

**A systematic review of literature and analysis of learning objects in the teaching of environmental education**

*Revisão sistemática de literatura e análise de objetos de aprendizagem no ensino de educação ambiental*

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**Abstract**

In the face of the advances in technology in the educational scenery, the implementation of teaching and technological tools that manage to assist students and teachers in diverse learning environments and to promote environmental education in the basic teaching system was necessary. Along with it, this research sought to analyze, through the Systematic Review of Literature (SRL), the scientific papers available in different databases that relate the learning objects in the teaching of environmental education, evaluating them according to their classification and characteristics. Methodological procedures have been organized primarily through SRL, followed by an analytical and qualitative study of LO's classification and characteristics. Lastly, 8 academic manuscripts have been analyzed through SRL and results have shown that there is a deficit of academic works that relate both LO and EE in the educational context.

**Keywords:** Educational technologies; Digital educational resources; Education for sustainability.

**Resumo**

Diante do avanço das tecnologias no cenário educacional foi necessária a implementação de instrumentos educacionais e tecnológicos capazes de auxiliar estudantes e professores nos diversos ambientes de aprendizagem e na promoção da educação ambiental no ensino. Com isso, buscou analisar por meio da Revisão Sistemática da Literatura (RSL) os trabalhos científicos disponibilizados em diferentes bases de dados que relacionam os objetos de aprendizagem no ensino de educação ambiental, avaliando-os quanto à sua classificação e as suas características. Os procedimentos metodológicos foram organizados primeiramente através de uma RSL e secundamente pelo estudo analítico e qualitativo da classificação e das características dos OAs. Por fim, 8 manuscritos acadêmicos foram analisados com a RSL e os resultados mostraram que há insuficiência de obras que relacionam OAs e EA no contexto educacional.

**Palavras-chave:** Tecnologias educacionais; Recursos educacionais digitais; Educação para sustentabilidade.

## **1. Introduction**

In the face of the SARS-CoV-2 pandemic, the advance in technologies in the educational context has become an urgent matter, given the need for (re)organization of educational environments and projects before the process of social isolation. Such a process reverberates in the implementation of Remote Teaching, based on the technological innovation of digital resources in different professional spaces, such as classrooms, virtual platforms, and mobile education (Melo; Vasconcelos; Fonseca Neto, 2022). According to Santos and Sá (2021), the usage of technological tools influenced the dynamics of human relations since information and communication must be mainly built by digital networks through interaction processes.

In this perspective, especially in the 21<sup>st</sup> century, innovation presented by Digital Technologies of Information and Communication (DTICs) impacted the (re)construction of digital networks (virtual spaces) and learning environments, shaping new ways of searching, communicating, teaching, and assimilating different types of knowledge since these pervade through cognitive processes of memory, perception, thought, and reasoning (Nicolay; Mendes, 2021; Schuhmacher; Schuhmacher, 2023). According to Cabral, Lima, and Albert (2019), the immersion of DTICs in the basic education system provides significant results in the conception of individuals in their formative processes, experiencing the usage of technological tools in the development of pedagogical practices. As a result, the production and dissemination of digital materials of an educational nature are necessary due to the fact that these provide activities and directions that will enhance and facilitate relations among different types of knowledge and processes of teaching and learning.

In this sense, social constructs of technology in the educational context are inevitable. This is why Batista and Freitas (2018) emphasize the contributions of the usage of technological devices in education with the purpose of assisting the needs and specificities of the pedagogical process in an attempt to foment improvements in the quality of teaching and learning. Based on this premise, Araújo (2019, p. 623 – 624) states that the insertion of digital resources “[...] allows a greater comprehension of contents, once the youth is inserted in a medium where they have a complete domain over them [...], providing transformations in the assimilated ideas through outlined methodologies”.

In this context, the selection and usage of technological resources in educational environments have become recurrent and widely denominated as Learning Objects (LOs), which aim to diversify educational processes through protagonism and collaborative work (Braga; Menezes, 2024). For the authors still, the non-determined conceptualization of LOs is the consequence of the recent perspective of this technology, which may be considered as “[...] components or digital unities, cataloged and available in storage on the internet in order to be reused for teaching purposes”. (Braga; Menezes, 2014, p. 21).

