objective of identifying pedagogical resources toward the teaching of programming specifically to students with visual impairments. The SLR was conducted in national and international databases, including the CAPES Theses and Dissertations Portal, BDTD, the Special Commission on Informatics in Education (Comissão Especial de Informática na Educação - CEIE), RBIE, RENOTE, the Workshop on Teaching CT, Algorithms, and Programming (Workshop de Ensino em Pensamento Computacional, Algoritmos e Programação - WAlgProg), ACM Digital Library, IEEE Xplore, Scopus, and Springer Link. The initial search resulted in 40 studies, of which 13 were selected for final analysis after the application of the inclusion and exclusion criteria. The results indicate that the pedagogical resources are mainly concentrated on solutions that explore different forms of perception, especially auditory and tactile perception, including accessible programming environments, physical languages, haptic resources, and adapted block-based tools. It is also observed that a large portion of the solutions combines software and hardware to enable learning, as well as a predominance of studies directed toward basic education. However, the study evidences relevant challenges, such as the difficulty of navigating traditional programming environments through screen readers, the structural complexity of code for students, and the limited exploration of theoretical foundations of learning.

The studies conducted by Filho et al. (2024) and Grebogy et al. (2024), although they analyze initiatives for teaching computing and CT through UC in basic education, do not identify studies that explicitly address aspects related to accessibility, inclusion, or teaching directed toward students with disabilities. On the other hand, the studies by

Araújo and Andrade (2020), and Robe et al. (2020) concentrate on the teaching of programming to people with disabilities, with an emphasis on technological adaptations and accessible pedagogical resources without contemplating, in a broader way, the development of CT, which should precede the learning of programming.

Taken together, the results of the 4 mentioned studies above evidence a gap in the literature at the intersection between accessibility, CT, and UC, indicating that these areas have been investigated isolated. In this sense, the present work differentiates itself by specifically investigating the use of UC activities in the teaching of CT to special education students, seeking to understand how this approach can contribute to the promotion of more inclusive educational practices specifically in the Brazilian context.

3. Systematic Mapping Study

This Systematic Mapping Study (SMS) aims to analyze initiatives on CT and UC in Brazilian special education, identifying trends, strategies, gaps, and challenges in adapting these practices for students with disabilities.

The GQM (*Goal-Question-Metric*) model proposed by Basili and Rombach (1988) allows the investigation to be structured based on the clear definition of an objective, the formulation of related questions, and the identification of metrics to answer them. The Table 1 presents the objective of this SMS organized according to this model:

Table 1. Goal of the SMS according to the GQM model

Analyze	Scientific publications
For the purpose of	Identifying and characterizing
With respect to	Studies that address the teaching of CT through UC initiatives applied to special education students in the Brazilian context
From the viewpoint of	Researchers in the fields of Informatics in Education and Computing Education
In the context of	Primary studies retrieved through manual searches in the proceedings of Brazilian conferences specialized in Informatics in Education and Computing Education (SBIE and EduComp).

According to Kitchenham and Charters (2007), the formulation of the main research question is an essential element in conducting an SMS, as it guides the entire process of study selection, analysis, and synthesis. Thus, based on the goal presented above, the main research question of this study seeks to understand: “Which UC initiatives have been used to support the teaching of CT in special education contexts in Brazil?”

Although the protocol proposed by Kitchenham and Charters (2007) recommends defining search strings as part of the planning of the SMS, this step was not necessary in this work. The studies were selected through a manual search on the SOL (SBC OpenLib) platform, which does not have an automated string-based search mechanism.

SOL gathers relevant publications in the field of computing in Brazil. The search focused on papers published in SBIE (Brazilian Symposium on Informatics in Education) and EduComp (Brazilian Symposium on Computing Education), which are among the main Brazilian conferences in Informatics in Education and Computing Education. The search was restricted to papers written in Portuguese or English.

Initially, all papers published in the proceedings of SBIE and EduComp from 2020 to 2025 were collected. Thus, the first stage of the SMS consisted of gathering all publications available in each edition of these two events during the defined period, forming the initial set of studies to be submitted to the subsequent selection stages. This strategy was adopted to ensure search coverage within the operational limitations of the database and to avoid excluding potentially relevant studies due to search tool restrictions.

