Environment, Development and Sustainability (2024) 26:3849–3887
https://doi.org/10.1007/s10668-022-02860-z

The construction of sustainability conceptions of Brazilian students in elementary school

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Received: 22 November 2018 / Accepted: 19 December 2022 / Published online: 3 January 2023

Abstract
Seeking to improve strategies and practices turned to education for sustainability, this research aimed to identify how the process of building sustainability conceptions in elementary school students takes place in a Brazilian institution. The present qualitative research complies with interpretive paradigm assumptions, and its main research method is the phenomenography analysis using drawings. The educational institution investigated in the study was the Pessoense Institute of Integrated Education (IPEI), in which students from the second, third, and fifth grades of elementary school participated in the research. As for the results, the students identified five different ways to understand sustainability, going from more external or superficial to broader. We were also able to notice that the process of creating these conceptions over elementary school years works progressively, that is, these conceptions expand along the school years. The findings in the research cooperate to improving practices of education for sustainability that is aimed at the teaching level studied for, when explaining the dynamics in the process of creating these sustainability conceptions from the students investigated, it supports a bolder choice of educational strategies, models and methods for such audience.

Keywords Education for sustainability · Elementary school · Environmental teaching · Sustainability conceptions · Education and sustainability · Phenomenography

1 Introduction

Several researchers (Busatto, 2015; Davis, 2015; Dubey et al., 2017; Engdahl, 2015; Green & Somerville, 2015; Griswold, 2017; Jenkins, 2015; Lopes & Tenório, 2006; Walker, 2017) defend that only through education it is possible to establish sustainability and sustainable development, since it is through education that people must have access to principles of sustainability so that, this way, they can put them into practice and become co-creators of sustainable societies.

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Due to the relevance of education for the consolidation of sustainable societies and to new models of development that are based not only on economic/financial indexes but also on social and environmental dimensions, there is the need to gather efforts for the improvement of strategies, models, and practices of education turned to this topic.

Even though some important effort has been employed over the past few decades for the improvement of Education for Sustainability (EfS) in the most different levels of teaching, its suitability for the most basic levels of formal education is still not enough and lacks more studies that could cooperate to a better adjustment of this educational model, to the needs and the dynamics of these students in these primary teaching levels (Davis, 2009; EPSD, 2010; Siraj-Blatchford et al., 2010; Somerville & Williams, 2015).

Based on the need to go further into studies related to education for sustainability in the more basic levels of formal education, to cooperate to more effectiveness in this educational model at these levels, and, consequently, to strengthen sustainable societies and sustainable development, this research aimed to identify how the process of building sustainable conceptions takes place in elementary school students in a Brazilian institution, one of the most basic levels of formal education.

The research results contribute to the improvement of practices of education for sustainability in elementary school students for, upon casting some light on how the process of building sustainability conceptions from students in this school level, whose dynamics is still under-studied (Davis, 2009; EPSD, 2010; Siraj-Blatchford et al., 2010; Somerville & Williams, 2015), they enable the choice of more appropriate educational strategies, models and methods to guide and help students along this building process.

The Pessoense Institute of Integrated Education (IPEI), a teaching institution located in Northeastern Brazil, was chosen to be the core of this study due to its distinct pedagogical approach, which tries to guide the institution's actions to raise mindful individuals with topics such as sustainability and sustainable development standing out.

2 Literature review

To subsidize the analyses and discussion of sustainability conceptions from the investigated elementary school students, the main sustainability conceptions currently accepted are presented and discussed along the first subtopic in the theoretical framework.

The second topic in the theoretical framework presents and discusses the main principles of education for sustainability and sustainability when directed to elementary school students.

2.1 Sustainability and its different concepts

According to several researchers, the current model of economic growth (financial paradigm) has caused major mismatches (Cavalcanti, 1998; Ehrenfeld, 2008; Elkington, 1997; Hanley et al., 2020; Jacobi, 2003; Jenkins, 2015; Jones et al., 2010; Obery & Bangert, 2017; Rosa et al., 2018; Sachs, 2002). On the one hand, it caused wealth accumulation. On the other hand, it spread environmental destruction and misery worldwide. Based on that, sustainable thought, or sustainability, which, according to Sartori et al. (2014), tries to balance the economic bias between environmental preservation and social development and has become more popular.

This new way of thinking about keeping human societies and their development, by conciliating them to environmental limitations and economic matters, becomes intrinsically interdisciplinary (Griswold, 2017; Lankoski, 2016) and is composed of a tridimensional view of reality, which leads to a new attitude in the process of making decisions, both on an individual, organizational, or society levels as a whole. Social actors who have adopted such a view must consider the financial rewards of their decisions and assess their impacts on the environment and society around them, both on a global, present, and future level.