Accordingly, one of the founding theorists of the discussion on LOs is David Wiley, who has defined them, primarily, as “any digital resource that may be reused to support the learning process” (Wiley, 2003, p. 7). However, Carneiro and Silveira (2014) consider these tools as materials that transcend digital conception, focusing on the characteristic of reusability through pedagogical objectives in educational and technological processes. In this premise, it is possible to notice that LOs do not present a definitive concept and may be considered digital tools (Lemos; Jucá; Silva, 2023), technological resources (Grossi; Leal, 2020), and didactic materials (Carneiro; Silveira, 2014), which means that they consist of different formats and objectives, acting upon as mechanisms of mediation, directed toward the facilitation of the learning process.

In the academic literature, the usage of LOs occurs in different fields of knowledge, such as Exact and Earth Sciences (Macêdo; Voelzke, 2020; Souza et al., 2015; Fiscarelli; Morgado; Félix, 2016), Health Sciences (Trindade et al., 2022), Human Sciences (Carvalho et al., 2018), and Linguistics, Letters, and Arts (Calicchio; Souza, 2022; Lebedeff, 2017). Consequently, it is noticeable that both the versatility and diversity of the application of technological and educational tools in different contexts of teaching and learning are relevant. The study developed by Lacerda, Sepel, and Falkembach (2017) highlights the importance of continuing education, directed toward the pedagogical usage of didactic and technological resources in an attempt to foment the comprehension of LOs to teachers and the empowerment of teaching and learning processes, decreasing conceptual difficulties and making it possible for the construction of scientific knowledge in different educational spaces.

In this sense, to Sousa et al. (2015), the usage of educational and digital technologies is inherently related to the cognitive development of individuals in the educational scenery in an attempt to provide and enable critical and reflexive thinking in different areas of

knowledge and approach, such as the teaching of Environmental Education (EE). Thus, educators may encourage motivation, concentration, and commitment to students by developing educative activities through challenges presented in LOs, which involve environmental and problematic themes, related to social and cultural aspects (Eichler; Del Pino, 2014). Given the implementation of Law no 9,795/1999, which discusses the presence and use of EA in educational institutions, formal and informal teaching must highlight and work on the concepts inherent to EE through the integration between science and technology, systematizing school curricula, teacher planning and school management, in an attempt to contemplate and improve educational, environmental and social knowledge belonging to different levels, modalities, disciplines and educational activities (Brasil, 1999).

In this case of technological expansion, the development of a relation between environmental literacy and alphabetization in the implementation of LOs in the educational scenery has become necessary. This is a favorable environment for the realization of activities that seek the construction of critical thinking about nature and different cultures, making it possible for the autonomy and responsibility of historical, social, and political aspects in the reading and intervention of the world (Souza; Pedruzzi; Schmidt, 2018; Freire, 2019). According to Topal, Yildirim, and Önder (2020), the EE's objectives align with communicational and conscient aspects, providing the mediation and assimilation of scientific concepts through didactic methods, techniques, and resources, that even use digital tools, such as websites, software, simulators, ArgGis online, augmented reality, apps for studying social and environmental issues.

The implementation of a group of technological elements and resources manages to make LOs more complete and diversified, making it possible to notice the refinement of the following characteristics: i. reusability, which states the reuse of resources in different learning environments; ii. Adaptability, which makes it necessary for the LO to adapt to the context; iii. Granularity, a group of reusable and interactive “grains” and elements; iv. Accessibility, which contemplates different audiences, scenarios, and gadgets; v. durability, which makes it interesting for the continuation of the tool in the face of technological advances; and interoperability, which describes the capacity of operating the resource through a diversity of hardware and software (Mendes; Souza; Caregnato, 2004). For the

authors still, “the objects with these characteristics are normally stored in large databases available on the internet, called repositories” (Mendes; Souza; Caregnato, 2004, p. 3).

Thus, it is necessary for educators to conduct research about papers available in different databases on LOs perspectives and applied to the teaching of EE in order to learn about the pedagogical practices and didactic and technological resources used in educational environments. As a result, the present study pursued to analyze, through SRL, scientific works available in different databases that relate learning objects in the teaching of environmental education, evaluating them according to their classification and their characteristics.

## **2. Methodology**

### **2.1. Research context**

The present study presents a qualitative approach and an exploratory objective. It was constructed under the perspective of Kitchenham’s (2007) Systematic Review of Literature as a medium for the knowledge of the nature of the different research available about a particular subject in an attempt to analyze and interpret the materials inserted in numerous databases. As to the planning stages, conduct, analysis, and dissemination of data, these will be described in the following. Moreover, the research was intended to the analysis of LOs found in the consulted databases, detailing the type, classification, characteristics, and repository of each digital educational resource, understood as a learning object in this research.

