

ARTICLE

## AN OVERVIEW OF OUTREACH ACTIONS DEVELOPED IN HIGHER EDUCATION COMPUTER SCIENCES <sup>1</sup>

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**ABSTRACT:** The tripod of Brazilian universities is composed of teaching, research, and outreach. Through outreach actions, it is possible to connect scientific knowledge and society's needs. Thus, supported by democratic values and equal rights, they can promote local social development. Understanding the social importance of outreach actions, we ask: how are outreach actions being carried out in universities? To answer this question, we did a systematic literature review considering the publications of the last 10 years in the following digital databases: ACM, CEIE, IEEE, RBIE, Renote, ScienceDirect, SBIE, and WIE. We used twenty-five keywords, one inclusion criterion, and six exclusion ones. After collecting the data, we critically analyzed the selected articles from a Freirean perspective, building an overview of the outreach actions in the Computer Sciences area. One of the eight items of this panorama shows, for example, that 61.54% of the outreach actions address topics related to computational thinking or teaching programming. Observing the general panorama found, we can conclude that the outreach actions presented a hegemony of study topics, a specific focus on a certain audience, and a low level of student protagonism, among other issues.

**Keywords:** university extension, computing, social values.

### UM PANORAMA DAS AÇÕES EXTENSIONISTAS DESENVOLVIDAS EM CURSOS SUPERIORES DE COMPUTAÇÃO

**RESUMO:** O tripé das universidades brasileiras é composto por ensino, pesquisa e extensão. A partir das ações de extensão, é possível articular o conhecimento científico em conjunto com as necessidades da sociedade e, dessa forma, respaldadas por valores democráticos e igualdade de direitos, tais ações são capazes de promover o desenvolvimento social local. Entendendo a importância social oportunizada

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pelas ações de extensão, propõe-se a seguinte pergunta: como estão sendo realizadas as ações de extensão nas universidades? Neste contexto, o método utilizado para responder à pergunta em questão foi a execução de uma revisão bibliográfica sistemática que considerou as publicações dos últimos dez anos presentes nas seguintes bases digitais: ACM, CEIE, IEEE, RBIE, Renote, ScienceDirect, SBIE e WIE. Foram utilizadas 25 palavras-chave, um critério de inclusão e seis critérios de exclusão. Após a extração dos dados e análise crítica referente aos artigos selecionados a partir de uma perspectiva freireana, foi construído um panorama sobre as ações extensionistas na área de Computação. Um dos oito itens que compõem esse panorama trouxe à luz, por exemplo, que 61,54% das ações de extensão abordam tópicos referentes ao pensamento computacional ou ao ensino de programação. Observando-se o panorama geral encontrado, foi possível concluir que as ações de extensão apresentaram, por exemplo, uma hegemonia de tópicos de estudos, foco específico em um determinado público, baixo protagonismo discente, entre outras questões.

**Palavras-chave:** extensão universitária, computação, valores sociais.

### UN PANORAMA DE LAS ACCIONES EXTENSIONISTAS DESARROLLADAS EN LOS CURSOS SUPERIORES DE COMPUTACIÓN

**RESUMEN:** El trípode de las universidades brasileñas está compuesto por docencia, investigación y extensión. A partir de las acciones de extensión es posible articular el conocimiento científico junto a las necesidades de la sociedad y, de esta manera, sostenidas en los valores democráticos y la igualdad de derechos, son capaces de promover el desarrollo social local. Entendiendo la importancia social que brindan las acciones de extensión, se aclara la siguiente pregunta: ¿Cómo se realizan las acciones de extensión en las universidades? En este contexto, el método utilizado para responder a la pregunta en cuestión fue la ejecución de una revisión sistemática de la literatura que consideró las publicaciones de los últimos 10 años presentes en las siguientes bases de datos digitales: ACM, CEIE, IEEE, RBIE, Renote, ScienceDirect, SBIE y WIE. Fueron utilizadas veinticinco palabras clave, un criterio de inclusión y seis criterios de exclusión. Después de extraer los datos y analizar críticamente los artículos seleccionados desde una perspectiva freireana, se construyó un panorama sobre las acciones de extensión en el área de Computación. Uno de los ocho puntos que componen este panorama dice, por ejemplo, que el 61,54% de las acciones de extensión abordan temas relacionados con el pensamiento computacional o la enseñanza de la programación. Observando el panorama general encontrado, es posible concluir que las acciones de extensión presentaron, por ejemplo, hegemonía de temas de estudio, focalización específica en un público determinado, bajo protagonismo discente, entre otras cuestiones.

**Palabras clave:** extensión universitaria, informática, valores sociales.

## INTRODUCTION

Paulo Freire was an assiduous critic of the traditional model of the Brazilian school, and throughout his academic career, he was against any type of education that considered the professor as the absolute holder of the knowledge that is passively transferred to the students. The author believed in an education that fostered awareness of the authoritarian nuances perpetuated in society and argued that pedagogy needed to create bridges between curricular knowledge and the social context of students (FREIRE, 1996). In this sense, education, which is not neutral, would be configured as a pedagogical path capable of freeing or imprisoning human beings within the values and customs consolidated throughout human history (FREITAG, 1986, p. 15).

Freire (1996) found the existence of values that make teaching practices dehumanizing since they understand students as clients and teaching as simple merchandise. In this way, when universities adopt the banking education molds, students are trained and domesticated, preventing autonomy and the formation of citizens with critical thinking based on solidarity, ethics, respect, and collaboration.

In this context, university education can become a vehicle of alienation from the moment that universities become involved solely and exclusively with the hegemonic classes which exercise social control and impose their intellectual schemes of domination that benefit few groups (PINTO, 1994).

In addition to these authoritarian and anti-democratic practices elucidated by Freire (1996) and Pinto (1994), there are other types of challenges that universities need to face. For Frigotto (2007), Brazilian universities, for example, are hostages of the market since there is a policy in the country regarding the massification of technical-scientific qualifications. Chauí (2003) states that universities need to respond to society's demands and, at the same time, receive strong pressure from the market, which, in turn, also pressures the political sphere. Kauling et al. (2011) list another type of problem: universities need to deal with increasingly limited funding policies.

It is necessary to understand that education is a revolutionary practice used to emancipate individuals and reduce social inequalities. Education, in general, must dialogue with the various existing knowledge and free people from the inhumane situations in which they find themselves, based on a change that is not only individual but also collective. Thus, in Freire's perspective, education must be humanizing, critical and libertarian (FREIRE, 1996).

In this sense, it is possible to state that the university needs to be reformulated from a human and liberating ideology to allow the social, cultural, and economic ascension of all and not be just a distributing instrument of cultural alienation that maintains old and unfair the social structure (PINTO, 1994).

Understanding that the university must connect and dialogue with society, be attentive to the social promotion mainly of subaltern groups and that needs to articulate the production of different knowledge, concerned with the interests of its surroundings, it is of vital importance that it has the autonomy to execute all its activities.

Regarding university autonomy, Art. 207 of the Brazilian Federal Constitution of 1988 defends: "Universities enjoy didactic-scientific, administrative, and financial and asset management autonomy, and will obey the principle of inseparability between teaching, research and outreach" (BRASIL, 2018).

Teaching, research, and outreach, also known as the university tripod, are basic components of the university and must be treated with the same importance. They are complementary and interconnected by knowledge; therefore, there is no component superior to the other. The university will be infringing on a constitutional precept if it treats the components of this tripod unequally (MOITA; ANDRADE, 2005, p. 78-79). Síveres (2013, p. 26) adds that teaching, research, and outreach have the task of integrating a wide variety of experiences that favor learning.

Teaching has activities aimed at student learning carried out in classrooms and laboratories. It cannot be understood that teaching is simply transmitting knowledge so that the other can reproduce it mechanically. Research is an activity (for example, course completion works and scientific initiation) that must be constantly carried out by professors and students to expand knowledge and solve/minimize

social problems. The concept of outreach encompasses a bilateral dialogue between the university and society (RAYS, 2003).

Deepening the discussion on university outreach, Sousa (1996) historically analyzes the components of the university tripod and observes that outreach has always been a way to reduce the social abyss even facing strong resistance from the elitism that has appropriated education. With the same line of reasoning as Sousa (1996), Gurgel (1986, p. 176) states that outreach is the link between the university and society. Based on outreach, it is possible to exchange knowledge between the university and popular knowledge and, in this scenario, it must be able to promote the political emancipation and social transformation of the popular classes, breaking with the dominant ideologies present in education.

Regarding this exchange of knowledge mentioned by Gurgel (1986, p. 176), Boaventura de Sousa Santos stated in an interview with PUC Minas, in 2017, that the university needs to understand that external knowledge is also important and that it must approach communities horizontally, regardless of their political position. As an example, he cited a project by the Faculty of Medicine of Manaus that allows interaction between students and traditional doctors from the Amazon. Another example cited was the action carried out in the undergraduate course of Naval Technology in Bahia, in which shipwrights, together with engineers, teach new knowledge to students of the course (CHOUCAIR; SANTOS, 2017).