According to Lankoski (2016), one characteristic that comes from the interdisciplinary nature of sustainability is the diversity of existing conceptions concerning the phenomenon. Lankoski (2016) follows the same train of thought as Taylor (2014) and Barros et al. (2014) when they consider that there are some mistakes around the conception of this phenomenon. Taylor (2014, p. 1181) states that "sustainability is a concept that has increasingly influenced development policy in the last 2 decades and yet the concept remains ill-defined."

Thus, we know that there are several ways to understand what sustainability is. Several authors from several areas express their conceptions of the phenomenon. Some of them agree, some of them do not (Cavalcanti, 1998; Ehrenfeld, 2008; Elkington, 1997; Heikkurinen & Bonnedahl, 2013; Jacobi, 2003; Jones et al., 2010; Lopes & Tenório, 2006; Montiel & Delgado-Ceballos, 2014; Sachs, 2002; Silva et al., 2014).

Ratiu and Anderson (2015) imply that this lack of common understanding concerning the definition of sustainability comes from different perspectives of the social actors that study the phenomenon, for they analyze it through different levels. While managers assess sustainability in organizations, sociologists assess individuals or groups, and politicians assess even larger populations.

According to Lankoski (2016), this contributes to different conceptions on the topic, which, at first, are interesting for the development of the study on the phenomenon but which, in the long run, force it into excessive generalization or superficiality, thus making progress toward the building of more solid grounds harder, where individuals, organizations, and society itself may look at to stroll toward sustainability.

Some difficulties emerge from this plurality of conceptions. Firstly, the one defended by Taylor (2014) and Sartori et al. (2014) is conceptual confusion, through which the term concerning sustainability is mistaken for something similar but with different meanings, such as when the term concerning ecological sustainability is used to replace the term concerning sustainability when the former has to do only with the ability of natural resources to replicate.

Secondly, there is the danger of involving vague concepts, which, according to Barros et al. (2014), Ratiu and Anderson (2015) and Lankoski (2016), hampers the operationalization of sustainable practices or the transformation of concepts that are socially put into practice by social actors, as well as when organizations are specifically mentioned. Moreover, it hampers the assessment on the organizational sustainability level since vague conceptions give rise to indexes that are also vague or superficial, which leads to inaccurate assessments. Still on vague conceptions, McIntyre et al. (2016, p. 161) state that "this increases the risk of sustainability approaches to be reduced to little more than just sophisms."

However, despite the difficulties mentioned and which come from the plurality of conceptions on the topic, we understand that this plurality is normal given the phenomenon's interdisciplinary nature and the several interests and actors that comprise the debate about sustainability. Thus, we look at these difficulties as inevitable consequences of that way of communal construction concerning the meaning of the word phenomenon. However, we

agree with Ratiu and Anderson (2015), who state that they can and must be minimized over time to decrease conceptual confusion and optimize sustainable social practices.

The variety of authors and conceptions about sustainability will be divided into two major groups concerning the number of aspects or viewpoints that comprise the scope of sustainability, with the single objective to enable its application. Firstly, those which address the topic from three basic aspects of sustainability, more commonly known as the "sustainability tripod," which are social, economic, and environmental aspects, and defend that upon balancing the taking of decisions and considering relevant variables of these three aspects, individuals, organizations, and societies may reach sustainability.

A second group also considers balancing the three basic aspects essential to reaching sustainability. However, it suggests additional elements besides the three basic aspects and considers them relevant for achieving sustainability. These additional aspects represent the details in the three main aspects and dimensions or different aspects.

The conceptions of sustainability expressed by several authors will be presented to enable the confrontation between sustainability conceptions from elementary school students and the conceptions from the different authors mentioned during this research analysis. This article will first show the authors who, despite their different conceptions of sustainability, address the topic from the three basic aspects that comprise their scope and see it as the element that brings their views together. Then, those who suggested aspects or additional dimensions to their conceptions of sustainability will be invited to join the discussion.

2.1.1 Sustainability concepts based on the "triple bottom line"

Elkington (1997) triggered the approach to sustainability from the three basic dimensions: environmental, social, and economical. He named this approach "the triple bottom line." However, it should be mentioned that he was not the first author to theorize on the topic, nor the first to suggest a set of sustainability dimensions. Before him, Sachs (1993) had already suggested a set of dimensions that composed sustainability. However, Elkington's model (1997) was different from the one presented by Sachs (1993) some years earlier, for he focused on a simpler approach by suggesting the understanding of sustainability from three dimensions only. In contrast, Sachs' suggestion (1993) has a broader and more complex scope that defends the existence of five dimensions.

