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A Critical Look at the Sustainable Development Goals from an Experience Carried Out by Elementary School Students: To Be or Not to Be, Is That the Question

Una mirada crítica a los objetivos de desarrollo sostenible a partir de una experiencia realizada por estudiantes de primaria: ¿ser o no ser, esa es la cuestión?

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Abstract

This study analyzes the limitations, possibilities, conditioning factors, and qualitative substrates for the significance of sustainability approaches in global discourses such as the 17 Sustainable Development Goals (SDG). In order to do this, an Environmental Education workshop was held with elementary students in two public schools in Rio de Janeiro, Brazil. The students (n = 103) were divided into five groups. Each group received a kit containing a photograph of a work of art, a photograph of Rio de Janeiro, and a news report. As a result of the activity, the participants made a drawing about the construction of a sustainable world. In order to identify their drawings, a qualitative analysis strategy was used through systemic networks and classification into levels of representation. The results indicate that the students relate some SDGs to each other, although the drawings concentrated on the level of representation as description. In School 2, greater sophistication and complexity are observed in the drawings, which include symbolic, syntactic, and semantic aspects. Finally, the conclusions indicate that the drawings include imperative verbs, prescribing modes of change and action for the children to participate.

Keywords: ecopedagogy, environmental education, drawing analysis, sustainability, sustainable development goals.

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Resumen

El presente trabajo analiza limitaciones, posibilidades, condicionantes y sustratos cualitativos para la significación de planteamientos de sostenibilidad en discursos globales como los 17 Objetivos de Desarrollo Sostenible (ODS). Para eso, se realizó un taller de educación ambiental con estudiantes de primaria en dos escuelas públicas de Río de Janeiro, Brasil. En cada taller, los estudiantes (n = 103) fueron divididos en cinco grupos, cada uno de los cuales recibió un kit con una fotografía de una obra de arte, una fotografía de Río de Janeiro y una noticia. Producto de la actividad los participantes elaboraron un dibujo acerca de la construcción de un mundo sostenible. Para la identificación de sus dibujos se recurrió a análisis cualitativo a través de redes sistémicas y clasificación en niveles de representación. Los resultados indican que los estudiantes relacionan algunos ODS entre sí, aunque los dibujos se concentraron en el nivel de representación como descripción. En la Escuela 2 se observaron mayores sofisticaciones y complejidad en los dibujos, los que incluyeron aspectos simbólicos, sintácticos y semánticos. Finalmente, las conclusiones indican que los dibujos incluyen verbos imperativos, prescribiendo modos de cambio y acción de los cuales niñas y niños se hacen partícipes.

Palabras clave: análisis de dibujos, educación ambiental, ecopedagogía, objetivos del desarrollo sostenible, sostenibilidad.

Introduction

This research on educational practice proposes discussion regarding the limitations, possibilities, conditioning factors, and qualitative substrates for the significance of sustainability approaches in global discourses, based on the presentation, discussion, and reflection of experiences from a workshop on environmental education in two municipal schools in Rio de Janeiro, Brazil. Held in 2019, these workshops were part of the schools' science fairs and approximately 100 elementary school students took part. The study dialogues with global agreements for sustainability and understands that environmental education in schools interprets and translates these agreements, and defines pedagogies and approaches for certain topics.

Within the range of pedagogical perspectives regarding environmental issues, we can identify certain more conservative approaches to the relationship between humans and nature and others that are more radical, which are characterized by containing different political-pedagogical macro trends of environmental education (Layrargues & Lima, 2014). The most radical views can be recognized by their commitment to changes in development models towards a post-development agenda (Kothari, Demaria, & Acosta, 2014). Indeed, the environmental issue is controversial and polysemic (Carneiro, 2005; Freire, Bozelli, Espinet, & Martins, 2012; Jatobá, Cidade, & Vargas, 2009; Teodoro, 2012).

The Sustainable Development Goals (SDGs) were adopted in 2015. They are part of the International Protocol of the United Nations (UN) General Assembly, where the signatory countries agreed to implement the *2030 Agenda for Sustainable Development*. These actions involve creating awareness, acquiring knowledge, and mobilizing actions to guarantee greater social justice and preservation of the environment. However, many of them do not reject the model of growth and development that we have experienced to date and instead propose palliative measures based on technological advances to solve environmental problems. In this respect, Nascimento (2012)

argues that the official and hegemonic environmental discourse is not transformative, so it should consider investments in technological development to solve environmental risks and problems, and approaches so that all human beings can access better futures and a higher quality of life on equal terms.

Different hegemonic discourses (Alves, 2010; Laclau & Mouffe, 2004) addressing environmental issues are guided by a common matrix that originated in the 1970s in the major Unesco conferences and, although their emphasis has changed, they continue to cultivate "market sustainability" (Lima, 2003). These discourses are particularly powerful in terms of involving various sectors of society, assuming a dimension of shared value, although they display weak feasibility (Lima, 2003), given that development proposals inserted into a capitalist society are oriented by the market (Harvey, 2003).

Moreover, these discourses have colonized various fields of knowledge—including education (Lima, 2009)—and we can highlight the following of them:

a) Agenda 21, launched in 1992 (Malheiros, Philippi Jr., & Coutinho, 2008) and its influence on school curricula.

b) Millennium Goals in the 2000s (Sachs, 2012) and the SDGs in 2015 (see 2030 Agenda, United Nation, UN, 2015).

c) Proposals at the local level for generative issues such as, for example, in 2019 the network of public schools in Rio de Janeiro used the approach to the SDGs as a theme.

However, political and cultural dimensions tend to be neglected when planning these approaches (Nascimento, 2012), since recognizing the differences between social groups in terms of access to a healthy environment and the power to make decisions regarding its different uses and their cultural values is part of critical scrutiny of the environmental issue.

So, for example, Freire and Rodrigues (2020) underline that "plural environmental knowledge" and having a civic education are ways to more radical approaches to the subject, since they focus on patriarchal and extractivist societies that consider the human being to be the center of everything and where anything can be commodified and consumed (Bauman, 2001). Furthermore, this knowledge proposes a dialogue with science that is understood as a human activity that seeks to discover, through a mixture of experimentation and theoretical reasoning, the entities, structures, and mechanisms that exist and operate in the world (Bhaskar, 1997; Hamlin, 2000). This dialogue about the fields of science and environmental education in light of their social objectives should create greater possibilities so that teaching-learning processes related to techno-scientific aspects can be immersed in social, political, and economic issues. This allows comprehension of the macrosocial issues that create socio-environmental problems, along with social participation based on decision-making that is not merely individual, but highly collective (Sauvé, 2010).

Given this global scenario of the environmental issue and the challenges for the 21st century and their pedagogical scope, we are interested in researching educational practice considering the possibilities of theoretical elaboration according to the following question: What are the limitations and possibilities of school pedagogical practice when resignifying global agreements for sustainability based on critical scrutiny of such agreements?