EduComp had its first edition in 2021. Therefore, the proceedings from 2021, 2022, 2023, 2024, and 2025 were selected, resulting in 215 papers. For SBIE, the proceedings from 2020, 2021, 2022, 2023, 2024, and 2025 were selected, totaling 930 papers. Overall, the initial set comprised 1,145 papers from the selected sources.

Following the methodological guidelines proposed by Kitchenham and Charters (2007), a set of inclusion and exclusion criteria was defined, as well as the process for selecting the studies to be considered in this SMS.

Table 2. Inclusion and exclusion criteria for the studies

Criteria	Description
Inclusion criteria	
IC1	Publications describing studies on the use of initiatives, proposals, or reports of UC activities aimed at special education audiences and supporting the teaching of CT.
IC2	Publications presenting initiatives, proposals, or reports of UC activities aimed at special education audiences and supporting the teaching of CT.
Exclusion criteria	
EC1	Publications that do not meet the inclusion criteria.
EC2	Publications not written in the defined languages, namely English and Portuguese.
EC3	Publications that do not report a proposal or application of the initiative in Brazilian territory.

To support the conduction of the SMS, the Porifera tool was used, which was developed to provide collaborative support for secondary studies [de Campos et al. 2022]. After the manual search on the SOL platform, all identified papers were imported into the Porifera tool. Porifera was then used to organize the screening process, record the researchers' decisions, and store the inclusion and exclusion justifications. In addition, Porifera enabled the structured monitoring of the selection stages and the automatic calculation of Cohen's Kappa agreement index [Cohen 1960], used to verify the level of agreement between the reviewers. The selection process was conducted in two filtering stages, described below:

1st Filter: In this stage, the two researchers independently read the title and abstract of each paper imported into Porifera, evaluating its adherence to the inclusion criteria established in the study protocol. For each publication, the researchers recorded their decision in the tool, as well as the associated justifications. At the end of this stage, Porifera consolidated the evaluations and identified cases of disagreement, that is, studies for which one researcher considered inclusion in the next stage and the other considered exclusion. In these cases, a consensus stage was carried out through discussion to define the final decision for each paper.

2nd Filter: In this stage, the two researchers again independently evaluated

whether the studies met the inclusion criteria, but based on the full reading of the papers approved in the first filter. The individual decisions were recorded in Porifera. The tool indicated the papers with disagreement regarding inclusion, and these papers were submitted to a new discussion between the researchers to establish a consensual decision. At the end of this stage, the final portfolio of studies included in the SMS was defined.

After completing the study selection stage and organizing the paper portfolio, the data extraction process was started. To answer the previously defined main research question, 13 subquestions were developed and are presented in the following section. Each selected study was carefully analyzed, and the answers obtained for each subquestion enabling the construction of a consolidated view of the results.

4. Overview of quantitative results

In the 1st filter, 1,145 publications were cataloged. Of these, 73 studies were accepted for the next stage, while 1,072 were rejected. In this stage, the agreement between reviewers presented a Cohen's Kappa index of 0.8232 and an agreement percentage of 85.15%. According to the classification proposed by Altman (1990), this result indicates very good agreement between the reviewers.

Next, the 73 pre-selected studies were submitted to the 2nd filter, corresponding to the full-text reading. At the end of this stage, 7 studies were accepted to compose the final portfolio, while 66 were rejected. In this stage, the Cohen's Kappa index was equal to 1, with an agreement percentage of 98.63%, which also represents, according to Altman (1990), very good agreement between the reviewers.

Table 3. Summary of the studies included in the final portfolio

Study	Reference	Brief description
Study 01	[Kologeski and Bona 2024]	An interdisciplinary computing course in which students developed plugged and unplugged educational materials.
Study 02	[Portal et al. 2024]	An unplugged paper-folding activity designed to support mathematics learning and CT through visual algorithms.
Study 03	[Germano et al. 2024]	An activity that combines paper-folding, through the construction of paper boats, with the study of linear functions.
Study 04	[Júnior et al. 2023]	A tactile board-based unplugged learning object designed to support a student with visual impairment in the development of CT skills.
Study 05	[Lima et al. 2023]	A study on the development of CT through narrative creation and digital games.
Study 06	[Goppinger et al. 2025]	A mathematics and Computational Thinking activity based on an interactive fox origami.
Study 07	[Bonfanti et al. 2020]	A workshop focused on adapting playful UC games, such as checkers, Tower of Hanoi, and Uno, to support the teaching CT to students with visual impairment.