Understanding the context exposed by Boaventura de Sousa Santos is important to avoid working with an outreach practice without listening to the other. The invisible cannot continue to be “unrepresentable subjects” or considered objects of study. Therefore, it is not possible to speak for them. Speaking on behalf of the other and withdrawing their participation means that the other remains in a marginalized position.

This marginalized position can be deconstructed if Síveres' thoughts are appropriated (2013, p. 18-20). For this author, the outreach allows other social actors who live far from universities (in terms of access) to have the possibility of reframing their reality. In other words: “it is appropriate to say that outreach is a way of being, a way of dialoguing and a possibility of learning”.

It is important to note that the outreach is backed by law. It should be noted that Resolution No. 7, of December 18, 2018, provides that all undergraduate courses must have 10% of the workload of their curricular matrix allocated to outreach activities. This resolution also establishes the conception and practice for outreach actions (BRASIL, 2018):

- (I) Bilateral communication and participation between the university and society to discuss and solve local problems;
- (II) To allow students to develop citizenship based on real problems and, in an interprofessional and interdisciplinary way, help build new solutions;
- (III) To produce new knowledge and activities with a human perspective (non-marketing) to break with the prevailing paradigms in the university and society;
- (IV) To establish a single, interdisciplinary, political, educational, cultural, scientific, and technological teaching-learning plan that allows the association between teaching, research, and outreach.

Corroborating Resolution No. 7, of December 18, 2018 (BRASIL, 2018), it is possible to state that outreach actions are necessary for the development of society since they must go beyond the walls of the university and involve all social stratifications. These actions need to demystify the idea that a university is an unreachable place and allow a dialogue between scientific and methodically rigorous knowledge with popular knowledge. From the outreach, the university becomes involved with the local social context and works, with the participation of the community to promote new social transformations.

Outreach actions need to be understood as an educational situation in which educators and students participate together, inferring that there is no knowledge superior to the other. The knowledge construction process must be participatory so as not to “verticalize” the outreach to the point of trying to “dominate and despise” the knowledge of the communities (FREIRE, 2013).

Garcia et al. (2013, p. 171) add that outreach encourages new critical ways of thinking and doing and, in addition, transfers the opportunity to teach and learn beyond the traditional space that is the classroom. For Freire (2013), the act of thinking and doing is understood as a pedagogical process against the hegemonic model, in search of autonomy, which focuses on dialogical interaction with the other.

Through outreach, the university participates in the local social context and helps, together with the different communities, to promote new social transformations. Universities must carry out their outreach actions aiming at critical-emancipating and non-critical, utilitarian, and decontextualized training.

From the understanding of the functions performed by an autonomous and critical university, together with the understanding that outreach actions must generate consequences in our society and, in this way, create opportunities for a better bias by breaking with the inequalities reflected by social and economic power, the following problem-question is formulated: how are outreach actions being carried out in universities?

A necessary excerpt on the question problem is highlighted here: the scope will be delimited for outreach actions carried out in courses in the Computer Sciences area. This record is necessary since Computer Science is the training and work area of the authors of this article.

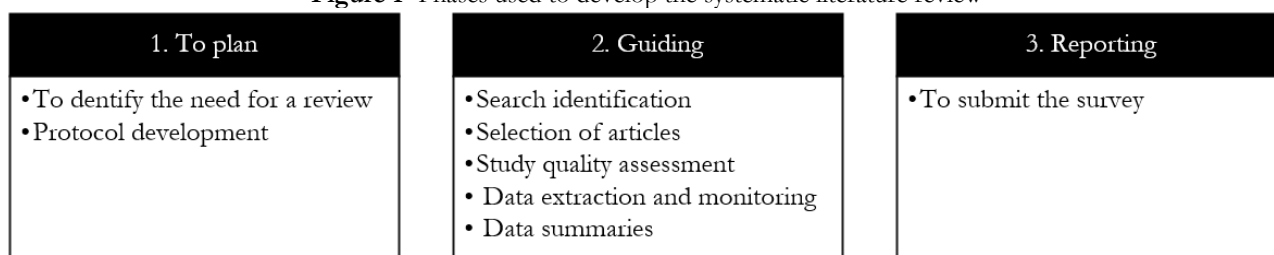
To answer the question problem, the objective of this article is to outline an overview of the outreach actions carried out in higher education courses in the Computer Sciences area, using as a methodology the application of a systematic literature review (SLR), considering a period of ten years (2010– 2020) of publications in renowned digital databases.

This article is divided as follows: the **Introduction** section, already presented, problematizes the research theme; the **Method** section describes in detail the methodology used step by step; the **Results and Discussion** section performs a critical analysis of the literature from Freire's perspective and the result obtained; and, finally, the **Final Considerations** section bringing the relevant conclusions to the topic addressed.

## METHOD

To trace an overview regarding the outreach actions carried out in higher education courses in the Computer Sciences area, the methodology adopted in this article is the development of an SLR, organized in three phases (planning, guiding, and reporting), following the guidelines (see Figure 1) from Kitchenham (2004).

**Figure 1-** Phases used to develop the systematic literature review



**Source:** Kitchenham (2004).

It is understood that, from an SLR, it is possible to carry out a complete, transparent, rigorous, reproducible, and impartial survey on the state of the art regarding a topic of interest. In the planning phase, the study protocol is built and validated and, in the conduction phase, the step-by-step established in the planning phase is executed. In the third and final phase, the material produced from the two previous phases is reported (published) in some scientific medium adhering to the research topic. In the following, each phase is explained in detail.



## Phase 1 – To plan the protocol<sup>2</sup>

The planning phase has two subphases: identifying the need for a review and its development.

The need for this review is because of seeking a theoretical-scientific foundation on the outreach actions carried out in higher education courses in the Computer Sciences area to consolidate evidence and results obtained in previous studies, such as questioning what objective of the outreach activities.

In the protocol development subphase, the objective is to define the SLR protocol settings. These settings are based on the following elements: theme, justification, objective, research questions and categories, digital libraries, search strings, and inclusion and exclusion criteria. These elements will be detailed throughout this section.

The delimitation theme of this SLR refers to Higher Education in courses in the Computer Sciences area, as already explained in the Introduction of this article.

The justification for the development of this SLR is the need to know the state of the art of university outreach actions of higher education courses in the Computer Sciences area, since, according to Resolution n.º 7, of December 18, 2018 (BRASIL, 2018), 10% of the workload of the curricular matrices of all Brazilian higher education courses must be composed of outreach activities.

In this context, the objective of this SLR is to seek, analyze and summarize the scientific articles that address outreach actions in higher education courses in the Computer Sciences area so that there may be subsidies to establish an overview of the respective actions. Therefore, to respond to the proposed objective, two research questions (RQ) were defined:

- RQ01 – What is the purpose of the outreach action?
- RQ02 – What is the outreach action format?

In addition to the RQs, six research categories (RC) were also elaborated and used to extract data from the articles, which allow, in this way, a deeper analysis of the subject, in addition to complementing the RQs. The RCs are: RC01 – location; RC02 – offer; RC03 – people; RC04 – conception; RC05 – implementation; and, finally, RC06 – objective.

It is also necessary to define which digital libraries will be used. For this article, eight libraries were selected: ACM<sup>3</sup>, CEIE<sup>4</sup>, IEEE<sup>5</sup>, RBIE<sup>6</sup>, Renote<sup>7</sup>, ScienceDirect<sup>8</sup>, SBIE<sup>9</sup> e WIE<sup>10</sup>. The respective digital libraries were chosen because they are relevant data sources for Education and Computer Science.

To perform queries using digital libraries, it is necessary to define the search strings. In this criterion, from other articles, the possible synonyms for the idea related to the term “outreach action” were studied.

As a result, 25 words were found. The search strings were created in Portuguese, the local language in which the research object is inserted, and in English, a language considered universal (see Appendix A). Also considering that digital libraries have character limits, eight search strings were created to contemplate queries involving all synonyms (see Appendix B).

Finally, the last two elements of the SLR planning are the inclusion criteria (IC) and exclusion criteria (EC). These criteria are arranged according to Table 1.

<sup>2</sup> This phase was reviewed by a researcher from the Federal Technological University of Paraná. This action reduces possible biases in the protocol.