This study therefore critically interpreted the SDGs in order to understand the local and global scale of socio-environmental problems and their interrelations, based on educational practice that characterizes the environmental issue as complex, and which has cultural, labor, political, and geoepistemological dimensions (Harvey, 2003), as well as political and economic transformations to understand the contemporary world, in addition to ecological dimensions. We assume the supposition that multimodal language (Márquez, Izquierdo, & Espinet, 2003) and

different textual genres (Borges, 2012) fulfill specific roles in the classroom and encourage the approach of the complexity of the environmental issue, providing meaning to school scientific knowledge present in environmental issues and which, in parallel, are open to other expressions such as art with a sociocultural approach, which we believe is essential for the development of a critical look at the SDGs in a pedagogical plan.

Framework of reference

As a theoretical framework we use aspects related to sustainability, environmental education, and representations that are relevant for this research.

Sustainability in contemporary society and academic debate on this concept

From a historical perspective, the term sustainability emerges from debates and concerns about the environment and human interference. Meanwhile, the environmental movement outlines different phases, where at the beginning of the 20th century ecology and economics were incompatible. According to Jatobá et al. (2009), moderate environmentalism emerged in the midst of the oil crisis in the 1970s, managing to reconcile economy and ecology, motivated by the threat of the continuation of the economic model due to the progressive depletion of the planet's natural resources. From that point onwards, conciliation was incorporated into official discourses, first with ecodevelopment—a term proposed by Ignacy Sachs (1993) and which comprises five dimensions: social, economic, ecological, cultural, and spatial—which provide a moderate viewpoint, but still somewhat critical of the developmental model (Kon, 2007) underway in Latin American countries (Trejos, 2012). Subsequently, in order to provide a more friendly perspective, the term was changed to sustainable development, which was defined as development that "that meets the needs of the present without compromising the ability of future generations to meet their own needs" (UN, 1987, p. 23). The concept is currently present in official speeches around the world and draws attention to ecosystems' limits of absorption and regeneration for the human future.

With regard to the range of definitions, Rodríguez and Héctor (2006) conducted a detailed study of the different conceptions constructed around sustainable development, but they emphasized the Spanish term *sostenible*[1]. In this respect, they consider that contrary to *desarrollo sustentable*, *desarrollo sostenible* transcends economic interests to reach an understanding of the need to establish mechanisms for the reappropriation of nature, which consider multidimensional aspects of the different collective identities. Furthermore, the term sustainable (in the sense used here) implies a relationship with nature that is the result of social, political, and economic arrangements and commitments on the part of the subjects, tending to seek a state-market-society-environment equilibrium (Rodríguez & Héctor, 2006).

Thus, in certain parts of Latin America, environmental disputes earn their own words with meanings that endorse more or less radical relationships regarding socio-environmental changes (López Ricalde, López Hernández, & Ancona Peniche, 2005). In a complimentary manner, the work of López-Pardo (2012) outlined a possible map of the transition towards sustainability and makes advances with regard to global governance, but continues to back technological innovations and new social structures. In addition to this are the terms

1. Translator's note: In Spanish there is debate regarding use of the term sostenible (to be sustainable in terms of ecology, economically viable and socially equitable) and the term sustentable (to be defendable and supportable/tolerable). However, in English both of these terms are directly translated as sustainable in this context, so, despite the fact that there is a difference between desarrollo sostenible and desarrollo sustentable in Spanish, the equivalent term in English is sustainable development and, therefore, this dilemma between the specific definitions in the Spanish language does not exist, at least with regard to the environmental issue.

weak and *strong sustainability* (Álvarez, 2013, Fernández & Gutiérrez, 2013; López-Pardo, 2012). Meanwhile, González-Gaudiano, Meira-Cartea, & Martínez-Fernández (2015) reestablished the criticisms of the term sustainable development and the proposals for the differentiation of weak and strong sustainability, given the plethora of debates on the subject with little consensus.

In contemporary times, it would be worthwhile to reflect and discuss how a society could in fact be considered sustainable (strong sustainability), when capitalist economic policies—which promote well-remunerated international relations, the expansion of industries, agriculture, etc.—do not allow an egalitarian society (Hearn, Foth, & Stevenson, 2011; Wade, 2004). Furthermore, the model continues to generate changes in the climate (Nobre, Lahsen, & Ometto, 2008), the mass destruction of natural resources (Vanhulst & Beling, 2013), and other environmental problems. In other words, we agree that, if we cannot move past moderate environmentalism in order to progress towards more radical perspectives that allow a post-development agenda to be specified (Kothari et al., 2014), approaches regarding sustainability will also have low effectiveness. It is for this reason that we believe that, since the 1980s, the emergence of discussions based on political ecology has contributed to the cultural aspects of local communities being intrinsically related to social and political structures, creating scenarios of disruption with existing arrangements. Thus, over time, environmental movements that advocate for social justice and propose resistance and alternatives to development have been gaining ground (Jatobá et al., 2009), as well as other possibilities for new socio-environmental emergencies and, although they are still theoretically based on the field of political ecology, such debate could, over time, contribute to strengthening the field of practice and research in environmental education.

On the other hand, Kothari et al. (2014) contend that the characteristics of a post-development agenda include political governance and the economy "centered on the community" (p. 370), which implies a more representative direct democracy and with government institutions responsible for local institutions, where the means of production are seen as public or community property and public policies for sustainability are adopted without emphasizing market competition at the global level. Likewise, we can state that another characteristic of the post-development agenda is justice and social equity, where cultural diversity and spiritualities are respected and where the relationship between human beings and nature also includes new approaches based on the value of non-human life.

In summary, the central concepts of this debate are related to placing sustainability in discursive plans and linking them to effective commitments for social transformation. Hence the connection with approaches that reveal the tensions between discursive hegemonies with respect to the environment. In the field of the most radical approaches, considering the post-development alternative and agenda, the proposal for sustainable societies arises (Diegues, 1992; Leff, 2007; Lima 2009), which emphasizes the plurality of roads to build. Indeed, the team conducting this research has been working with the emergence of "new" roads (Freire & Rodrigues, 2020) and what we have found enables us to characterize the *Swaraj* in India (Kothari, 2018), the *Buen vivir* among the Andean ancestral peoples (Acosta, 2012), and *Ubuntu* in sub-Saharan Africa (Le Grange, 2018) as perspectives that are not seen as being closed and nor do they seek to be all-encompassing.

We would like to point out that post-development is a term that does not make much sense for Latin America, since many of our countries have not yet achieved "development" as such (understood as control and power of capital). Even so, the examples cited exist in regions that have not achieved *this* western development either, which is positive, perhaps because for them some of the challenges of global agreements already form part of their routines and their relationships with nature.

Lastly, we know that the debate regarding these issues is not straightforward, because although we have adopted the term sustainability, supposing a link with emancipatory and transformative processes of society, many authors point to the existence of limitations in the proposals based on the global scenario presented in the introduction.