Based on the "triple bottom line" expression, Elkington (1997) pinpoints the need to link the social and the environmental dimensions to the economic dimension in making decisions and in the deeds of several social actors, from personnel to organizations and society, as a whole, which aims to enable the balance and livelihood of the entire planet.

The environmental dimension represents the limits imposed by nature. It brings the social actors the challenge to balance the satisfaction of human needs and respect for nature's limits, not from a preservationist perspective, but as a way to use its resources orderly, thus guaranteeing its preservation and use by present and future generations, since most of these resources are limited.

The social dimension represents society's needs and desires. It shows the challenge of reconciling economic objectives, social needs, and unlimited desires with environmental limits.

Finally, the economic dimension, the only one considered until recently, will be considered along with the other two dimensions. It represents the financial objectives and, as a

challenge, suggests that they must observe the limits imposed by nature and the needs and desires of the society that interacts with the different social actors.

After Elkington's proposition (1997) concerning the triple bottom line, several authors agreed with his ideas and continued to explore this approach to understand sustainability, among them Jacobi (2003). To him, sustainability can be understood differently, as it has been previously discussed, and one of them is that it comprises three pillars, named social, economic, and ecological sustainability, similar to Elkington's proposition (1997).

To Jacobi (2003),

> these dimensions explicit the need to improve life quality levels compatible with environmental preservation. It answers the need to harmonize environmental and social-economic processes by maximizing the production of ecosystems to favor present and future human needs (Jacobi, 2003, p. 193).

Concerning Elkington (1997) and Jacobi's conceptions (2003) about sustainability, we can readily see the interdisciplinary nature, which is a characteristic of this new perspective and can be seen when the authors define it as a larger structure comprised of three aspects that must be considered as a whole but which, for centuries, were analyzed independently, which ended up making the economic paradigm unacceptable in the long run.

Based on Jacobi's concept (2003), we can state that sustainability is mediation or harmonization effort between processes and social-economic and environmental needs, intending to ensure their present and future supply, and, to enable this harmonization, it is necessary to consider these three aspects in the process of individuals' decision-taking.

Jacobi (2003) follows the same train of thought as Cavalcanti (1998), to whom sustainability also refers to a search for harmony between social-economic needs and environmental possibilities, as seen below:

> Sustainability means the possibility of continuously acquiring equal or higher life conditions for a group of people and their successors in a given ecosystem. The concept of sustainability is equivalent to the idea of keeping our life support system. It means behavior that tries to abide by the laws of nature (Cavalcanti, 1998, p. 165).

However, there is more nature empowerment in Cavalcanti's lines (1998) when he includes the search for behavior that tries to abide by the laws of nature as a meaning of sustainability, thus leading to the comprehension that the other two aspects considered by sustainability, that is, the economic and social aspects, must be developed in a way to respect the environment's possibilities, limitations, and pace to guarantee the "life support" mentioned by the author, not only in the short run, for the current generations, but equally in the long run, for future generations.

Back to Elkington's considerations (1997), Cavalcanti (1998), and Jacobi (2003), Jones et al. (2010), years later, defended that sustainability could be seen as a set of conditions that enable harmony and conciliation between human and natural systems, so that they can coexist indefinitely, besides supplying the needs of life quality.

2.1.2 Sustainability concepts beyond the "triple bottom line"

Despite the great step taken by sustainability conceptions based on the triple bottom line by Elkington (1997), several other authors tried to develop broader conceptions that could accommodate more important elements or dimensions within the scope of sustainability,

both concurrently or even before Elkington's approach (1997). One of them was Sachs (1993), as previously mentioned.

Since the beginning of its theorization on eco-development, which took place even before Elkington (1997) suggested the triple bottom line typology, Sachs (1993) went beyond the three basic pillars of sustainability, which would later serve as a basis for Elkington's approach (1997), by presenting a set of broader dimensions or aspects that, according to him, compose sustainability, which are social, economic, environmental, spatial, and cultural.

Later on, Sachs (2002) expanded his array of dimensions even further and started to consider the following eight dimensions: social, cultural, ecological, environmental, territorial, economic, national policy, and international policy. Thus, he defended the idea that several other dimensions can be considered when we think of sustainability besides the three basic dimensions previously mentioned, which are part of the set of dimensions suggested by Sachs (2002) and serve as a basis for the other dimensions.

Confirming Sachs' understanding (1993) about the possibility of considering extra dimensions concerning sustainability conceptions, Onel et al. (2018) suggest that sustainability may be understood as the concern with building and keeping a socially fairer society environmentally clean, economically balanced, and culturally diverse. He includes the cultural dimension in his conception of the phenomenon, like Sachs (1993).

Other authors who reached beyond the three basic dimensions of sustainability and suggested a fourth dimension were Lopes and Tenório (2006). They suggested what became known as the tetrahedron for sustainability, which consists of adding the educational dimension to the three basic sustainability dimensions.