<sup>3</sup> <https://dl.acm.org/>

<sup>4</sup> <http://www.br-ie.org/pub/index.php/index>

<sup>5</sup> <https://ieeexplore.ieee.org>

<sup>6</sup> <http://www.br-ie.org/pub/index.php/rbie>

<sup>7</sup> <http://seer.ufrgs.br/renote/>

<sup>8</sup> <https://www.sciencedirect.com/journal/computers-and-education>

<sup>9</sup> <http://www.br-ie.org/pub/index.php/sbie>

<sup>10</sup> <https://www.br-ie.org/pub/index.php/wie/index>

**Table 1** – Inclusion and exclusion criteria

<b>INCLUSION CRITERIA</b>		
<b>Identifier</b>	<b>Description</b>	<b>Justification</b>
IC01	Articles published between 01/01/2010 and 07/21/2020	It is understood that a decade is enough to gather the necessary information
<b>EXCLUSION CRITERIA</b>		
<b>Identifier</b>	<b>Description</b>	<b>Justification</b>
EC01	Not available for download	Unable to read
EC02	Duplicate articles	Redundancy
EC03	Posters, short papers, abstracts, editorials, presentations or call for papers	Present ideas and information still in development
EC04	Articles not related to university outreach	Outside the scope of the research
EC05	Articles that do not cover undergraduate courses in the Computer Sciences area	Outside the scope of the research
EC06	Articles referring to systematic reviews	Present summarized (not complete) information from other articles

**Source:** Our creation.

## Phase 2 – To execute the protocol

The execution phase consists of five subphases: (1) research identification; (2) article selection; (3) assessment of study quality; (4) data extraction and monitoring; and (5) data synthesis.

To find the largest possible number of articles related to outreach actions in the Computer Sciences area and based on Kitchenham (2004), the following strategies were outlined in subphase (1) **research identification**:

- To use search strings in Portuguese and English, but consider articles written in another language;
- To resort to other studies to look for the synonyms used in the search strings;
- To consult experts in the field; in this case, a specialist from the Federal Technological University of Paraná;
- To use only relevant digital databases for the topic in question;
- To use a tool to manage bibliographic references<sup>11</sup>;
- To create forms to document the data obtained.

Subphase (2) **article selection** uses the study protocol settings defined in Phase 1. Initially, the search strings were applied individually to each of the digital libraries; therefore, 64 consultations were performed (8 strings X 8 digital libraries).

Considering the ACM, the following data were found:

- consultation with String 1 – 4 articles;
- consultation with String 2 – 12 articles;
- consultation with String 3 – 8 articles;
- consultation with String 4 – 2 articles;
- consultation with String 5 – 85 articles;
- consultation with String 6 – 144 articles;

<sup>11</sup> <https://www.mendeley.com>

- consultation with String 7 – 90 articles;
- consultation with String 8 – 57 articles.

When applying the eight search strings in the ACM, a total of 402 articles were found. The same reasoning applied to the other seven digital libraries. To exemplify the result of these consultations, Table 2 illustrates the number of articles from each search string applied in the respective digital libraries.

**Table 2** – Number of articles per digital library

	<i>String 1</i>	<i>String 2</i>	<i>String 3</i>	<i>String 4</i>	<i>String 5</i>	<i>String 6</i>	<i>String 7</i>	<i>String 8</i>	TOTAL
ACM	4	12	8	2	85	144	90	57	402
CEIE	13	17	0	3	5	1	0	2	41
IEEE	0	0	0	0	10	18	7	2	37
RBIE	4	3	0	1	0	0	0	0	8
Renote	1	0	1	0	0	0	0	0	2
SBIE	3	5	0	1	1	0	0	0	10
ScienceDirect	0	0	0	0	2	1	2	1	6
WIE	4	10	0	1	3	1	0	2	21
<b>TOTAL</b>	<b>29</b>	<b>47</b>	<b>9</b>	<b>8</b>	<b>106</b>	<b>165</b>	<b>99</b>	<b>64</b>	<b>527</b>

**Source:** Our creation.

Nesse contexto, ao aplicar o CI01 na ACM, foram encontrados:

When analyzing Table 2, considering all consultations carried out, a total of 527 articles are observed. Next, the inclusion criterion “IC01 was applied – Articles published between 01/01/2010 and 07/21/2020” to subsequently download these files.

In this context, when applying CI01 in the ACM, the following was found:

- with a String 1 – 3 articles;
- with a String 2 – 11 articles;
- with a String 3 – 6 articles;
- with a String 4 – 2 articles;
- with a String 5 – 43 articles;
- with a String 6 – 64 articles;
- with a String 7 – 58 articles;
- with a String 8 – 28 articles.

The total number of articles found in ACM was 215. The same reasoning applies to other libraries. Table 3 illustrates the number of articles in their respective digital libraries considering the application of IC01.

**Table 3** – Number of articles per digital library considering IC01

	<i>String 1</i>	<i>String 2</i>	<i>String 3</i>	<i>String 4</i>	<i>String 5</i>	<i>String 6</i>	<i>String 7</i>	<i>String 8</i>	TOTAL
ACM	3	11	6	2	43	64	58	28	215
CEIE	7	11	0	3	2	1	0	0	24
IEEE	0	0	0	0	10	14	5	1	30
RBIE	3	3	0	1	0	0	0	0	7
Renote	0	0	0	0	0	0	0	0	0
SBIE	0	2	0	1	0	0	0	0	3



ScienceDirect	0	0	0	0	1	0	1	0	2
WIE	3	8	0	1	1	1	0	0	14
<b>TOTAL</b>	<b>16</b>	<b>35</b>	<b>6</b>	<b>8</b>	<b>57</b>	<b>80</b>	<b>64</b>	<b>29</b>	<b>295</b>

Source: Our creation.

When observing Table 3, 295 articles of the 527 articles found initially remained after IC01 was executed. The next step was to apply the exclusion criteria (EC) to eliminate all articles that are outside the scope of this research. Therefore, the data will no longer be detailed by search strings, but by the **total** in each digital library versus inclusion and exclusion criteria.

Table 4 presents the result of applying the six EC<sup>12</sup>. After applying **CE01** (attempting to download), 258 articles remained<sup>13</sup>. It was not possible to download 37 articles, 33 from ACM and 4 from IEEE. After applying the CE02 (verification performed by the titles of the articles), 203 articles remained. In this criterion, 55 articles were excluded<sup>14</sup>, 23 da ACM, 23 from ACM, 21 from CEIE, 1 from IEEE, 3 from RBIE, 1 from SBIE, 1 from ScienceDirect, and 5 from WIE.

To apply criteria CE03, CE04, CE05, and CE06, the titles, abstracts, and keywords of the articles were analyzed. In case of doubt, the conclusion of the article was also read. If doubt persisted, the complete reading of the article was carried out.

Table 4 – Result of applying the inclusion and exclusion criteria

	CI01	CE01	CE02	CE03	CE04	CE05	CE06	TOTAL
ACM	215	-33	-23	-33	0	-124	-1	1
CEIE	24	0	-21	-1	0	0	0	2
IEEE	30	-4	-1	-7	-3	-11	0	4
RBIE	7	0	-3	0	0	-4	0	0
Renote	0	0	0	0	0	0	0	0
SBIE	3	0	-1	0	0	0	0	2
ScienceDirect	2	0	-1	0	0	-1	0	0
WIE	14	0	-5	-1	0	0	-1	7
<b>TOTAL</b>	<b>295</b>	<b>-37</b>	<b>-55</b>	<b>-42</b>	<b>-3</b>	<b>-140</b>	<b>-2</b>	<b>16</b>
		295-37= <b>258</b>	258-55= <b>203</b>	203-42= <b>161</b>	161-3= <b>158</b>	158-140= <b>18</b>	18-2= <b>16</b>	

Source: Our creation.

After applying **CE03**, 161 articles remained. In this criterion, 42 articles were excluded<sup>15</sup>, 33 from ACM, 1 from CEIE, 7 from IEEE, and 1 from WIE. After applying CE04, 158 articles remained. In this criterion, 3 articles were excluded<sup>16</sup>, all from IEEE. After applying CE05, 18 articles remained. In this criterion, 140 articles were excluded<sup>17</sup>, 124 from ACM, 11 from IEEE, 4 from RBIE, and 1 from

<sup>12</sup> To carry out the CE conference, download the data.xlsx file.

<sup>13</sup> See data.xlsx, select all filters in SOURCE and EXCLUSION CRITERIA. The result is the articles (258 in total) that were able to be downloaded.

<sup>14</sup> See data.xlsx, select all filters in SOURCE and, in the EXCLUSION CRITERIA filter, leave only CE02 checked to see the excluded ones.

<sup>15</sup> See data.xlsx, select all filters in SOURCE and, in the EXCLUSION CRITERIA filter, leave only CE03 checked to see the excluded ones.

<sup>16</sup> See data.xlsx, select all filters in SOURCE and, in the EXCLUSION CRITERIA filter, leave only CE04 checked to see the excluded ones.

<sup>17</sup> See data.xlsx, select all filters in SOURCE and, in the EXCLUSION CRITERIA filter, leave only CE05 checked to see the excluded ones.