Environmental education in educational practices

We place our research in the field of environmental education, since we recognize the role of research on this topic in Latin America. Thus, based on commitments to social transformation, "the challenges of environmental education are the awareness and awakening of the reflexivity of a human being who needs to rethink their relationship with the environment and the values that permeate it" (Marin, 2006, p. 277).

Throughout the 2000s, environmental education in Latin America has been increasingly understood as a political field (Bourdieu, 2011), where different social agents display different political and operational positions. This implies understanding it in its genealogical complexity, considering linear and historicist representations that do not ignore the confrontations, conflicts, and struggles that constituted it (Meira, 2009) and which approach it from a double perspective: on the one hand, they establish its limitations and the relative position that its occupies socially and, on the other, they point to its internal structure to interpret the causes of its vulnerability and subordination to the dynamics of other people, despite the progress made in the past (Núñez, Castro, & Cartea, 2017).

Therefore, the internal and external disputes that characterize aspects or tendencies of environmental education assume different and sometimes antagonistic characteristics that give their identity a dynamic notion, revealing the external tensions that give rise to, for example, the appearance of education for sustainable development, as stated by González-Gaudiano and Puente (2010), as well as education for sustainability, which, far from being rhetoric, decries a struggle to hegemonize the field of environmental education. Lima (2009) argues that a substitution of terms also represents a political and pedagogical regression, since it makes use of identity frameworks marked by critical and emancipatory socio-environmentalism and by a new denomination that promotes economist aspects in the developmental discourses of moderate environmentalism and the conservative influences of contemporary thought about neoliberal hegemony. In the current times (Giddens, 2003), this problem is accentuated, because many authors consider that the discourses have a hybrid nature (Fairclough, 1992): if, on the one hand, hybrid discourses are constitutive of late modernity, on the other—when environmental education is committed to social transformation—not all of them serve this purpose.

That said, from a regional perspective, in Latin America (González-Gaudiano & Lorenzetti, 2009) the debate regarding pedagogical practice in environmental education has somewhat ill-defined outlines: on the one hand, there are conservationist proposals (Layrargues & Lima, 2014) that focus their pedagogies on the ecological issues of the environmental debate, pragmatic proposals that support effective management of consumer goods from production to disposal using technology; and, on the other, there are the formulas of political and social organization to which our young democracies often do not respond (Gadea & Scherer-Warren, 2005).

On the other hand, although the interdisciplinary characteristic of environmental education enriches the field with wide-ranging and profound discussions, the study of the environment involves many other areas that span a variety of different school subjects. Similarly, despite the fact that environmental concern has gained space in school curricula around the world (Torales, 2013), it still inhabits a "non-place" in public policies, and in educational spheres (Freire & Rodrigues, 2020).

Indeed, science teachers are often made responsible for teaching environmental education. However, González-Gaudiano (2005) considers that addressing the environmental aspect in the school curriculum in the form of subjects "would not only fragment the environmental topic, as with other subjects, but would prevent its articulation with different areas of knowledge in search of creating interdisciplinary relationships" (p. 126). In this regard, Leff (2002) argues that the fragmentation of knowledge in the subjects would be directly related to the disaffection of people from environmental problems, while Figueiredo (2020), far from solving the debate, identified the existence of a interdisciplinary approach to environmental education in higher education, so interdisciplinarity would appear to be a way of restructuring school knowledge that has traditionally been disciplinary.

Drawing as a way to evoke and give meaning to observed phenomena

In the context of science education where the workshop was carried out, we sought theoretical contributions from this field and its relationships with the representations. This is because being able to explain the world around us based on the natural sciences means relating facts and imagined theoretical entities in such a way that the discourse created is meaningful (Merino & Sanmartí, 2008). The evolution of explanations throughout the history of science has involved reviewing "the ways of looking" at facts, as well as imagining theoretical entities and talking about them. Likewise, teaching science in school involves helping our students create imaginary entities and use them in a meaningful way to explain their observations, in this case with the SDGs. Thus, learning throughout schooling would be related to stimulating children to test their initial models by means of conducting new experiments and imagining changes in their models so they are more consistent and they have better ways to talk about them (Scott & Jewitt, 2003).

In school, these entities are not necessarily part of expert science, but they should be consistent with it in one way or another, so that they can evolve through schooling, that is, the entities in school science should reflect academic science (Acher, Arcá, & Sanmartí, 2007). From this perspective, therefore, learning implies changing the meaning of experiences, so if we encourage our students to develop strategies that help them imagine models, communicate them, test them, and regulate them, we can state that they are carrying out a school scientific activity (Izquierdo & Adúriz-Bravo, 2003).

In this respect, when we talk about "models", we mean that, like other meta-scientific concepts, these notions defy the formal definition (Ziman, 2001). For example, an accepted point of view today is that a model "is a representation of an idea, object, event, process, or system, created with a specific objective" (Justi, 2006). In some way, this representation abstracts and translates the modeled entity not only on the basis of direct perceptions, but also on the basis of previous ideas. In the context of scientific activity, imagining implies modeling. The process of modeling also involves changing the ways of talking about the phenomena and the model created. Therefore, initially the words or drawings used to describe a phenomenon or a certain interpretation come from everyday language and from analogies related to situations or explanations that are already known (Selley, 2000). Through the process of modeling, students recognize the need to create new representations and use new words—or drawings in our case—that better express the model that gives meaning to the observed phenomena. This new meaning of a representation would be a type of "visualization", which is very important in science and even more so in science education, where students are required to acquire this ability in order to progress between levels of representations (macro, micro, and symbolic), as well as in sublevels (3D, 2D, 1D) and manage to move between them (Gilbert, 2005). Although studies related to visualization have so far examined representations in chemistry and do not use the terminology adopted in this article, the idea of progression in the representational competence of Kozma and Russell (2005) is useful, as it suggests which educational opportunities should be provided in order to develop visualization. However, this progression needs to be reformulated in terms of "levels of representation", which are specific for each scientific notion, in our case the SDGs (UN, 2015).

Methodology

In order to put the ideas discussed thus far into action and investigate the limitations, possibilities, conditions, and qualitative substrates offered by school practice to resignify the SDGs, we use a qualitative methodological approach that constitutes a case study. This approach allows a phenomenon to be studied in its real context (Yin, 2003), while at the same time expanding knowledge of the SDGs and their limitations through intensive study of a group of students (Taylor & Bodgan, 1994).

School context and participants

The participants belong to municipal schools that are within the structure of the Municipal Education Council of Rio de Janeiro and are located in the Olaria neighborhood in the suburbs of the city. The schools have urban characteristics and are in an area in which the population density is greater than 30,000 inhabitants/km2. The students belong to lower and lower-middle economic strata. The general characteristics of each school are the following:

- School 1 operates on a part-time basis (morning and afternoon) and receives students from 1st to 9th grade. A total of 47 students from this school took part in the workshop and were divided into three sessions. The students (boys and girls) were between 11 and 15 years old.
- School 2 operates on full-day basis, with music being a central part of its institutional development plan, which enables students to develop in the field of musical arts. This school accepts students from 7th to 9th grade and 57 students (boys and girls) took part in the workshop, being divided into three sessions. They were between 12 and 15 years old.