According to Kitchenham (2007), SRL planning involves the definition of mechanisms of search, identifications, and analysis, anchored on the need for pre-revisions, which “[... ] determined research questions, inclusion and exclusion criteria, source of data extraction, and research string”. (Lima et al., 2021, p. 11). Based on this perspective, the question that led to the development of the research was: how do LOs support the teaching of EE in the context of the usage of educational technologies?

In order to conduct this investigation, both inclusion and exclusion criteria were constructed (Table 1) with the purpose of shortlisting the available works that address the problem investigated in this study. In this context, the research was conducted on the following databases: the Brazilian Digital Library of Theses and Dissertations (BDLTD), Capes journals, and the Scientific Electronic Library Online (SciELO). The analysis was limited to the period between 2019 and 2023 in an attempt to obtain the most recent papers in literature and at all levels of education.

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**Table 1** – Criteria used in the research database.

Inclusion	Exclusion
The usage of LO in EE teaching	Antagonistic works to the research's objective
Research Papers in Portuguese and English	Languages different from Portuguese and English
Articles, master's theses, and Doctoral dissertations	Books, conference proceedings, and expanded abstracts
Publications between 2019 and 2023	Research works from different periods of investigation
Free access	Paid access and repeated works

Source: Authors (2023).

In this sense, SRL was conducted for the construction of the string, according to the research question, to pursue the identification of similarities among the academic materials in the literature. In order to achieve it, Boolean operators (“AND”, “OR”) were used and adjusted accordingly to the forms of research in the databases (Table 2). For Kitchenham (2007), this stage of the review highlights the realization of primary studies, aiming at the identification of direct evidence through definitions previously considered in the planning. In the face of it, the conduction of SRL and proceedings of search, acquisition, and study analysis of primary studies outline three stages: i. Selection of works; ii, application of inclusion and exclusion criteria; and iii. Readings of articles, master theses, and/or doctoral dissertations.

**Table 2** – Database research

String and Descriptors	Databases	Stage 1	Stage 2	Stage 3
1 - “learning object” AND “environmental education” AND (educational OR teaching OR learning)	CAPES Journals	60	32	4
2 - “learning object” AND educational tools AND sustainable development	Brazilian Digital Library of Theses and Dissertations (BDLTD)	6	3	3
3 - “digital resources” AND sustainability AND teaching	SciELO	3	1	1
	Total	69	36	8

Source: Authors (2023).

Lastly, SRL's final stage was the analysis and dissemination of results, given the need to communicate the data obtained that focused on widening discussions in different contexts of society and academia and emphasizing efficient strategies in the processes of dissemination (Kitchenham, 2007). The following section details the results of the present research work, as well as the evaluation of articles, master theses, and doctoral dissertations gathered in the research proceedings.

## **2.2. LOs analysis Criteria**

As instruments of analysis, the present article uses definitions of classification, according to Mercado, Silva, and Gracindo (2008), and Battistella et al. (2009), and of technical characteristics, according to Mendes, Souza, and Caregnato (2004), aiming at qualitatively evaluating the nature of LOs obtained in the SRL. In this sense, Mercado, Silva, and Gracindo (2008) classify LOs between simple and combined. The first perspective refers to the uniqueness of the resources used – as images and texts –, whereas the second contemplates a group of educational tools – for instance, the gathering of different materials that involve hypertexts, simulators, and animations.

After that, for Battistella et al. (2009), the classification of LOs outlines the aspects of non-interactive (static content as texts and multimedia) and interactive (contemplating evaluative, collaborative, and exploratory requirements). Finally, the following characteristics were analyzed: reusability, accessibility, and granularity that consider the principles of Mendes, Souza, and Caregnato (2004). The choice of such characteristics occurred in the face of the integration of aspects, which might contemplate the materials and LOs analyzed, mainly.

## **3. Results and discussion**

### **3.1 SRL Data**

Results obtained according to the research question “how do LOs support EE teaching in the context of the usage of educational technologies?” are analyzed in this section, based on the criteria previously considered in the third stage of the conducted research. In order to answer the question, the reading of 8 works originated in the process of search, acquisition, and evaluation of obtained results was realized. Next, the description of authors, disciplines, or ministered courses were introduced, as well as the level of education where LOs had been applied in EE teaching during the period between 2019 and 2023 (Table 3).