The Table 3 presents the final portfolio of the 7 studies accepted after the application of the 2nd filter. In addition to basic bibliographic information, the Technical Report

(link) provides a brief synthesized description of the main contribution of each study in the context of this SMS.

Once the final portfolio was defined, the general characteristics of the selected studies were analyzed. Considering the time frame from 2020 to 2025 adopted in this SMS, a higher concentration of relevant studies was observed in 2024, with 3 publications, followed by 2023, with 2 studies (Figure 1). The years 2020 and 2025 presented 1 publication each. This result suggests that the topic has gained greater visibility in recent years, although the identified production remains numerically limited.

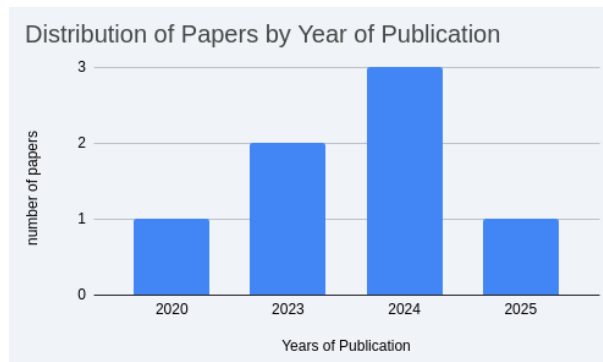


Figure 1. Distribution of Papers by Year of Publication.

To provide an overview of the results of this SMS, Table 4 presents the research subquestions and the answers obtained from the 7 selected studies. It should be noted that, in some subquestions, the response categories are not mutually exclusive; therefore, the same study may have been classified into more than one category.

Table 4. Summary of the research subquestions, responses, and SMS results

Research Subquestions	Response Categories	Results	
		Qty.	%
SQ01. Can the UC initiative be used by any audience, or is it specific to people with some type of disability?	Universal or open to any audience	4	57.14%
	Specific to a target audience with disabilities	3	42.86%
SQ02. Which materials were used in the UC initiative?	Physical manipulative materials	7	100%
	Digital support resources	2	28.57%
	Resources adapted for specific needs	1	14.29%
SQ03. Is the initiative an individual, pair, or group activity?	Individual activity	4	57.14%
	Not specified by the study	3	42.86%
SQ04. Which CT pillars does the initiative stimulate?	Algorithms	6	85.71%
	Decomposition	5	71.43%
	Pattern recognition	5	71.43%
	Abstraction	5	71.43%
	Not specified by the study	1	14.29%
SQ05. For which types of specific needs was UC adapted?	Autism Spectrum Disorder (ASD)	4	57.14%
	Visual impairment	3	42.86%
	Hearing impairment	1	14.29%

Research Subquestions	Response Categories	Results	
		Qty.	%
SQ06. What was the level of dependency of the students with disabilities who participated in the study?	Not specified by the study	7	100%
SQ07. In which subject was the UC initiative applied?	Extracurricular activity or extension project	2	28.57%
	Computing/Informatics	1	14.29%
	Mathematics	1	14.29%
	Not specified by the study	3	42.86%
SQ08. Which educational levels were addressed?	Elementary School I	3	42.86%
	Elementary School II	3	42.86%
	High School	3	42.86%
	Higher Education	2	28.57%
SQ09. Who was responsible for applying the UC initiative?	Study researcher(s)	4	57.14%
	Regular subject teacher	2	28.57%
	Special education teacher	1	14.29%
	Not specified by the study	2	28.57%
SQ10. Which evaluation method was used to verify the acquisition of CT skills?	Direct observation	4	57.14%
	Questionnaires or written tests	1	14.29%
	Not specified by the study	2	28.57%
SQ11. In which environment was the UC initiative applied?	Regular inclusive classroom	4	57.14%
	Other	1	14.29%
	Not specified by the study	2	28.57%
SQ12. What motivated the use of the unplugged activity in the research?	Introductory exploration about computing	4	57.14%
	Exploration of mathematics concepts together with CT	2	28.57%
	Suitability for inclusive contexts	1	14.29%
	Suitability for a pedagogical approach	1	14.29%
	Other motivations	1	14.29%
	Not specified by the study	1	14.29%
SQ13. Which challenges were found in the application of UC in special education?	Adaptation of materials, limited world knowledge of the blind student, and lack of tactile sensitivity of the student	1	14.29%
	Not specified by the study	6	85.71%

5. Results by Research Subquestion and Discussion

This section presents and discusses the results obtained from each research subquestion defined for this SMS.