In both schools, the central theme for 2019 was related to the SDGs and, in the case of School 2, we worked in cooperation with the teacher training program of the Universidad Federal de Río de Janeiro.

Description of the workshop

The workshop was organized and adapted based on what was proposed by Figueiroa, Andrade, Mejía-Cáceres, Pedroso, and Freire (2019) at three times with different semiotic modes, encouraging interactions between students. The objectives guiding the design of the workshop were the following:

- Recognizing different aspects of sustainability.
- Analyzing data and images referring to local or global socio-environmental problems.
- Relating content discussed with the SDGs.
- Reflecting on the roles of citizens based on the experiences and localities of the students.

As conceptual content we worked with terms such as environment and sustainability. The procedural contents considered were, among others: analyzing and relating the SDGs with the texts and images presented, and discussing and presenting the tasks in groups and drawing the subject's personal view on the basis of the discussions. As attitudinal content we stimulated sustainability as a social value, listening, group work, and feeling part of socio-environmental issues, while as a learning objective we expected that at the end of the workshop the students would be familiar with the SDGs, connecting them with a more complex view of sustainability in which they perceive themselves as agents of socio-environmental change.

The didactic model used was inspired by the planning of ecopedagogy (Payne, 2018) and training in environmental education (Cosenza, Freire, Martins, & Espinet, 2014), in which the activities progress in stages of diagnosis, educational action, and generative dialogue, which we complemented with participatory methods including group discussions and shared visualization techniques, and with drawings regarding the SDGs.

The workshop began with a brief presentation of the instructors before the students were asked to form five working groups and it was explained that each group would receive a kit with: a) a photograph of Rio de Janeiro, b) an image of a work of art, and c) a text on a news report. The instruction was for them to have to discuss and consider the question: what do these three objects have in common? (See Annex 1).

A mediator from the research group was present for all of the groups, leading the discussion through previously chosen key questions that provoked reflection on the socio-environmental problems that we are experiencing at present: What do you observe? How are the elements that make up the pieces of material related? What do you think this image means? Is there something in common between the photograph, the images, and the reports? Do these materials have something to do with the environment?

After discussion in groups, one or more representatives briefly presented the reflections that emerged from analyzing the pieces of material to everyone in the room. At the end of the presentations, each group stated in which of the SDGs the topics discussed could be placed. This was followed by a period of collective discussion regarding the concept of sustainability and the SDGs, before proceeding to explain the connections between the pieces of material presented, seeking contrasts, rights, and access to the SDG proposals. After the explanation and relating of the SDGs, the following questions were asked: What discussions were raised by your group? What does all this have to do with the environment? What does sustainability mean? How can we interpret sustainability as a (current) social value in the piece of material analyzed? What aspects of the SDGs can be represented in the material?

Finally, the students had to draw or write on a blank sheet something that they considered was important to guarantee a more sustainable world based on the discussion carried out on the evocative questions on the SDGs.

Strategies to analyze the data

To understand the data collected in the workshop, in terms of limitations, possibilities, conditions, and qualitative substrates for the significance of the SDGs, we mainly used the drawings made by the participants in the workshop. Based on these inputs, we established a strategy based on three progressive stages:

Classification of the main components of the drawings. This stage begins with the search for regularities, possibilities, and limitations. Among the different methodological options to organize and analyze qualitative data obtained from open instruments, interviews, observations in the classroom, drawings, and other records, we can use "systemic networks". In this respect, Bliss, Monk, and Ogborn (1983)—proponents of this methodology—argue that the networks that result from reviewing the drawings would show the dependence and independence between the ideas, feelings, and values, which, in our case, were expressed by students participating in the workshop. That said, each configuration is just one of the many possible that can occur and which have to be interpreted by the researcher, who structures them based on what is said, written, or drawn, as in our case. In order to create that link between what is said, written, and drawn in the systemic network, Bliss et al. (1983) proposed rules that allow a common graphic language to be established between the individuals using this methodology. The criteria and results that are obtained once the process has been verified may (or may not) satisfy linguists or scientists, but they allow the description of the data to be connected with the possible characteristics (or interpretations) of them.

The construction of a systemic network generally begins when the drawings to be organized are interpreted. The first step was therefore the organization, classification, and coding of the drawings (Figure 1), before then counting the frequency percentage of the events (Figure 2).

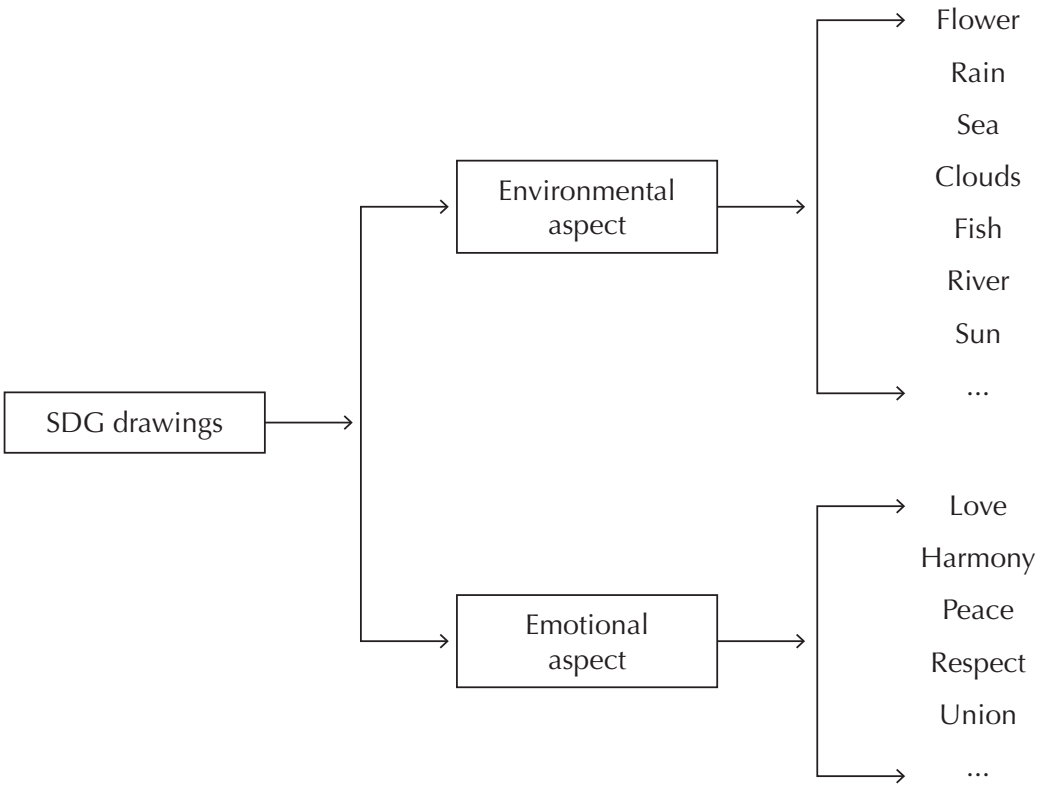


Figure 1. Systemic network with the main components of the drawings collected in the workshop.
Source: Prepared by the authors.