ScienceDirect. Finally, after applying CE06, 16 articles remained<sup>18</sup>. In this criterion, 2 articles were excluded, 1 from the ACM and 1 from the WIE.

In sub-phase (3) **study quality assessment**, all articles were read completely. Even after applying the inclusion and exclusion criteria, it was found that three articles were out of scope. Next, the reason for the exclusion of each one is described.

*Conquering with the Rest: Virtualization of a Game for Teaching Mathematics (Conquistando com o Resto: Virtualização de um Jogo para o Ensino de Matemática)*. This article was excluded because the focus is to show the development of a game and not the outreach action that made its development possible.

*The Internship in the Degree in Computer Sciences as a Space for the Training of Researcher Professors of their Practice: An Experience Report (O Estágio na Licenciatura em Computação como Espaço para Formação do Professor Pesquisador de sua Prática: Um Relato de Experiência)*. This article was excluded because the objective is to demonstrate a report on internships in Computer Sciences. One of the results of the internship was the creation of an outreach project.

*Activity proposal for the fifth year of elementary school: Unplugged Algorithms (Proposta de atividade para o quinto ano do ensino fundamental: Algoritmos Desplugados)*. This article was excluded because it addresses an outreach proposal, but the idea of outreach action has not yet been carried out.

The list of the **13 articles** (16-3) selected to compose the corpus of the analysis of this SLR can be seen in Box 1. This table contains the ID and the full reference of the article. The ID is used in the next sections to identify the articles involved in answering the research questions and categories.

**Box 1** – Final sample of selected articles

ID	References
1	FARIAS, Elany Marinho B. <i>et al.</i> A Importância dos Programas de Extensão no Ensino e Prática de Programação e Desenvolvimento de Protótipos. <i>In: XXV SIMPÓSIO BRASILEIRO DE INFORMÁTICA NA EDUCAÇÃO (SBIE 2014)</i> . <i>Anais...</i> Dourados: UFGD, 2014. p. 16-20.
2	FERREIRA, Luiz Carlos Branquinho Caixeta <i>et al.</i> A PBL-Based Methodology for IoT Teaching. <i>IEEE Communications Magazine</i> , [S. l.], v. 57, n. 11, p. 20-26, 2019.
3	SANTOS, Simone C. dos <i>et al.</i> Applying PBL in Teaching Programming: an Experience Report. <i>In: IEEE FRONTIERS IN EDUCATION CONFERENCE (FIE)</i> . <i>Anais...</i> San Jose: IEEE, 2018. p. 1-8.
4	DUNN, Deborah L.; STRADER, Robert G.; PICKARD, Michael M. Camps on a Shoestring: How We Survived a Summer. <i>In: PROCEEDINGS OF THE 42ND ACM TECHNICAL SYMPOSIUM ON COMPUTER SCIENCE EDUCATION</i> . <i>Anais...</i> Dallas: Association for Computing Machinery, 2011. p. 383-388.
5	KOHLER, Luciana P. De Araújo <i>et al.</i> Circuito de quatro estações aplicando a computação desplugada. <i>In: XXV WORKSHOP DE INFORMÁTICA NA ESCOLA (WIE 2019)</i> . <i>Anais...</i> Brasília: SBC, 2019. p. 1369-1373.
6	MACIEL, Herison; MENDES, Marília; MARQUES, Anna Beatriz. Desenvolvimento de aplicativos móveis com App Inventor por alunos do ensino médio: relato de um projeto de extensão com foco em acessibilidade. <i>In: XXIV WORKSHOP DE INFORMÁTICA NA ESCOLA (WIE 2018)</i> . <i>Anais...</i> Fortaleza: SBC, 2018. p. 195-204.
7	SANTOS, Aellison C. T. dos <i>et al.</i> Ensino de programação para Olimpíada Brasileira de Informática. <i>In: XXI WORKSHOP DE INFORMÁTICA NA ESCOLA (WIE 2015)</i> . <i>Anais...</i> Maceió: SBC, 2015. p. 122-126.
8	FARIAS, Carina Machado de <i>et al.</i> Estimulando o Pensamento Computacional: uma experiência com Scratch Jr. <i>In: XXV WORKSHOP DE INFORMÁTICA NA ESCOLA (WIE 2019)</i> . <i>Anais...</i> Brasília: SBC, 2019. p. 197-206.
9	SCORTEGAGNA, Liamara. Programa de Extensão e-TEIA: Integração do Ensino, Pesquisa e Extensão no Curso de Licenciatura em Computação na Modalidade EAD. <i>In: WORKSHOPS DO VI CONGRESSO BRASILEIRO DE INFORMÁTICA NA EDUCAÇÃO (WCBIE 2017)</i> . <i>Anais...</i> Recife: SBC, 2017. p. 774-783.
10	SANTOS, Erika Raquel Silva dos; OLIVEIRA, Fábio Cristiano de Souza; NETO, Ivaldo Barbosa da Mota. Raciocínio Lógico e Computação: Descobrimos Estratégias de ensino por meio da Olimpíada Brasileira de Informática. <i>In: XXI WORKSHOP DE INFORMÁTICA NA ESCOLA (WIE 2015)</i> . <i>Anais...</i> Maceió: SBC, 2015. p. 266-270.

<sup>18</sup> See data.xlsx, select all the filters in SOURCE and, in the EXCLUSION CRITERIA filter, leave only SELECTED checked to see the selected articles.

11	MOLINA, Diego Munguía; ALFARO, Jaime Gutiérrez; CARMIOI, Samanta Ramijan. Systematization of the Experience of Engineering Students as Facilitators of Free Cartography Workshops. <i>In: 2019 XIV LATIN AMERICAN CONFERENCE ON LEARNING TECHNOLOGIES (LACLO)</i> . <i>Anais...</i> San Jose Del Cabo: IEEE, 2019. p. 237-244.
12	HARARI, Viviana; HARARI, Ivana. Teaching Programming to Kids in Situation of Social Vulnerability. <i>In: 2017 TWELFTH LATIN AMERICAN CONFERENCE ON LEARNING TECHNOLOGIES (LACLO)</i> . <i>Anais...</i> La Plata: IEEE, 2017. p. 1-8.
13	CAVALCANTE, Tamer Stefani Guimarães; CAVALCANTE, Evellyn Soares; ORGAMBIDE, Alejandro César Frery. Uma Nova Abordagem para a Inclusão Digital: Relato de uma Experiência de Extensão na UFAL. <i>In: ANAIS DO WORKSHOP DE INFORMÁTICA NA ESCOLA (WIE 2010)</i> . <i>Anais...</i> [S. l.: s. n.] p. 1087-1096.

**Source:** Our creation.

For **(4) data extraction and monitoring**, a specific form was developed. This form is composed of the “Item” component (label that identifies what will be extracted), “Value” (extracted data), and “RQ/RC” (relates the extracted data to the questions and research categories in which the answer is desired).

After the complete reading of the articles, in sub-phase **(5) data synthesis**, 13 new forms<sup>19</sup> were created to synthesize the data. The tab number of each report represents the article that has an ID from Box 1 mentioned above.

### Fase 3 – Reporting the review

The main objective of this phase is to communicate the obtained results; therefore, it is necessary to choose a journal that adheres to the topic addressed in this article and adjust the results and discussions obtained according to the journal's rules.

To privilege the review reporting phase, it is important to consider open-access journals, to guarantee the circulation of information about this review. In addition, it is necessary to search for journals that adhere to the research theme – Education and Computer Sciences.