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**Table 3** – Organization of research works by authors, subject/course, content, and level of education in databases.

Databases	Authors	Subject or course/content	Level of education
CAPES Journals	Napal, Mendióroz-Lacambra, and Peñalva (2020)	Subject: Sciences Content: Sustainability in the digital era	Kindergarten
	Topal, Yildirim, and Önder (2020)	Subject: Geography Content: Earth's crust, earth, and the universe	Elementary School
	Cáceres-Jensen et al. (2021)	Chemistry and Physics courses: Content: Chemical kinetics and sustainability	Tertiary Education
	Jokhan et al. (2022)	Content: Information and communication literacy Contents: Artificial intelligence (IA) and sustainable education	Tertiary Education
BDLTD	Stangherlin (2020)	Subject: Geography Content: Sugar-ethanol activity	Elementary School/Middle School
	Chaibub (2021)	Subject: Arts Content: Brazilian biome, <i>Cerrado</i>	Elementary School/Middle School
	Buture (2021)	Subject: Sciences Content: Industrial solid residues	Elementary School/Middle School
SciELO	Grossi and Leal (2020)	Course: Environment Content: LOs evaluation in the Environment course	Tertiary Education

**Source:** Authors (2023).

Table 03 exemplifies the diversity in the implementation of LOs in different contents, contexts, and subjects, outlining the fields of knowledge as Exact and Earth Sciences, and Human and Social Sciences, contemplating almost all levels of education, making it possible to notice the versatility of such educational tools. Next, academic works about the usage of LOs in EE teaching, obtained from the research on CAPES journals, BDLTD, and SciELO databases will be detailed.



Napal, Mendióroz-Lacambra, and Peñalva (2020) have built work on DTICs as teaching and learning tools, aiming at assisting the Sustainable Development Goals (SDGs), once the authors have elaborated an educational platform named *Zapatoons*, which works as a system of selection and shortlisting of educational videos on natural and social sciences. Furthermore, this tool also aims at assisting teachers, professors, and students in the process of scientific literacy and refinement of abilities of sustainability, and working knowledge through digital resources.

The study developed by Topal, Yildirim e Önder (2020) exemplified the influence of technological apparatus in the formation and consciousness of individuals that work in conjuncture, the ideas, and goals of educational movies as LOs, supporting the development of themes that approach different environmental and scientific issues. Furthermore, Oliveira et al. (2021) highlight that pedagogical practices with the usage of digital resources are noticeable throughout the decades, becoming a didactic and technological alternative with a meaningful strength for the processes of teaching and learning in sciences and other disciplines.

Cáceres-Jensen et al. (2021) developed a study case with 22 students (Chemistry and Physics courses), relating the content of chemical kinetics with the concepts of sustainability by using digital resources in order to solve global and environmental problems in an attempt to strengthen creative, critical, and reflexive thinking in the digital era. In addition, the authors made usage of digital spreadsheets and analyzed them from the perspective of Technological Pedagogical Content Knowledge (TPACK). Such a model emphasizes the process of (self)assessment and verification of teachers and professors about the usage of digital tools and their contributions to the teaching and learning processes (Draeger, 2021).

Then, Jokhan et al. (2022) built a study using Artificial Intelligence (AI) as a digital resource and facilitator in order to contemplate the Sustainable Development Goals (SDGs), based on a sample of 1,523 students from the course of Information Technology Literacy at the University of the South Pacific (USP). In the previous study, the usage of AI was aimed at investigating the academic performance of students at the beginning of the course through methods and resources such as Intelligent Early Warning System (iEWS), Learning Management Systems (LMS), and Random Forest (RF). After using educational tools, students obtained a better performance and refinement of their abilities directed toward the

fourth SDG – education of quality – during undergraduate courses, assisting and solving challenges related to sustainability in education.

Research works found on BDLTD contemplate the material/physical and digital perspectives of LOs. In the face of it, Stangherlin (2020) constructed an educational video that detailed the historical, social, economic, and environmental process of sugarcane culture in Brazil, contextualizing its importance and influences in the geographic space in *Barra Bonita*, contemplating the subjects of sciences, geography, and history, as well as the students of 6<sup>th</sup> grade of Elementary School with scientific knowledge. The previous study coincides with the principles presented in the National Environmental Education Policy (NEEP), as to the promotion of the construction of attitudes, abilities, and ecological awareness of the preservation of the environment by developing tools and methodologies designed to an environmental dimension in formal and informal education (Brasil, 1999).