Identification of the drawings with an SDG. The second stage continues in a complementary fashion to the classification of the drawings, with thematic assignment to one of the 17 SDGs. Once the drawings had been coded and their main components identified using the networks, we then linked them to the themes established in the SDGs. This assignment was carried out by two expert researchers and they used a Cohen's kappa coefficient to assess subjectivity in the classification of the drawings.

Levels of representation of the SDGs. Finally, the third stage of this strategy is carried out by assigning the representation levels (Kozma & Russell, 2005). As we stated previously, these levels have to be reformulated to be specific to the sustainable development goals and objectives (UN, 2015). Table 1 shows the levels and their translation in terms of the SDGs and what is expected for each level, making it clear that this is strictly speaking a first methodological approach.

Table 1
Levels of representation linked to the SDGs

Code	Levels	Description
Level 1	Representation as description	When asked to represent the sustainable world, the person creates representations based on symbols already represented in the SDGs or in the works of art in the kit; uses common sense and/or generic images.
Level 2	Early symbolic abilities	When asked to represent the sustainable world, the person creates representations based on one of the aspects of sustainability (ecological, economic, others), but also includes some symbolic elements to accommodate the limitations of the medium (e.g., the use of symbolic elements such as arrows to represent dynamic notions, time, movement, or an observable cause on a static medium such as paper) creating their own representations.
Level 3	Syntactic use of formal representations	When asked to represent the sustainable world, the person creates representations based on the link between two or more dimensions of sustainability, exhibiting a process or behavior considering the medium (although they are not precise processes, they are oriented towards the transformation of society), using symbols and creating their own representations.
Level 4	Semantic use of formal representations	When asked to represent the sustainable world, the person uses a system of formal symbols to represent underlying entities and processes, whether observable or not, which express different dimensions of sustainability, as well as including temporary relationships between past, present, and future, and cause and effect. The person can make connections with two different representations or transform one representation into another based on the shared meaning of the different representations and their characteristics.
Level 5	Reflective and rhetorical use of representations	When asked to represent the sustainable world, the person uses one or more representations to explain the relationship between different dimensions of sustainability, including temporary relationships between past, present, and future, and cause and effect, within a social context in which the person is a participant in social change/transformation.

Source: Prepared by the authors based on Kozma and Russell (2005).

In order validate the matrix and assign the drawings a level and an SDG, we used the kappa coefficient test (concordance index) with two environmental education experts. As an indicator of reproducibility, this has the drawback that even if the two observers use independent criteria for the classification, a certain degree of agreement could potentially be produced by chance. It is preferable for a concordance index to take this into account and somehow indicate the degree of agreement that exists above that expected by chance. In this respect, the index most commonly used index is that proposed by Cohen (equation 1) called the kappa coefficient (k), which is defined as:

$$K = \frac{P_0 - P_C}{1 - P_C} \qquad \text{(ecuation 1)}$$

With P_0 being the proportion of observed agreements and P_c the proportion of agreement expected in the hypothesis of independence between observers, that is, agreement by chance. In our case, the degree of agreement in the classification of the drawings was 0.86 in terms of the *k* value. According to Cerda and Villarroel (2008), for values obtained in the [0.61-0.80] range, the degree of agreement is considered substantial.

Results and Discussion

This stage is separated into two sections. The first provides a more general description of the discussions that took place during the workshops and the possibilities experienced to overcome the official and hegemonic environmental discourse, adding the cultural and power dimensions. The second and more specific stage outlines the meanings of the drawings and the levels of representation with regard to the environment aspect, which ranged between sustainability proposals that reproduce hegemonies and those that are oriented towards social transformation.

Discussions carried out during the workshops. Qualitative substrates for the significance of the drawings

One or more representatives of each group presented the news report, work of art, and the photograph (Annex 1), and then orally reported their specific observations, often in relation to their own day-to-day life, before later expanding on the relationships towards the SDGs or the lack of them in their lives.

The students who were given kit 1 highlighted the expressions of the people, the arid environment in the background, and a sick child. They noted the difference in the structure of the houses in the same area of the city (some luxurious and others precarious), the lack of basic sanitation as the common point in the three different pieces of material and how this negligence can cause various diseases and be related to a community's lack of empowerment. The role of the different textual genres thus fills the role of adding the information that the disease involves social determinants and is not purely a biological condition (Buss & Pellegrini-Filho, 2007). The contents of the kit showed the most explicit relationships with SDGs 1, 2, 3, and 6

Meanwhile, some of the groups that examined kit 2 highlighted the vivid colors, the lifeless and tired expressions of possible workers, and industry as the workplace. They highlighted the pollution in Guanabara Bay (BG) and were surprised by the number of unemployed people in Brazil. They related all the pieces of material to poor working conditions and unemployment. The contents of the kit showed the most explicit relationships with SDGs 7, 8, and 10.

The students who were given kit 3 mentioned the destruction of the planet and the human being in art. They linked the increase in diseases to pollution, the neglect of the authorities regarding quality healthcare, and also with diseases caused by the lack of basic sanitation. Similarly, they connected the three pieces of material with the increase in atmospheric, acoustic, visual, and water pollution, the neglect of the authorities with regard to the population, and the increase in temperatures, diseases, and pollution. In this case, the contents of the kit showed the most explicit relationships with SDGs 3, 6, 13, 11, 14, and 15. Finally, despite the possibilities of relating the photograph of the University Hospital located on the UFRJ Campus, the students did not mention SDG 4.

The students who were provided with kit 4 mentioned the expressions of the people, their thinness, the arid land, and the lack of opportunities in the artwork. They talked about economic and food inequality in Brazil. They observed the amount of garbage in a river and many related the three pieces of material with areas that have problems of poverty, hunger, and unequal access to better living conditions. The contents of the kit made it possible to establish the most explicit relationships with SDGs 1, 2, 10, 12, and 14.

Finally, the groups that had access to kit 5 were able to observe people protesting for their rights in the photograph; they mentioned social and political problems. They made a connection between wars and their negative consequences, such as deaths, suffering, and the absence of collective interests. They related the three pieces of material to themes such as war, the need for effective world peace, social and political rights served by the public government, and the action of the UN in extreme cases. The contents of this kit showed the most explicit relationships with SDGs 9, 10, 16, and 17.