Research Subquestion **SQ01**, “Can the UC initiative be used by any audience, or is it specific to people with some type of disability?”, aimed to identify whether the analyzed UC initiatives were designed for a specific audience of people with disabilities or whether they were conceived for broader use, without focusing on a specific special education audience. As shown in Table 4, most initiatives, corresponding to 4 studies (57.14%), were classified as universal or open to any audience, while 3 studies (42.86%) presented proposals specifically directed to a target audience with disabilities. Among the four studies designed for a universal audience (Studies 02, 03, 05, and 06), only Study 06

required adaptation, with the inclusion of audio description for a student with low vision. This result may indicate the accessible, flexible, and potentially inclusive nature of UC, allowing its application both in regular classrooms and in special education contexts. Of the three activities developed specifically for a target audience with disabilities, Study 01 proposed an activity aimed at students with Autism Spectrum Disorder (ASD), while Studies 04 and 07 were designed for students with visual impairment. The presence of studies focused on specific types of disabilities shows that, in some cases, more targeted adaptations are still necessary.

In Subquestion **SQ02**, “Which materials were used in the UC initiative?”, all analyzed studies, corresponding to 7 studies (100%), used physical manipulative materials, such as paper, paper folding, boards, and concrete objects. Only 1 study (14.29%) used resources adapted for specific needs, such as braille (Study 07), and 2 studies (28.57%) used digital support resources (Studies 02 and 06). In this SMS, digital support resources refer to multimedia resources that do not constitute the central element of the proposal, being used only as support. In Study 02, an algorithm in video format was used to present the sequence of steps for the paper folding activity. In Study 06, an interactive algorithm in a computational environment was used as the initial stage of the activity, which was later carried out in an unplugged format. The manipulative materials appeared in different formats across the studies, including paper folding activities (Studies 02, 03, and 06), board games and tactile resources (Studies 04 and 07), as well as activities based on narratives and pedagogical dynamics (Studies 01 and 05).

In **SQ03**, “Is the initiative an individual, pair, or group activity?”, most activities, corresponding to 4 studies (57.14%), were classified as individual activities (Studies 03, 04, 05, and 06), while in 3 studies (42.86%) this information was not specified (Studies 01, 02, and 07). The lack of detail in a significant portion of the studies makes it hard to understand the potential of these initiatives to promote collaboration among students.

In **SQ04**, “Which CT pillars does the initiative stimulate?”, as shown in Table 4, 5 of the 7 analyzed studies (71.43%) simultaneously addressed the four pillars of CT (Studies 02, 03, 05, 06, and 07). Only Study 04 presented a specific focus on the development of the algorithm pillar. Study 01 did not specify which CT skills were stimulated by the initiative. Except for Study 04, which addresses only the algorithm pillar, most of the analyzed initiatives tend to stimulate multiple CT pillars simultaneously. This may reflect the nature of UC itself, which is generally used as an introductory approach to teaching CT. Thus, the activities are designed to promote a broader and more integrated understanding of the concepts, rather than a segmented approach to each pillar.

In **SQ05**, “For which types of specific needs was UC adapted?”, the most recurrent audience in the analyzed studies was students with ASD, present in 4 of the 7 studies (57.14%), followed by students with visual impairment, addressed in 3 studies (42.86%), and hearing impairment, present in only 1 study (14.29%). The initiatives aimed at visual impairment (Studies 04, 06, and 07) tended to require more explicit adaptations, such as tactile materials, raised resources, or audio description. In contrast, most proposals involving students with ASD (Studies 01, 02, 03, and 05) appeared in regular classroom contexts, without necessarily presenting specific adaptations. This difference suggests that accessibility demands vary according to the students’ profiles and should be described more precisely in the studies.