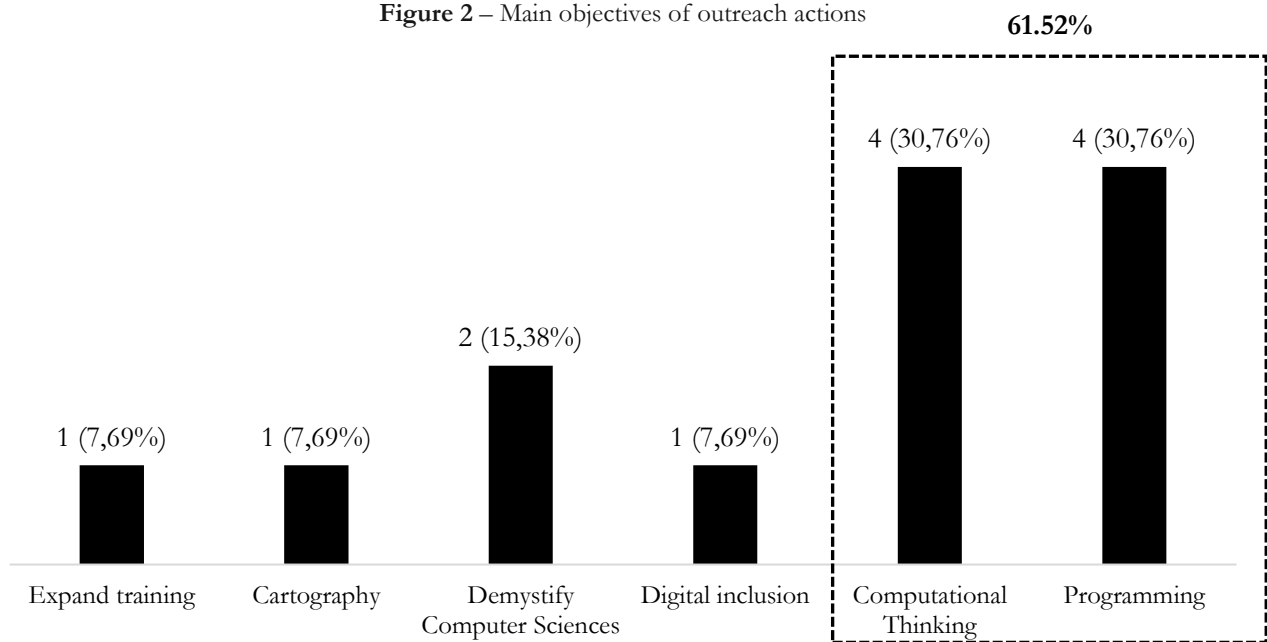
## RESULTS AND DISCUSSION

From the data extraction, it is possible to collect evidence to answer the research questions (RQ) as well as the research categories (RC). Note that the numbers in square brackets [ ] refer to the IDs in Box 1.

Considering “RQ01 – What is the objective of the outreach action?”, the following result was obtained: four articles [1, 5, 6, and 8] (30.76%) have the objective of stimulating computational thinking. Another four articles [2, 3, 7, and 12] (30.76%) aim to teach programming from a pre-established language. Two articles [4 and 10] (15.38%) are intended to demystify the Computer Sciences area. One article [9] (7.69%) expands the training of students who take a degree in Computer Sciences. One article [11] (7.69%) aims to offer cartography workshops; and, finally, one article [13] (7.69%) seeks to promote inclusion through digital literacy. Figure 2 illustrates this scenario.

<sup>19</sup> To perform the data synthesis check, check tabs 1 to 13 of the data\_extraction\_template.xlsx file. Each tab represents an article from Box 1; for example, tab 1 corresponds to the article that has ID 1, and so on.

Figure 2 – Main objectives of outreach actions



Source: Our creation.

Figure 2 shows that research involving outreach follows the direction of two major topics: computational thinking and teaching a programming language. These topics, when combined, represent 61.52% of searches. The respective scenario demonstrates the trends and interests of research related to outreach actions in the Computer Sciences area.

Brazilian education, including courses in the Computer Sciences area, is permeated with the interests of the dominant classes since this class financially supports the educational system. In this sense, universities become large factories of manpower for the labor market, and professors, within this system controlled by a minority, become agents of the transmission of ready and finished knowledge, which prevents the formation of students with a critical view of the social problems that involve them (PINTO, 1994).

The principles of Computer Sciences were crystallized considering structural and systemic ideals, which prevent the participatory dialogue of the area with another knowledge. However, there is a wide possibility of activities within Computer Sciences that cannot be delimited by an old domain of interest (MERKLE, 2020). Outreach actions, for example, must problematize a real, objective, and concrete situation that is related to the social and historical context of the community that will be involved. Only then will this collective be able to act critically on the problem and, in this way, build the necessary knowledge to overcome the obstacles of its reality (FREIRE, 2013).

In Mantoan's view (2004), students cannot be “objectified”. They are people with origins in different social and historical contexts and, therefore, have different views of the world, desires, and needs.

When the university adopts this type of uncritical thinking about the human, social, and historical context, it becomes filled with anti-pedagogical values and, therefore, fails to meet the local social demand, making the good life of different social groups unfeasible, since its three pillars (teaching, research, and outreach) are tainted with the reductionist and stereotyped view of the market.

Considering that our society uses different forms of communication and that every day new systems appear to mediate human relations, it is understood that the theme addressed in the article [2] “A PBL-Based Methodology for IoT Teaching” is of extreme importance. However, it is observed that the article relates more to a teaching methodology, and not the appropriation and construction of

knowledge by students from their local context, which would allow them to bring about a real transformation in their lives and, consequently, in their surroundings.

Despite good intentions, many outreach professionals “extend” a technique without considering the needs and different knowledge socially constructed from the practices of everyday interactions of all those involved. Outreach actions should be understood as a liberating practice capable of generating opportunities for a collective to improve their lives. The outreach professional must be part of this collective and commit to the construction of knowledge, as a subject and with other subjects (FREIRE, 2013).

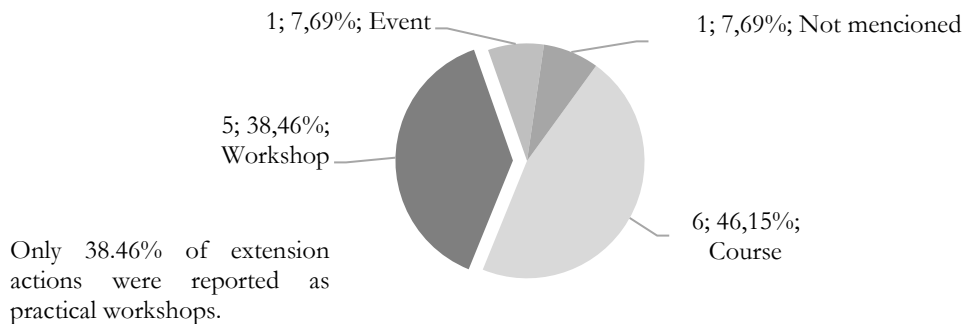
Shifting Freire's thought (1996) referring to a pedagogy of autonomy to outreach actions, the following questions are pointed out: what does an outreach teach? What is the reason? To what end? What is the point of studying a certain topic and not another?

According to Freire (1996), there are many local problems without answers, and care must be taken when choosing them since the choice already demonstrates its political character. These choices, permeated by beliefs and values, can favor a set of knowledge over others.

It is important to note that, when planning an outreach action, one should always keep in mind that the desired social transformation will need to be built together with the community and that it can appropriate the developed knowledge, achieving its autonomy in the resolution or minimization of a problem so that good living can be achieved. Using top-down concepts, following a trend, teaching for only teaching, extending ready-made knowledge to those who still do not have it – all these are attitudes that must be curbed.

Regarding “**RQ02 – What is the format of the outreach action?**”, it should be noted that six articles [2, 3, 6, 7, 10, and 13] (46.15%) report the outreach activities in the course model. For five articles [1, 4, 5, 11, and 12] (38.46%), the adopted format was workshops. Only one article [8] (7.69%) used the event format, and one article [9] (7.69%) did not mention the format of the respective outreach action. Figure 3 shows this scenario.

**Figure 3 – Formats used for outreach actions**



**Source:** Our creation.

Figure 3 shows that less than half of the outreach actions were reported as practical workshops. The authors of this article understand a course as an event that can last for hours or months to teach a certain content to its audience, with a more theoretical methodology. The workshops, on the other hand, are events lasting hours or a few days and constitute a workspace in which one builds and learns in practice.

Some articles focused on a practical perspective of outreach. As an example, the article [5] “Circuit of four stations applying unplugged Computer Sciences” (“*Circuito de quatro estações aplicando a computação desplugada*”) is cited, which aims to introduce computational thinking in students of elementary schools in the region using playful activities. The article also reports that computational thinking is a way of teaching how to solve problems, design systems and understand human behavior.

The article [11] “Systematization of the Experience of Engineering Students as Facilitators of Free Cartography Workshops” narrates a practical experience with a humanistic view carried out in



primary and secondary schools in rural communities in Costa Rica, evaluated with a low social development index. It is important to emphasize that the authors combined social cartography with free software and data technology in conjunction with the students' local knowledge of the community. In other words, the students determine what is relevant to be represented collectively on the map.

With a practical and humanistic perspective, the article [12] "Teaching Programming to Kids in Situation of Social Vulnerability" presents the results of an outreach action carried out on the outskirts of the city of La Plata with the objective of teaching programming to children and adolescents in conditions of social and economic vulnerability. In addition, the action also supports these students in their school activities using the computer.

As described in the previous paragraphs, the social concern of the professors is noted in their outreach actions. However, only four articles [1, 3, 11, and 12] explicitly reported that students worked on building the action, and not just participated in a prescriptive, ready-made, and formatted idea.

It is important to recognize the human aspects and understand the multiplicity and diversity of educational activities, as well as their different possible solutions and use (MERKLE, 2020). This action will prevent the teaching environment from becoming a normative and excluding environment. Freire warns that outreach actions cannot follow the bias of an education that domesticates students, prevents the confrontation of ideas, and disregards the construction of knowledge from interactions between professors and students (FREIRE, 2013).