The discussions produced generated an approach to environmental issues that is close to the objectives proposed to address socio-environmental complexity, managing to create didactic strategies for the topic. Indeed, in light of the questions and the debates, the students gave explanations regarding their views on the environmental issue, many of which reproduced official statements of moderate environmentalism. Concern for future generations was the subject of debate, as well as the more ecological understanding of sustainability. More than the texts, the photographs gave the discussion the possibility of identifying with the reality of urban spaces and some students who looked at the image of the river said that there was also a river near their home where their parents used to swim, but which is now completely polluted. Others, when studying Pablo Picasso's work of art, related the "war" to their day-to-day experiences of shootings in the surrounding communities, characteristic of the realities of violence, insecurity, and social conflict in the city of Rio de Janeiro. This provided an exchange of local experiences that enabled relationships to be made with the global situation, through experiences of the past or present; and possibly the future? In some way this was represented in the drawings based on what the students considered to be important to ensure a more sustainable world.

Between reproduction and social transformation: the meanings of the drawings and the levels of representation with regard to the environmental aspect

In the second stage of analysis in this process, we characterized the drawings based on the steps described in the methodology. First, we presented the main components of the drawings, then their identification with an SDG and, finally, the classification of the levels of representation that evoked the possibility of building new approaches to a sustainable world and overcoming its limitations, possibilities, conditioning factors, and qualitative substrates pedagogically.

Stage1: Classification of the main components of the drawings. In Figure 2 we can see the iconographic contents present in the drawings from the two schools. The two groups of drawings analyzed show a significant proportion of elements of the environment: forest, rivers, sea, fish, and elements such as planet Earth and water, as well as emotional aspects: joy, peace, and union with others. We were also able to observe that the set of drawings from School 1 contained certain elements that were not seen in the drawings from School 2, including people working in traditional activities such as fishing and representations of government. In the drawings from School 2, there were also differentiating elements, such as flowers and rain. Representations of emotions were observed in the drawings from both schools, but depictions of harmony, peace, union, and health were prevalent in those from School 1. At this stage it was not possible to observe a single trend in the drawings, but solely iconographic contents with ecological or other meanings, precisely because of the fact that emotions were present, as well as trades, the urban aspect, and institutions. However, in the drawings from School 1, the sun was the element represented most frequently, being present in 30% of them. In School 2, the sun was the second most represented aspect (26%), as was the forest (see Figure 2). These results are consistent with studies that have interpreted drawings with depictions of the student environment. For example, in their study, Profice, Pinheiro, Fandi, and Gomes (2013) found representations of forest with trees and flowers in the majority of the environmental drawings made by students. As regards the limitations, these results are consistent with those

of Martinho and Talamoni (2007), in that most of the drawings analyzed depict forests, rivers, animals, and plants, providing a naturalistic view of the environment influenced by religion, family, the media, and teaching materials. As a conditioning factor, we observe similar results to Elisei (2008), with low inclusion of people in the drawings that represent the environment, which indicates the possibility of an anthropocentric influence where humanity is dissociated from nature. With regard to the possibilities, Pedrini, Costa, & Ghilardi (2010) note the presence of the sun and clouds as representative of environmental drawings, which could be a line of research to continue with the workshop based on the images chosen to evoke reflection among children in schools.

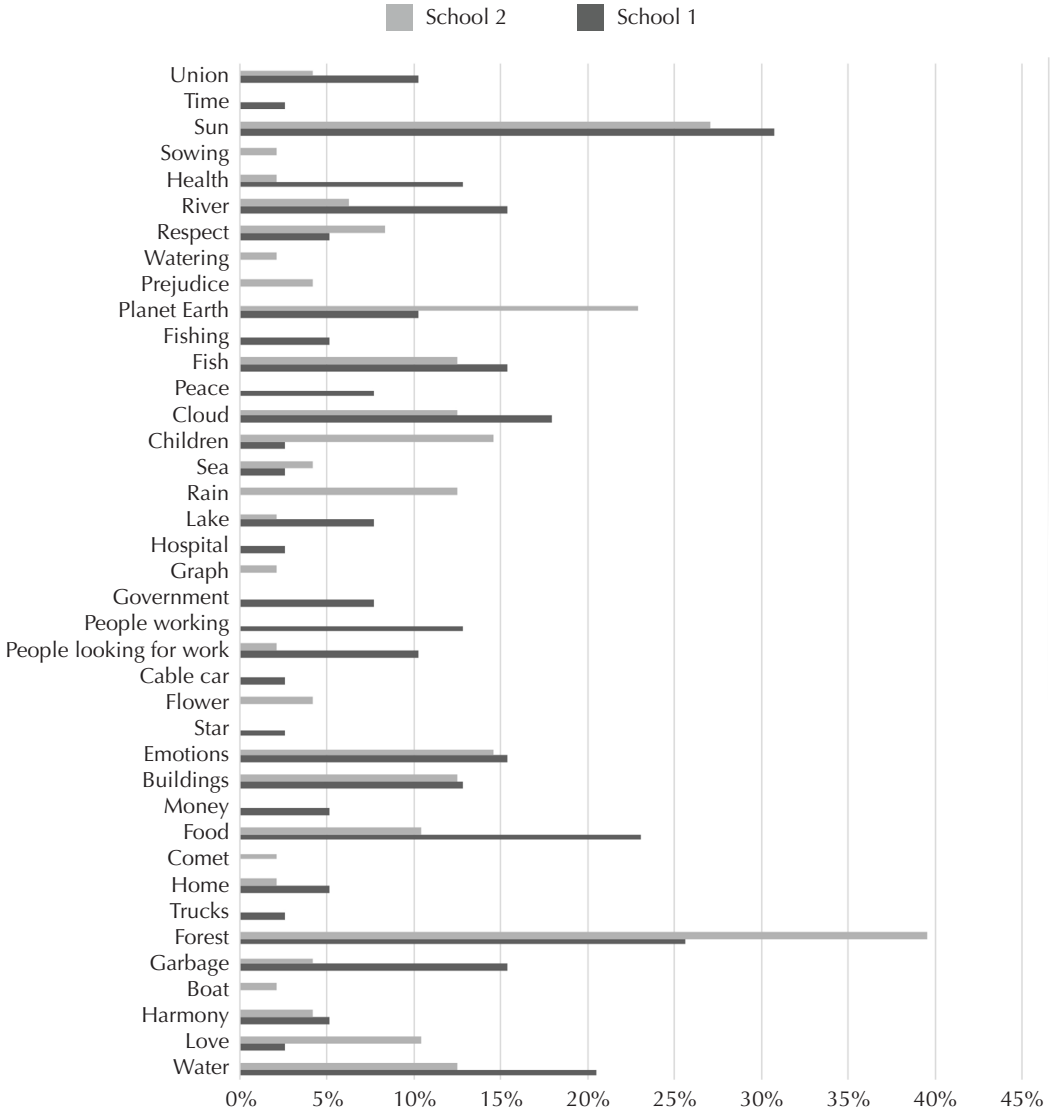


Figure 2. Iconographic content of the children's drawings.
Source: Prepared by the authors.