Subquestion **SQ06**, “What was the level of dependency of the students with disabilities who participated in the study?”, aimed to identify the level of dependency of students with disabilities, considering the following levels: independent, moderate dependency, high dependency, and severe dependency. However, none of the selected studies, corresponding to 7 studies (100%), provided information on the students’ level of dependency. Therefore, it was not possible to conduct a comparative analysis or identify patterns related to this aspect.

In **SQ07**, “In which subject was the UC initiative applied?”, a considerable portion of the studies, corresponding to 3 studies (42.86%), did not clearly specify the subject in which the activity was applied (Studies 01, 04, and 06). Among the studies that presented this information, 2 studies (28.57%) reported application in extracurricular activities or extension projects (Studies 02 and 07), 1 study (14.29%) was applied in the context of computing, informatics, or CT (Study 05), and 1 study (14.29%) was applied in the context of mathematics (Study 03). No initiatives were identified in other possible curricular contexts, such as arts or language classes. This absence is relevant because some activities could present interdisciplinary potential. For example, the paper folding activities reported in Studies 02, 03, and 06 could be related to arts education, while the narrative-based activity in Study 05 could also be explored in Portuguese language classes, as it involves text production. Therefore, the results suggest that the interdisciplinary potential of UC activities in special education is still underexplored in the analyzed studies.

In Subquestion **SQ08**, “Which educational levels were addressed?”, the analyzed initiatives were distributed across different educational levels, with a higher concentration in Elementary School I (Studies 01, 02, and 05), Elementary School II (Studies 01, 02, and 06), and High School (Studies 02, 03, and 07), each with 3 studies (42.86%). Higher Education (Studies 04 and 07) appeared in 2 studies (28.57%). The stronger presence of initiatives in basic education may be related to the introductory and playful nature of UC. The stronger presence of initiatives in basic education levels may indicate the introductory and playful nature of UC, which is frequently used to present initial concepts of CT. However, the presence of initiatives in Higher Education also stands out. When analyzing the two cases conducted at the university level, both correspond to proposals developed for students with visual impairment. This may indicate that, even in Higher Education, UC can play a relevant role as an accessibility strategy for this student profile.

In **SQ09**, “Who was responsible for applying the UC initiative?”, 4 studies, corresponding to 57.14%, were applied by the researchers themselves (Studies 01, 02, 04, and 07). In addition, 2 studies (28.57%) reported the participation of regular subject teachers (Studies 02 and 05), and only 1 study (14.29%) identified the participation of special education teachers (Study 04). Furthermore, in 2 studies (28.57%), this information was not specified (Studies 03 and 06). Overall, the results indicate a predominance of activities conducted by the researchers themselves.

In Subquestion **SQ10**, “Which evaluation method was used to verify the acquisition of CT skills?”, as shown in Table 4, the most recurrent evaluation method was direct observation of student performance, identified in 4 studies (57.14%) (Studies 02, 03, 04, and 05). In addition, 2 studies (28.57%) did not clearly specify the evaluation method used (Studies 01 and 06), while only 1 study (14.29%) used questionnaires or written tests (Study 07). The predominance of direct observation may be related to the nature

of UC activities, which are generally dynamic, practical, and centered on task execution. On the other hand, the limited use of more structured evaluation methods may indicate a limitation in how the results of these initiatives are measured. The lack of more formal and systematic evaluation methods may make it difficult to consolidate stronger evidence on the effectiveness of these activities in developing CT.

In **SQ11**, “In which environment was the UC initiative applied?”, most initiatives, corresponding to 4 studies (57.14%), were conducted in regular inclusive classrooms, characterized by mixed classes with students with and without disabilities (Studies 02, 03, 05, and 06). In addition, 2 studies (28.57%) did not specify the application environment (Studies 01 and 04). Only 1 study (14.29%), corresponding to Study 07, was classified as “other”, as it was developed in the context of the National Science and Technology Week. This result suggests that UC initiatives have been mainly explored in inclusive regular classrooms rather than in specialized or segregated environments. This is relevant because the same studies classified as regular inclusive classroom applications (Studies 02, 03, 05, and 06) were also identified in SQ01 as universal or open to any audience. In these cases, the activities were not necessarily designed for a specific disability, but students with disabilities were able to participate either without adaptations or with adjustments that allowed them to work together with the rest of the class. Therefore, this finding may reinforce the potential of UC as a flexible pedagogical approach for special education, since its use of concrete, visual, and manipulative resources can support the participation of diverse students in shared learning environments.