Understanding that the construction of knowledge and multiple identities are socially constructed, it can be said that, regardless of prior knowledge and being in a favorable environment, any person, democratically, could contribute effectively to the expansion of their knowledge and of the community in which it operates (MERKLE, 2010). From Freire's perspective (1996), the various types of knowledge are constructed, modified, and truly expanded through practice; and, in this context, the practice and the exchange of experiences constitute a way for the multiple knowledge to be apprehended and, in this way, learned. If the theory-practice relationship does not occur, only a verbal scenario will be created that can reproduce hegemonic principles without realizing it.

In this sense, considering the formative and educational environment, any pedagogical methodology that corroborates the principle that the knowledge transmitted by professors is educational, unilateral, and absolute dogmas must be denied, being impossible to be changed and that they lend only to the subordination intellectual (MANTOAN, 2004). The understanding that teaching is not transferring knowledge must be witnessed and experienced in practice, and not just understood by professors and students in their political, ethical, epistemological, and pedagogical dimensions (FREIRE, 1996).

Outreach actions should promote practices in which professors and students seek together and learn together. One cannot detach the social experience from the learning process, and one can consider that the professor's task is to socialize knowledge and promote practical actions for the debate (FREIRE, 2013).

The bases for building outreach actions must be founded on the principles of autonomy and openness to the diversity of knowledge that professors and students already bring with them from their personal experiences (FREIRE, 2013). These previous experiences, placed in a healthy confrontation of educational practices, can become rich and meaningful experiences that, in most cases, teach more than the curriculum (FREIRE, 1996, 2013).

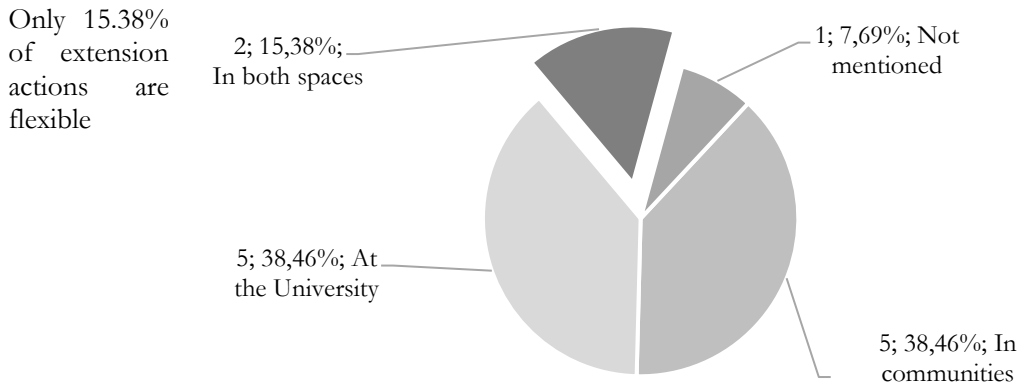
It is noted that 38.46% of the articles explicitly reported that the respective outreach actions promoted a practical experience articulated with the theory. In this scenario, the professor, or rather the facilitator, will not teach content but rather teach critical thinking based on the social construction of knowledge.

Once the research questions have been discussed, reflections regarding the research categories are now presented. Category **RC1 – location** summarizes information about the location of the implementation of the outreach activities. It is observed that five articles [2, 3, 6, 7, and 13] (38.46%) show that the actions are performed at the university. Another five articles [4, 5, 9, 11, and 12] (38.46%) were implemented outside the university, that is, in surrounding communities. Two articles [1 and 8]



(15.38%) report that the practices took place in both spaces. Only one article (7.69%) [10] did not mention the location of the outreach activities. Figure 4 summarizes this context.

**Figure 4 – Location of development of outreach actions**



Source: Our creation.

The objective of this category is to find out if outreach practices occur at the university or if they seek a dialogue within the living space of the people. In this scenario, there is a tie for locations, with five actions that are carried out within universities and five that are carried out outside this space.

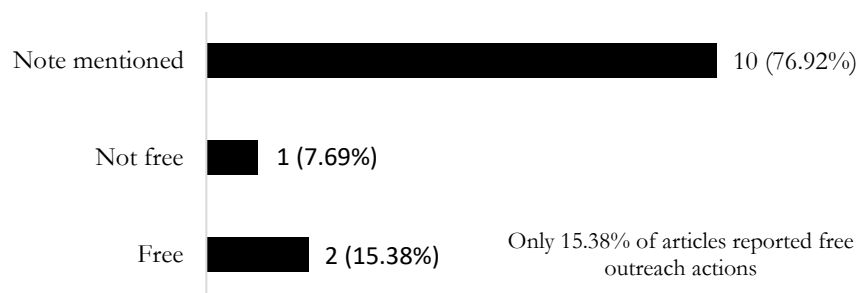
It is not possible to transform the university and the communities based on outreach actions if there is no dialogue with the participants if they are treated only as data or only as a number to fill out reports. Professors must remain open to the social, cultural, economic, and geographic context of students (FREIRE, 2013).

When analyzing Figure 4, only 15.38% of outreach actions are flexible regarding the development location and, therefore, can be carried out both inside and outside the university. Not necessarily all actions must follow this concept. It is important to point out that, regardless of where the outreach actions will be carried out, it must consider the local reality of its participants and connect it to the activities proposed in the action.

The world interferes with knowledge, and knowledge interferes with the world. In this dialectic path, learning with the other, with the other's place, is a step for outreach practices to untie from the banking ideals present in Brazilian education, becoming, truly, a vehicle of social transformation.

The **RC02 – offer** category has the objective of verifying whether the outreach actions are free or not. After extracting the data, two articles were obtained [11 and 12] (15.38%) that explicitly report that the offer is free. One article [4] (7.69%) explicitly informs that there is a payment of a fee (\$75.00) to participate in the outreach activities. Ten articles [1, 2, 3, 5, 6, 7, 8, 9, 10, and 13] (76.92%) do not make it clear whether fees are paid. Figure 5 shows this scenario.

**Figure 5 – Types of offers for outreach actions**



Source: Our creation.

It is possible to notice that the authors were not concerned with mentioning whether the outreach actions are free or not. For Freire (1996), from educational practices, teaching, research, or outreach activities, the professor, together with the community, creates ways to overcome the social injustices that are consolidated and perpetuated each day. This vision of Freire (1996) can be represented, for example, in the article [13] “A New Approach to Digital Inclusion: Report of an Outreach Experience at UFAL” (Only 15.38% of articles reported free outreach actions). The purpose of the article is to promote inclusion through digital literacy for employees of a company that provides property security services at the University.

Social injustices are hidden behind the discourse according to which the worker is in the current condition of poverty because he/she does not produce what is necessary, he/she lacks more knowledge, and he/she needs to adapt to this reality, when, in fact, the reason for their poverty is due to the exploitation they suffer from the market (PINTO, 1994).

Many students do not enter universities because they do not have the minimum amount of time and quality for their studies. Many of them work and study in schools that do not have adequate structures for teaching and with poorly paid professors, while families with better financial conditions manage to keep their children in quality schools (PINTO, 1994).

The article [12] “Teaching Programming to Kids in Situation of Social Vulnerability”, for example, describes the experience of an outreach activity in which programming is taught to a community in a situation of social vulnerability and, therefore, aims to minimize the existing precarious teaching conditions. This action was carried out in assistance centers located on the outskirts of the city of La Plata (Argentina).

No social transformation will occur if there is no understanding that men and women have choices and build their history. These people cannot adapt to poverty, they need opportunities to get out of it (FREIRE, 1996), as described in the article [13].

Given the above, it is stated that outreach actions should reduce the existing social fragmentation, allowing a better life, especially for the most vulnerable. In this sense, outreach actions need to be free of charge so that they can encompass the neediest, avoiding widening the social gap by privileging those who already have good financial conditions.

Category **RC03 – people** summarize the data regarding which people the outreach action was intended for. After analyzing the data, it is concluded that the outreach actions covered different types of audiences, such as children [8, 10, and 12], adolescents [12], basic school students [1], elementary school students [4, 5 and 11], high school students [1, 3, 4, 6, 7 and 11], students from the university [1 and 3], only students of the Electrical and Computer Engineering course [2], only students of the Computer course [9], and, finally, university employees [13]. Figure 6 illustrates this scenario.

**Figure 6** – Relationship between the people of the outreach actions versus the respective articles analyzed

	Articles													Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	
Children								•		•		•		3
teenagers												•		1
Public schools (basic education)	•													1
Public schools (elementary education)				•	•						•			3
Public schools (high school)	•		•	•	•	•	•				•			6
University	•		•											2
Electrical and Computer Engineering Courses		•												1
Bachelor's Degree in Computer Sciences									•					1
University staff												•		1

<b>Total</b>	3	1	2	2	1	1	1	1	1	1	2	2	1
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**Source:** Our creation.