In the same perspective, Chaibub's study (2021) foments the construction of a digital tool that describes the historicity, mythology, and poetics of the Brazilian biome, *Cerrado*, from the related interface between Arts and Environmental Education, presenting poems and cave paintings from the *Cerrado*. Along with it, educational tools previously described outline the characteristics of an LO, for instance, accessibility, adaptability, durability, granularity, interoperability, metadata, and reusability, presented in the study by Aguiar and Flôres (2014).

Consequently, the last available work on BDLTD was Buture (2021) who developed and encouraged the reusability of solid residues, arising from industrial activities for the construction of sustainable products, such as eco bags and scale models, working critical learning in EE from the perspective of charter and agro-industrial cooperatives. In the face of the objectives and basic principles of EE, Brazil (1999) details the implementation of educational practices of a humanist, plural, and critical nature with an emphasis on sustainability, outlining the educational scenery through social and environmental dimensions, once it encourages students in the conservation of the environment in an ecologically, politically, and conscient manner.

The study developed by Grossi and Leal (2020) details the process of LO evaluation present in a learning space (moodle) by analyzing, in the results, the characteristics, such as interactivity, participation, flexibility, and affective aspects. Moreover, obtained LOs present the following formats: video, files (PowerPoint, PDF, Word, and images), and internet pages,

contemplating the disciplines of effluent management, environmental microbiology, and environmental chemistry. The authors concluded the absence of affectiveness, engagement, flexibility, interaction, and interactivity in most of the analyzed LOs in order to foment the learning process of students on contents about the environment in distance learning. In this sense, LOs can be used as assisting tools in the assimilation of knowledge, strengthening the cognitive development and refining attention, memory, and perception of individuals throughout their processes of conceptualization and interaction (Machado, 2016).

In the face of the research conducted on the databases, it is possible to observe the insufficiency of works that relate LOs to EE teaching, contrasting with the study of Lima et al. (2016) that has exemplified that the simple usage of digital educational tools outlines the concepts of continuous education, unavailability of space and technological resources, and the lack of time for the realization of activities.

### 3.2. Analysis of obtained LOs

Academic works obtained through SRL were submitted to analysis directed toward the classification and characteristics of LOs, according to Mercado, Silva, and Gracindo (2008), Battistella (2009), and Mendes, Souza, and Caregnato (2004) in an attempt to learn and identify the type and location of storing of those digital educational tools. Thus, Table 4 details the analytical proceeding:

**Table 04** - Analysis of OAs found in the databases.

Authors	Type	Classification	LOs characteristics	Repository
Napal, Mendióroz-Lacabra e Peñalva (2020)	Software	Combined, multimedia, interactive, evaluative, exploratory, and collaborative	Reusability, accessibility, and high granularity.	Zapatoons.info
Topal, Yildirim e Önder (2020)	Videos	Combined and non-interactive	Reusability, accessibility, and moderate granularity	YouTube
Cáceres-Jensen et al. (2021)	Hypertext	Simple and non-interactive	Reusability, moderate accessibility, and low granularity	Google tools

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Jokhan et al. (2022)	Software	Combined, multimedia, interactive, evaluative, exploratory, and collaborative	Reusability, low accessibility, and high granularity	TheMathWorks
Stangherlin (2020)	Video	Combined, non-interactive, and multimedia	Reusability, accessibility, and moderate granularity	YouTube
Chaibub (2021)	Text	Combined and non-interactive	Reusability, moderate accessibility, and low granularity	Public domain
Buture (2021)	Scale models, Ecobags (analogic)	Simple and non-interactive	Low reusability, moderate accessibility, and low granularity	Not identified.
Grossi and Leal (2020)	Image	Simple and non-interactive	Reusability, low accessibility, and low granularity	Moodle at the Federal Center of Technological Education of Minas Gerais
	Hypertext	Combined, non-interactive, and multimedia	Reusability, moderate accessibility, and low granularity	
	Text	Simple and non-interactive	Reusability, low accessibility, and low granularity	
	Video	Combined, non-interactive, and multimedia	Moderate reusability, accessibility, and granularity	

**Source:** Authors (2023).

Table 04 exemplifies the nature of each digital educational resource used in the works analyzed, making it possible to notice the multimodalities (text, video, software, among others), and the characteristics of LOs in different educational spaces. In addition, it was possible to observe that the studies make use of mediatic resources in the development of pedagogical practices, which implies a greater capacity to reuse them in different learning contexts, making planning more complete and complex by the scientific community (Souza, 2020). In this sense, Braga and Menezes (2014) report that the diversity of interactive elements enhances the intervention and immersion of students in didactic activities due to

the fact that it establishes a reciprocal relationship between the object and the individual, encouraging the interest and motivation in the construction of knowledge.