Stage 2: Identification of the drawings with an SDG. Figure 3 shows a comparison between the characterization of the 17 SDGs represented in schools 1 and 2. The most frequently identified SDGs in both schools were: Life below water (14) and Life on land (15), which are related to the photographs provided (see Annex 1). With regard to limitations, we can see that SDGs 4, 9, and 10 were not identified in any of the drawings analyzed.

On the other hand, the SDGs Zero Hunger (2) and Partnerships for the Goals (17) were identified only in the drawings from School 1, while the SDGs No Poverty (1) and Gender Equality (5) were identified in a minority in the drawings from School 2. The frequency of identification between the schools was similar with respect to SDGs 3, 11, 12, and 14, while SDGs 8, 13, 15, and 16 showed differences between those depicted most. In School 1, the frequency of the SDG Decent Work and Economic Growth (8) was proportionally three times higher in School 1 than in School 2, and the SDG Peace, Justice and Strong Institutions (16) was twice as high as in School 2. In School 2 the frequency of identification of the SDG Climate Action (13) was four times higher than in School 1, and SDG Life on Land (15) was seen four times more than in School 1 (see Figure 3).

On the one hand, these findings enable us to observe a certain preponderance of the SDGs in the children's drawings that are made according to the inputs provided and, on the other, based on their local vision of socio-environmental problems and their interrelations. With regard to the SDGs that were not identified, this may be because of their abstract nature or the lack of emphasis in the materials presented for reflection. There is also the fact that educational practice characterizing the environmental issue is often done focusing on SDGs 13, 14, and 15, neglecting more complex issues that include cultural, labor, political, and geoepistemological dimensions (Harvey, 2003).

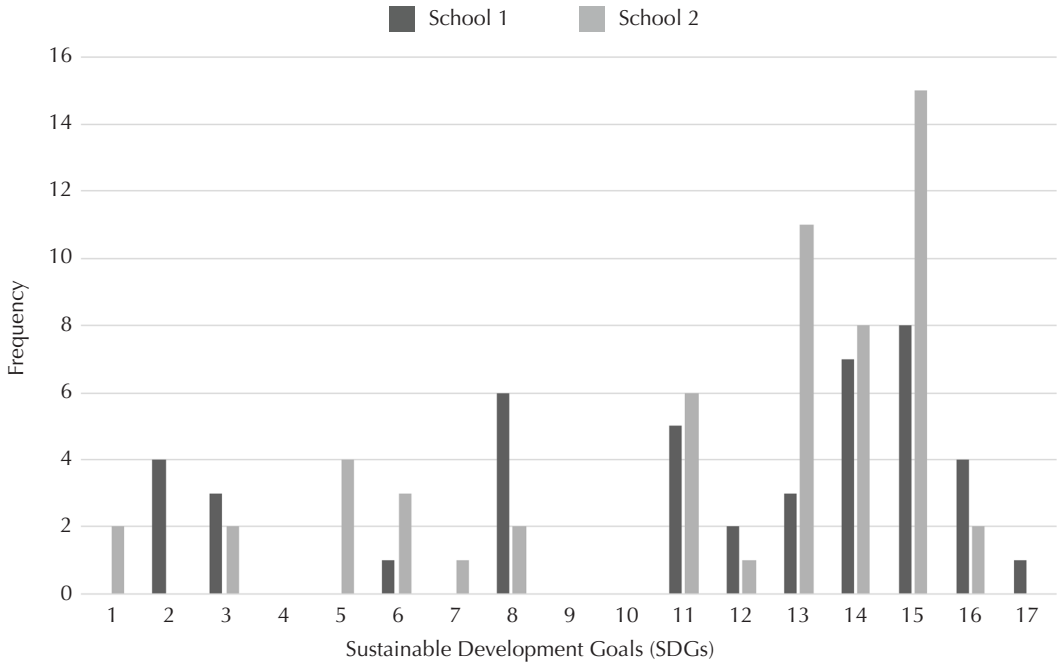


Figure 3. Identification of the SDGs in the drawings.
Source: Prepared by the authors.

Stage 3: Levels of representation of the SDGs. Figure 4 shows the levels of representation of the SDGs identified in the drawings from School 1 and School 2. Some 64% of the drawings from the first school and 52% of the drawings from the second were classified as level 1. When the children were asked to symbolize the sustainable world in the workshop, their drawings were depictions that were mostly limited to symbols already expressed in the SDGs or in the works of art included in the kit, which were common sense and/or generic images such as trees, fish, sun, clouds, and birds.

Meanwhile, 23% of the drawings from School 1 and 31% of the drawings from School 2 were classified as level 2, in which they include greater consideration of the sustainability aspect (ecological, economic, or other), but they also include certain symbolic elements to accommodate the limitations of the medium (for example, the use of symbolic elements such as arrows to represent dynamic notions, time, movement, or an observable cause using a static medium such as paper), creating their own representations.

Similarly, in both schools approximately 10% of the drawings were classified as a having a sophistication level of 3, that is, in the children's drawings representations we observe representations based on the link between two or more dimensions of sustainability, displaying a process or behavior involving the environment (although they are not precise processes, but oriented towards transformation of society) through symbols and also by creating their own representations.

In School 2, there was a slight preponderance of more robust and sophisticated drawings that were classified as level 4 (8%) compared with School 1 (3%). In these drawings it was possible to identify effects of time, processes, and cause and effect relationships, as well as symbols to represent government institutions. In neither of the schools did the drawings made by the students show level 5 of sophistication, where one or more representations would be expected to explain the relationship between different aspects of sustainability, including temporal relationships between past, present, and future or cause and effect in a social context in which the person is a participant in social change/transformation.

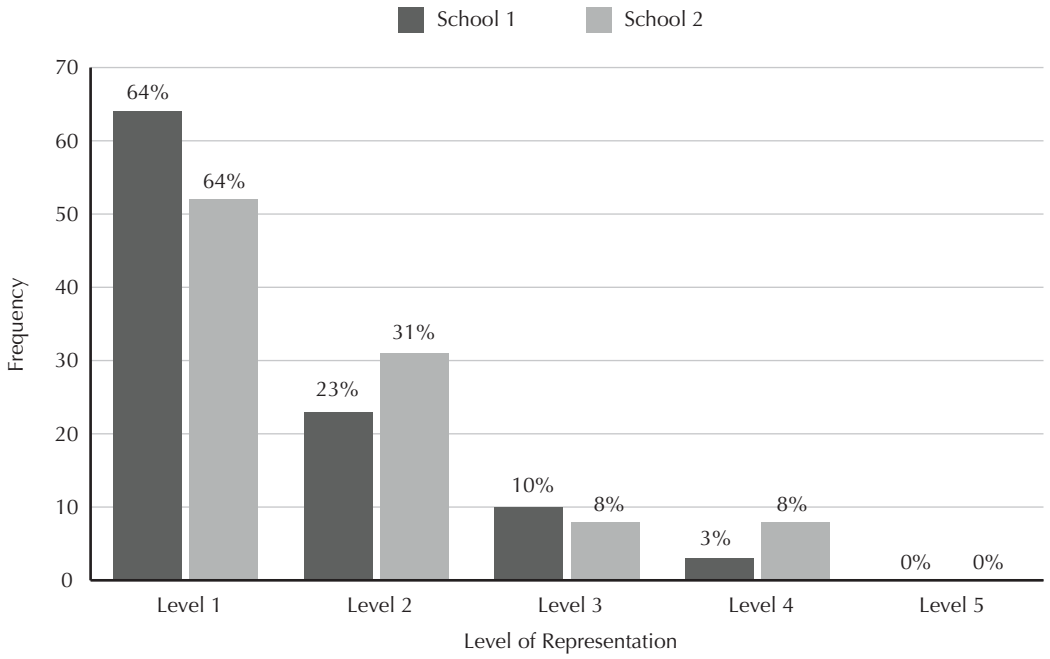
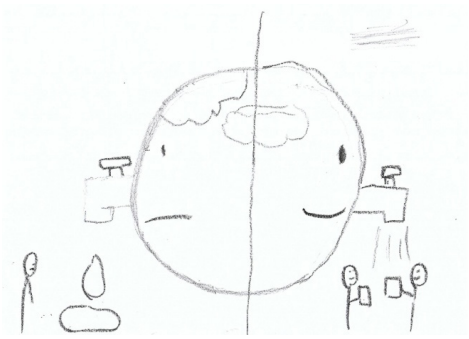