The horizontal reading of Figure 6 shows that high school students are the most involved in outreach actions (there were six articles) and the article [1] (vertical reading) reports the action which encompasses more diverse public schools (elementary, middle, and high school students, in addition to students from the university).

Regarding the six articles covering secondary education, several topics were addressed. For example, article [1] proposes the learning of abstractions and logical reasoning. Articles [3 and 6] aim at teaching practical programming and systems development. Article [7] also has a bias toward teaching programming but is directed towards the Brazilian Computer Olympiad (OBI- *Olimpíada Brasileira de Informática*). Article [4] seeks to demystify the areas of science, technology, engineering, and mathematics (STEM). Finally, and as already described elsewhere in this article, article [11] narrates an outreach action that offers free cartography workshops.

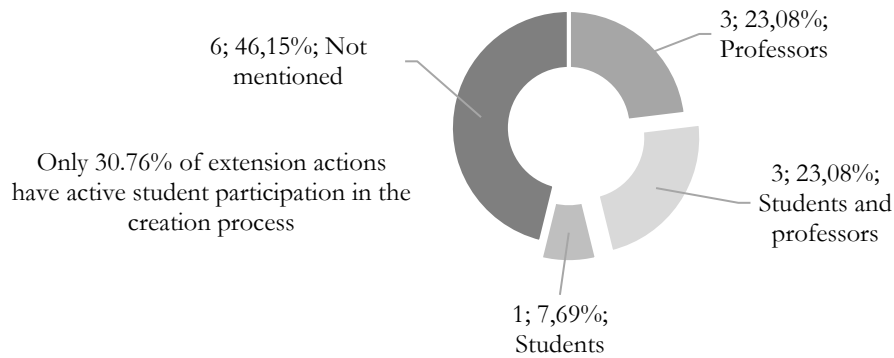
We observed that the people of outreach actions go beyond the people that already attend the university, which corroborates with the thought of Pinto (1994) when he states that the university must primarily be concerned with students who failed to enroll in their programs, which is a much larger share compared to the number of students who entered. Pinto (1994) states that the university is a trainer of future leaders and for this reason, it cannot just allow the entry of an elitist class but rather direct its gaze to the most vulnerable.

We also observed that education is rooted in values and beliefs that preach the discourse of neutrality to maintain a certain system of the known, and, therefore, solidify a certain social system that is beneficial to a minority (FREIRE, 1996). For Mantoan (2004), teaching is increasingly moving towards an elitist and homogenizing education. The training environment needs to dialogue with what happens around it, as well as with the people who are in these places, regardless of their social and economic conditions.

Based on the thoughts of Pinto (1994), Freire (1996), and Mantoan (2004), previously exposed, it can be said that outreach actions should also have a look at communities in social vulnerability so that they do not marginalize the differences. These differences must be the engine of transformation. Social transformation must go beyond the walls of universities and change the reality around them.

When going beyond the walls of the university, however, it is important to realize that one cannot simply replace the way of life of communities with ready-made and formatted knowledge. For Freire (2013), including new people in the educational process also means listening to them and learning with them; one should not leave the university to tame those who do not have certain scientific knowledge.

Category **RC04 – design** describes who is involved in the conception of the outreach activities. In this scenario, three articles [2, 3, and 4] (23.08%) demonstrate that the outreach action was created only by the professors. Three other articles [6, 8, and 11] (23.08%) report that professors and students were involved in the creation of the outreach activities. Only one article [13] (7.69%) addressed the outreach action being conceived only by students. Finally, six articles [1, 5, 7, 9, 10, and 12] (46.15%) did not make it clear who is responsible for creating the outreach action. The result of the RC04 – design is shown in Figure 7.

**Figure 7** – Main involved in the creation of outreach actions

**Source:** Our creation.

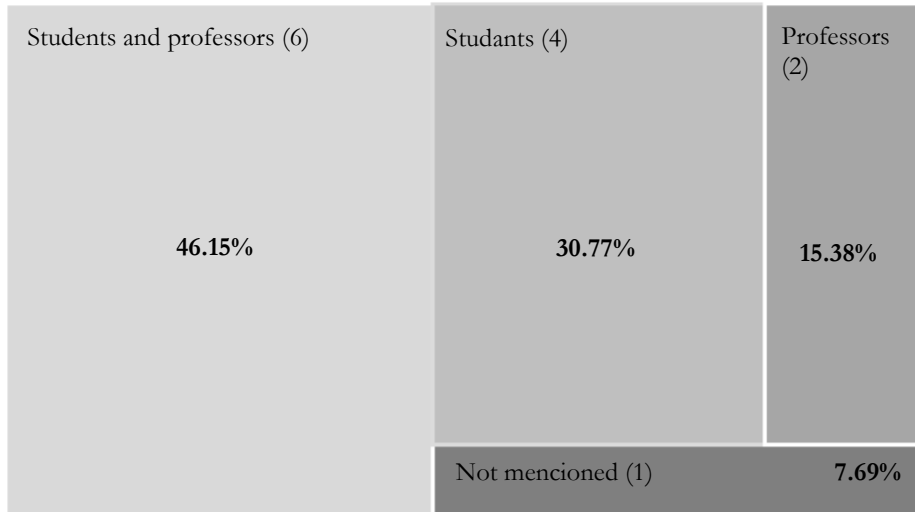
By understanding that knowledge is unfinished, the professor learns while teaching, and the student teaches while learning, and therefore, no knowledge should be absolutized. This thought is important because it helps to perceive authoritarian educational practices that disrupt the training environment. In a supportive environment, everyone learns more because everyone learns from everyone else (FREIRE, 1996).

From the analysis of Figure 7, it is noted that the involvement of students in the creation of outreach actions is low. When adding the actions developed only by students and students together with professors, only four articles are obtained as a result [6, 8, 11, and 13] (30.76%).

The very creation of the outreach action must include the target audience in a participatory manner. The feeling of urgency cannot be considered in its construction: the important thing is the journey that each one will experience and develop during this journey. By not wanting to “waste time” in dialogue with the people of the outreach activities, the outreach professional will simply be ignoring the historical and accumulated knowledge of the communities, and, in this way, the action will no longer disseminate knowledge to impose knowledge (FREIRE, 2013).

Any type of education must be humanizing, favor and encourage public participation in the construction and expansion of their reality so that they can gain autonomy in solving their problems (FREIRE, 1996). This people cannot be considered as an object that passively waits for a solution from specialists. A person from outside the community does not understand more about a certain problem compared to a person who lives with this problem daily.

To assess who implemented the outreach action, category **RC05 – implementation** was created. Six articles were obtained [3, 5, 7, 8, 11, and 12] (46.15%) that report outreach actions that were implemented by professors and students. Four articles [1, 6, 9, and 13] (30.77%) present actions led only by students. Two articles [2 and 4] (15.38%), carried out the implementation of outreach actions only by professors. Finally, an article [10] (7.69%) does not make it clear who is responsible for implementing the outreach activity. Figure 8 illustrates this scenario.

**Figure 8** – Responsible for implementing the outreach actions

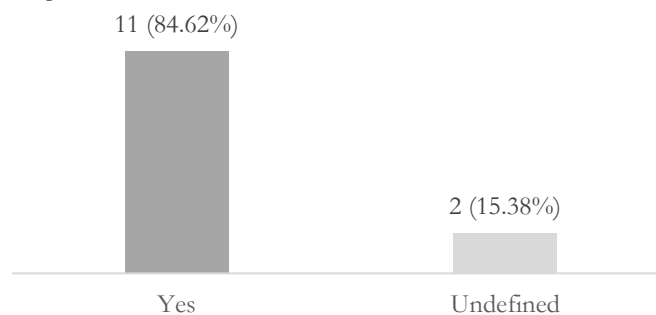
Source: Our creation.

Figure 8 shows a greater participation of students in carrying out outreach actions. When adding the outreach actions conducted by students/professors (6) and students (4), there are ten articles [1, 3, 5, 6, 7, 8, 9, 11, 12, and 13] (76, 92%). This scenario demonstrates better participation of students, making them protagonists within the teaching and learning process and, enabling them to be agents of knowledge dissemination.

This context corroborates Freire's view (1996) when the author defends the idea that students need to be understood as subjects in their interactions with others, including professors. Students need to be involved in activities that allow them to develop their communication and critical thinking skills, in addition to acting as thinking beings.

Considering that every educational practice is political, it is necessary to understand that different realities are constructed from the most varied points of view. For this reason, it is important to bear in mind that participation and exchanges of experience are essential for students to achieve their autonomy (FREIRE, 1996).

Category **RC06 – objective** analyzes whether the outreach actions achieved the proposed objectives. After extracting the data, the result was: 11 articles [1, 3, 4, 5, 6, 7, 8, 9, 11, 12, and 13] (84.62%) state that the objective proposed in the outreach action has been successfully achieved. In two articles [2 and 10] (15.38%), it was not clear whether the result was satisfactory. This scenario can be viewed in Figure 9.