In addition, in the formulation of LOs, Fiscarelli, Morgado, and Félix (2016, p.354) emphasize “the need for the consideration of their pedagogical and technical characteristics in their evaluation, seeking the alignment of learning objects to pedagogical practices”. Thus, the present research article sought to analyze the requirements of reusability, accessibility, and granularity of the digital educational resources present in the studies obtained. The first characteristic (reusability) outlines the capacity to reuse LO in different situations and applications; however, in Buture (2021), with the usage of scale models and eco bags, it is possible to observe that, for being a physical material, it is at risk of deterioration, moisture absorption, and loss of quality when stored in non-structured and inadequate spaces. In this sense, it is relevant to highlight that accessibility must be an essential priority in the elaboration of LOs, once its usage is directed toward a heterogeneous audience in different contexts and types of equipment when considering the following aspects: visual, textual, auditory, and tactile (Rodrigues; Bez; Konrath, 2014), with different degrees of intensity in each research work – as the usage of images that do not contemplate students with educational needs in the category of visual deficiency. In an attempt to assist and transform educational environments, LOs must relate a maximum number of didactic and pedagogical resources, such as texts, videos, and software, among others, consequently implying a greater granularity of the materials used.

Although Law No. 9,795/1999 exemplifies the need to reorganize educational environments according to EE guidelines and regulations, there are still few studies in the Brazilian scenario about the use of OAs for teaching themes, problems and environmental situations, which aim at comprehensive training of students, teachers and the school community through awareness, conservation and qualification of the environment in educational institutions (Brazil, 1999). It can be stated that the development and constructs of the aforementioned law are still absent in academic research and teaching in Brazil, possibly making the training process of subjects belonging to the educational context insufficient.

Thus, the analyzed results emphasized the implementation of LOs directed to the support of teaching and learning processes, aiming at the fact that each perspective develops

specific strengths and weaknesses in the face of the context of application and evaluation. These aspects make it possible to obtain and work them physically and digitally.

#### **4. Conclusion**

As an educational dimension, Environmental Education (EE) may strengthen different concepts, practices, and contexts of learning, relating contents, disciplines, and subjects in an interdisciplinary and transdisciplinary manner, making it possible for the construction of sustainable, reusable, and digital learning objects (LOs) in educational sceneries. In this sense, the present article illustrated the results obtained through a Systematic Review of Literature (SRL) about the usage of LOs in EE teaching, realizing the search, acquisition, and analysis of the studies found in CAPES Journals, BDLTD, and SciELO databases.

Along with it, the process of research demonstrated a lack of academic works, involving criteria of inclusion and exclusion, delineated in the investigation, obtaining a total of 8 materials (articles and dissertations) at all levels of education, with the exception of High School, making it possible to notice the need to learn, develop, and expand technical and pedagogical concepts on LOs, supported as technological propositions in favor of EE teaching. In this sense, this study has concluded that the low quantitative number of works that articulate LOs and EE may have originated from the insufficiency of understanding about the usage of educational technologies (digital literacy) and the lack of continuous formation directed to teachers and professors in the transversal treatment and approach of issues of environmental themes in the classroom along with limited educational spaces for the realization of activities and exacerbated workloads. Consequently, LOs have contributed to the processes of EE teaching and learning as tools that have been used in different educational spaces and contexts, given their characteristics found, such as accessibility, reusability, and granularity with different intensities in each work, assisting teachers and professors in the construction of educational practices and strategies and strengthening autonomy, comprehension, criticism, and reflection of students in the assimilation of knowledge and environmental literacy.

Therefore, the development of future studies is necessary with similar objectives to this research in order to foment the search and construction of LOs in different approaches and pedagogical objectives, including studies that discuss critical EE, education for the sustainable development and the acquisition of social and cognitive competencies

(motivation, concentration, active listening, communication, group work) that are important for the students to build sustainable thinking and to get the EE compliance from the Law No. 9,795/1999.

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