Figure 4. Representation of the SDGs in the children's drawings.
Source: Prepared by the authors.

Looking at Figure 4 allows us to infer that not all students displayed sufficiently elaborate levels of representation to demonstrate the semantic skills to create their own representations or to characterize comprehensive understanding of the SDGs. Such understanding requires them to recognize the limitations of the global proposal. Merino and García (2019), who analyzed student representations using Kozma and Russell's (2005) framework, observed this same difficulty in deepening the levels of sophistication and complexity of the representations.

Table 2
Examples of drawings analyzed at each level of representation of the SDGs

Drawing classified as level 1	Drawing classified as level 2
	
Drawing classified as level 3	**Drawing classified as level 4**
	

Source: Prepared by the authors.

In Table 2 we can see examples of different levels of representation, from those in which there are not many relationships between the SDGs (levels 1 and 2), to those where elements of the local/regional context can be observed (presidential sash, local public health system) and cause and effect relationships, prescribing modes of change and action in which individuals are participants.

Conclusions

The discussions and reflections during the workshops—generated thanks to the interpretation of kits with photographs, works of art and news reports—allowed us to observe the appearance of limitations, possibilities, and conditions related to sustainability (its complexity and incompleteness).

The strategy of working with this structure in the workshop provided new paths towards pedagogical practices so that the participants of the activity can interpret, reflect, and dialogue with others about day-to-day or specific problems related to socio-environmental demands. Collective reflections allow us to understand the need to change attitudes and actions to effective criticisms of the current world panorama, as well as the quest to construct new collective and emancipatory paths.

The absence of level 5 representations indicates the need to work on skills in both schools to integrate different conceptual fields and levels of abstraction, characterizing pedagogical limitations to sustainability approaches, which requires medium- and long-term processes. It also reveals that educational processes are needed that are oriented towards pedagogical action committed to socio-environmental changes.

This leads us to understand that certain improvements have to be made to the workshop, such as its short length, in order to tackle problems as complex and extensive as the ones we address here. With regard to the methodological limitation, given that the sessions were not recorded, some relationships between the SDGs that were mentioned orally were not recorded in the drawings. In terms of conditioning factors, in most of the drawings there was a lack of political representation, issues related to oppression, or resistance. However, we noted that for many of the participants from both schools this was a process that made it possible to understand the problem regarding sustainability and an opportunity for direct discussion regarding environmental, social, and political problems at the local level, marked by their urban contexts with processes of exclusion.

Similarly, we want to highlight that during the year, School 2 developed a collaborative project on the subject with Universidad Federal de Río de Janeiro, which could have had a positive influence on the sophistication of the drawings. This is consistent with the distribution of the drawings in levels 2 to 4 in terms of the progressions in representative skills. In the level 4 drawings it was possible to characterize individual commitments to socio-environmental changes, where the drawing included the role of the student as an agent of change. This was a potential of the workshop and it enables us to infer that the students depicted dimensions of sustainability with their own representations, characterizing and moving past their urban, complicated, and vulnerable daily lives.

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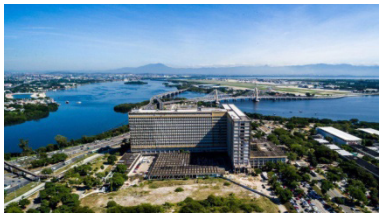
Annex 1

Kits distributed to the students with the images and their sources.

Kit	Photograph	Work of art	News report
1	 Favela (2015) - María Angélica Mejía-Cáceres	 Os retirantes - Candido Portirari	Falta de acesso a saneamento básico resulta em baixa renda e gasto com internações, diz estudo[2]. Source: https://g1.globo.com/economia/noticia/2019/04/23/falta-de-acesso-a-saneamento-basico-resulta-em-baixa-renda-e-gasto-com-internacoes-diz-estudo.ghtml
2	 Guanabara Bay (2016) - Carolina Andrade da Silva	 Operários - Tarsila do Amaral	Desemprego recua para 12,3% em maio e atinge 13 milhões de brasileiros[3]. Source: https://g1.globo.com/economia/noticia/2019/06/28/desemprego-fica-em-123percent-em-maio-aponta-ibge.ghtml
3	 Hospital Universitario da UFRJ	 A criação do mundo - Salvador Dali	Mudança climática: 7 gráficos que mostram em que ponto estamos[4]. Source: https://g1.globo.com/natureza/noticia/2018/12/06/mudanca-climatica-7-graficos-que-mostram-em-que-ponto-estamos.ghtml
4	 Rio Cascata (2016) - Tainá Figueroa Figueiredo	 Criança morta - Candido	Estes dados mostram que a fome ainda é um problema no Brasil[5]. Source: https://super.abril.com.br/sociedade/por-que-ainda-nao-da-para-afirmar-que-nao-existe-fome-no-brasil/

2. Our translation: Lack of access to basic sanitation results in low income and expenses for hospitalization, according to a study.
3. Our translation: Unemployment falls 12.3% in May to 13 million Brazilians.
4. Our translation: Climate change: 7 graphs that show where we are.
5. Our translation: These figures show that hunger remains a problem in Brazil.

5	 Manifestação (2015) - María Angélica Mejía-Cáceres	 Guernica - Pablo Picasso	Líbia: ataque com carro-bomba mata três funcionários da ONU em Bengazi[6]. Source: https://nacoesunidas.org/libia-ataque-com-carro-bomba-mata-tres-funcionarios-da-onu-em-bengazi/

Source: Own elaboration.

6. Our translation: Libya: A car bomb attack kills three UN workers in Benghazi.