**Figure 9** – Relationship between the number of outreach actions that achieved the proposed objective

Source: Our creation.

Figure 9 shows that, in general, the results of the outreach actions were achieved. However, it should be noted that four articles [1, 5, 7, and 12] made their respective conclusions based on

observations during the activities. They did not perform, for example, pre-and post-tests. As an example, it is possible to bring the article [5] “Circuit of four stations applying unplugged Computer Sciences” (*Circuito de quatro estações aplicando a computação desplugada*), which reported having achieved the objective after all the recreational activities had been carried out. In this sense, it was noticed that the children were able to develop some computational thinking skills. The article [12] “Teaching Programming to Kids in Situation of Social Vulnerability” describes that the objective was reached, by observing the activities carried out by the students.

In opposition to the previously mentioned validation methods, the article [3] “Applying PBL in Teaching Programming: an Experience Report” carried out a 360° evaluation and theoretical and practical evaluations. The article [4] “Camps on a Shoestring: How We Survived a Summer” carried out pre- and post-tests on the concepts related to STEAM.

It is important to emphasize that outreach actions must generate opportunities for a better life (FREIRE, 2013). The results present the perspective that the people learned what was taught, but do not better detail the social impact that should be achieved.

Even with all the effort of the outreach professors and understanding of the good intention they have, the concept of outreach is used in a limited way, since in many cases the lack of deeper results is noted, results that should be based on the transformation of reality and not just on teaching only for teaching (FREIRE, 2013).

Article [4], for example, addresses the demystification of the area of exact sciences, which is, in fact, a relevant subject. However, the action was not built with the community, in addition to having charged a fee of \$75.00 for participation. It is mentioned in article [4] that some subsidies were donated by schools and companies, but not all participants were contemplated.

The results of educational practices will only be positive if the subjects involved can appropriate knowledge and apply it in real situations in their daily lives (FREIRE, 1996). In this way, the results of outreach actions cannot be the training of subjects with a technique disconnected from their reality, but rather, they must allow for better opportunities for living well (FREIRE, 2013).

## FINAL CONSIDERATIONS

According to Resolution No. 7, of December 18, 2018, 10% of the activities that make up the curricular matrix of undergraduate courses must be directed toward the development of outreach actions. In addition, this resolution also defines some guidelines, such as dialogicity between society and university, citizenship training of students with a multidisciplinary vision in solving real problems, application of a humanistic perspective to understand the needs of the people and the inseparability between teaching, research, and outreach (BRASIL, 2018).

Given what was previously exposed about the obligation and importance of outreach actions in higher education courses, the following question arises: how are outreach actions being carried out in universities? To answer this question, a systematic bibliographical review was carried out to understand the general panorama of the outreach actions developed in higher education courses in the Computer area in the last ten years.

Considering the parameters outlined in the Method section, the following overview was obtained, which constitutes a finding of this research: **(1)** 61.52% of outreach actions in the Computer area address the topics of thinking computational or programming teaching; **(2)** 38.46% were reported as practical workshops; **(3)** 38.46% were implemented in communities that do not belong to the university environment; **(4)** 15.38% explicitly reported that people participation was free; **(5)** high school students make up 46.15% of the target audience; **(6)** 30.76% of the outreach actions reported the participation of students during the creation process; **(7)** 76.92% of actions were carried out by students and professors; and, finally, **(8)** 84.62% achieved the proposed objective.

After analyzing the result and contributing to the advancement of knowledge in the Computer area on the object of study “outreach”, we concluded that **(1)** there is a preference regarding the topics covered in outreach actions. However, it is emphasized that care must be taken to avoid



possible content determinism. The content must be part of the people's reality and, therefore, be selected together with them to promote a real social transformation. **(2)** Few actions were found (38.46%) reported as practical workshops. We observed that it is in practice that knowledge is constructed and, therefore, outreach actions must go beyond theoretical actions, but must not be disjointed from them.

**(3)** We observed that outreach actions often do not go beyond the walls of universities. The respective actions should also cover those who are not within the universities. **(4)** Few articles (15.38%) explicitly mentioned free participation in outreach actions. Outreach actions must prioritize the most vulnerable, therefore, the gratuity of these actions must be intrinsic to their planning.

**(5)** Almost half of the outreach actions (46.15%) focused on certain types of people. Outreach actions should cover a diverse audience, and not just those who are already inside universities. **(6)** Few actions (30.76%) were created with the active participation of students. In this scenario, it is emphasized that students must also assume a leading role in the creation of outreach actions. However, **(7)** when it comes to conducting outreach actions, students (76.92%) assume this position of protagonism.

The RBS showed **(8)** that 84.62% of the actions reached the proposed objective, which, is an expressive result. However, it is worth asking: what was the real objective? What was the social problem worked on? What was taught? Who was it taught to? How was it taught?

From the previously exposed findings, it can be stated that the main contribution of this research lies in the construction of an overview of outreach actions in the Computer area, which used the political-pedagogical thinking of Freire (2013) as a beacon to carry out the necessary analyses. This panorama elucidates that there is a long way to go within the outreach field considering the Computer courses area so that the outreach can become a mechanism capable of articulating the scientific knowledge of the university with the needs of the community in its surroundings, to be able to transform the social reality.

In this context, based on this study, we recommend that, when planning an outreach action, it is necessary to:

- Work with the demands of society, respecting the dialogue between the university and the external people;
- Seeking a balance between theory and practice;
- Diversify the people for which the outreach is intended and valued, mainly, those who are in situations of socioeconomic vulnerability;
- Encouraging student protagonism so that the components of this group can become transforming agents of their reality, thus becoming critical citizens who have a humane look at contemporary social problems.

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## APÊNDICE A

In Portuguese: ação da extensão, ações de extensão, atividade de extensão, atividades de extensão, curso de extensão, cursos de extensão, ensino e extensão, ensino, pesquisa e extensão, experiência de extensão, experiências de extensão, extensão universitária, extensões universitárias, pesquisa e extensão, prática da extensão, práticas da extensão, programa de extensão, programas de extensão, projeto de extensão, projetos de extensão, projeto de pesquisa e extensão, projetos de pesquisa e extensão, proposta de extensão, propostas de extensão, projeto extensionista and projetos extensionistas.

In English: extension action, extension actions, extension activity, extension activities, extension course, extension courses, teaching and extension, teaching, research and extension, extension experience, extension experiences, university extension, university extensions, research and extension, extension practice, extension practices, extension program, extension programs, extension project, extension projects, research and extension project, research and extension projects, extension proposal, extension proposals, extension project, and projects extension workers.

## APPENDIX B

The search strings were grouped as follows:

1. **String 1** (Portuguese and singular): "computação" AND ("ação da extensão" OR "atividade de extensão" OR "curso de extensão" OR "ensino e extensão" OR "ensino, pesquisa e extensão" OR "experiência de extensão" OR "extensão universitária").

2. **String 2** (Portuguese and singular): "computação" AND ("pesquisa e extensão" OR "prática da extensão" OR "programa de extensão" OR "projeto de extensão" OR "projeto de pesquisa e extensão" OR "proposta de extensão" OR "projeto extensionista").
3. **String 3** (Português e plural): "computação" AND ("ações de extensão" OR "atividades de extensão" OR "cursos de extensão" OR "experiências de extensão" OR "extensões universitárias" OR "práticas da extensão").
4. **String 4** (Portuguese and plural): "computação" AND ("programas de extensão" OR "projetos de extensão" OR "projetos de pesquisa e extensão" OR "propostas de extensão" OR "projetos extensionistas").
5. **String 5** (English and singular): "computing" AND ("extension action" OR "extension activity" OR "extension course" OR "teaching and extension" OR "teaching, research and extension" OR "extension experience" OR "university extension").
6. **String 6** (English and singular): "computing" AND ("research and extension" OR "extension practice" OR "extension program" OR "extension project" OR "extension research project" OR "extension proposal" OR "extensionist project").
7. **String 7** (English and plural): "computing" AND ("extension actions" OR "extension activities" OR "extension courses" OR "extension experiences" OR "university extensions" OR "extension practices").
8. **String 8** (English and plural): "computing" AND ("extension programs" OR "extension projects" OR "research and extension projects" OR "extension proposals" OR "extensionist projects").

#### **AUTHOR'S CONTRIBUTIONS:**

Author 1 - Formal Analysis, Conceptualization, Data Curation, Writing – First version, Investigation, Methodology, and Visualization.

Author 2 - Project Administration, Data Curation, Review and Editing, Resources, Supervision, and Validation.

#### **CONFLICT OF INTEREST DECLARATION:**

The authors declare that there is no conflict of interest with this article.

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