In Subquestion **SQ12**, “What motivated the use of the unplugged activity in the research?”, the main motivation observed was the introductory exploration of computing concepts, present in 4 studies (Studies 02, 03, 05, and 07). Another recurrent motivation was the integration with mathematics content, identified in Studies 02 and 03, which used paper folding activities (origami) to simultaneously develop geometric concepts and CT skills. Regarding pedagogical suitability, Study 07 highlights the need to overcome traditional teaching methods by using the playful nature of UC as an alternative. Study 04 presents a motivation related to suitability for inclusive contexts, through the development of a tactile learning object for a student with visual impairment. In Study 06, the only one classified as “Other Motivations”, the motivation for using UC was the exploration of its playful potential together with plugged activities. Study 01 did not clearly specify the factors that motivated the adoption of the approach.

Finally, in **SQ13**, “Which challenges were found in the application of UC in special education?”, only 1 of the 7 analyzed studies (14.29%) explicitly described the challenges encountered. Study 04 pointed out difficulties related to the adaptation of materials, the limited world knowledge of the student with visual impairment, and low tactile sensitivity, factors that directly affected the execution of the proposed activities. In the other studies, especially Studies 02, 03, 05, and 06, the initiatives were applied in regular classes with the presence of students with disabilities. In these cases, the authors reported general difficulties in conducting the activities, but did not provide a detailed analysis of the specific challenges faced by special education students. The lack of deeper discussions about challenges reveals a limitation in the analyzed literature, making it difficult to understand the practical barriers involved in applying UC in inclusive contexts. This may indicate the need for future studies to investigate these difficulties in greater detail,

especially considering the context of special education.

6. Final Considerations and Future Work

This study aimed to analyze and characterize initiatives that use UC initiatives to support the teaching of computing and the development of CT in special education contexts in Brazil. The small number of selected studies suggests that, although UC and CT have been increasingly discussed in Informatics in Education and Computing Education, their application in special education remains underexplored within the analyzed SBIE and EduComp publications.

Among the main limitations observed in the analyzed literature, the following stand out: the small number of studies found; the lack of detailed information on the participants' level of dependency; the limited description of the adaptations made; the scarcity of formal evaluation methods; and the limited discussion of the challenges faced during the application of the activities. These limitations indicate that the area still requires more detailed investigations, with greater methodological rigor in the description of the studies and in the analysis of the results.

As a limitation of this study, the search scope should be highlighted, as it was restricted to the SBIE and EduComp events and to the period from 2020 to 2025. This choice allowed the analysis to focus on relevant national events in Informatics in Education and Computing Education, but excluded studies published in journals, other conferences, dissertations, theses, or international databases. In addition, the manual screening of 1,145 publications may be subject to reviewer fatigue and unintentional omission. This risk was mitigated through independent screening by two reviewers, consensus discussions, decision tracking in Porifera, and the high Cohen's Kappa agreement obtained in both selection stages.

As future work, it is recommended to expand the search scope to other national and international databases, including journals, academic repositories, and events related to education, accessibility, inclusion, and computing. Future studies may also investigate or suggest interdisciplinary applications beyond mathematics and computing, particularly in the arts and language education, given the interdisciplinary potential of unplugged computing. Another possible direction for future work is the development of guidelines for adapting UC activities to special education contexts. Such guidelines could support teachers and researchers in creating more accessible materials, considering the needs of this audience. Future studies could also propose and validate specific evaluation instruments to measure the development of CT pillars in students with disabilities.

Thus, this study contributes by organizing and synthesizing the available knowledge on the intersection between UC, CT, and Special Education in the Brazilian context. The results indicate that the area is still under development, but also point to promising directions for researchers, teachers, and other professionals interested in promoting a more inclusive and accessible Computing Education.

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Declaration on the Use of Artificial Intelligence

For this work, the generative artificial intelligence tool Claude, developed by Anthropic, was used to support spelling revision, improve textual clarity, translate the text into English, and adjust $\text{\LaTeX}$ structures. The tool was used only as an auxiliary resource for writing and formatting, and was not used to define the research objectives, conduct the systematic mapping study or interpret the results. All methodological decisions, analyses, and conclusions presented in this work are the responsibility of the authors.

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