However, it should be mentioned that McIntyre et al. (2016) reviewed the conception of sustainability turned to dimensions only, whether the basic dimensions or even the models composed of a larger set of dimensions. To them, the understanding of sustainability must be essentially linked to the idea of inter-management of the Brundtland commission (Brundtland, 1987).

According to McIntyre et al. (2016) and Böhme et al. (2018), in case the sustainability conceptions are not linked to the idea of inter-management, individuals and organizations may be coated with sustainability, even if they do not act to ensure the development of future generations by simply complying with the requirements in each of the sustainability dimensions pointed out by whichever theoretical model was chosen, which, in itself, does not guarantee the maintenance of resources for the provision of the needs of future generations.

This way, based on the review by McIntyre et al. (2016), which was backed up by Böhme et al. (2018), individuals, organizations, and society that take into account not only the three or more dimensions suggested for the model for taking sustainable decisions that were presented and discussed in this article are considered relevant for the formation of a sustainability type of culture but consider them from a perspective that is aimed at keeping and, why not, expanding life quality for future generations.

Silva et al. (2014, p. 94) address another aspect of sustainability that is equally important to understanding the phenomenon. To them, it refers to the neglect of an individualistic mind searching for a collective mind, as seen in the following words: "Sustainability would, then, be linked to a notion of collectivity that goes beyond the one that is present in the other forms of organizational operation with social-environmental objectives, for they have a predominantly individualistic purpose." This way, to the authors, one of the characteristics and conditions for sustainability is the development of collective minds and the detachment from individualistic notions.

Whitmarsh and O'Neill (2010), Fischer et al. (2017), Figueroa-García et al. (2018), and Onel et al. (2018) consider ethical awareness as one more subcomponent of the social dimension of sustainability. On this, the authors state that considerations about the ethical aspect in the decision-making processes are also part of the scope of sustainability.

The conceptions and approaches presented so far make it possible to see some fundamental characteristics of sustainability and suggest an overall comprehension of what it is like.

Concerning the fundamental characteristics of sustainability, it is possible to look at sustainability's interdisciplinarity through the different dimensions that make it, from the most basic ones, defended by Elkington (1997), Cavalcanti (1998), and Jacobi (2003), to the most specific ones, pointed out by Sachs (1993) and Lopes and Tenório (2006).

Moreover, it is possible to identify the collective character of sustainability through arguments by Silva et al. (2014), who defend that sustainable actions try to migrate from an individualistic mind to a collective one.

Although there is a wide variety of different conceptions about the phenomenon, there is a basic and mutual element concerning most of the conceptions discussed, which is the search for harmony and conciliation between social-economic needs and nature, aiming at a correlation that may last indefinitely, which complies with Ratiu and Anderson (2015), when they said that

> most of the understanding about sustainability can be categorized by its dependency on survival and resources such as core-defining elements. The survival of a human system is key to most conceptions, as well as the need to preserve critical resources on which the survival of human systems depends (Ratiu & Anderson, 2015, p. 4).

It is important to emphasize that several actors are still working out their research in the area of sustainability based on the "triple bottom line" concept (Hawn et al., 2018; Jia et al., 2018; Lim, 2017; Wang et al., 2019; Yates, 2018). In other words, even with the popularization of broader sustainability conceptions that consider extra dimensions besides the "triple bottom line," many researchers are still leading relevant research based on a conception supported by the three basic dimensions of sustainability social, environmental, and economic.

This research comes with driving questions based on the several sustainability conceptions presented and discussed along this subtopic, including the most basic and broader ones. How do children understand sustainability? How does the process of building these conceptions during elementary school years take place? What are the most appropriate EfS strategies, models, and methods to help this audience develop their conceptions of sustainability?

Upon considering the importance of EfS for the development of sustainability conceptions in children (Davis, 2015; Dubey et al., 2017; Griswold, 2017; Jenkins, 2015; Walker, 2017), the next subtopic will address and discuss some of the main EfS principles that are needed to guide practices that can lead individuals, especially children, along the process to build their sustainability conceptions by helping them to develop broader and more critical ideas.

2.2 EfS as a booster in the process of building sustainability conceptions in children

In previous studies, a set of the main educational guiding characteristics, principles, and practices for sustainability directed at elementary schools was identified and summarized

(Coelho et al., 2018; Silva et al., 2019). They will be presented and discussed on this topic to be confronted with the findings in the present research and, thus, enable the identification of the best educational strategies, models, and methods to introduce education for sustainability to elementary school students.

There are many differences between education for sustainability and other current educational methods. There are even major differences between education for sustainability and similar models, such as environmental education (Coelho et al., 2018). This is why it is important to understand these differences and discuss their implications to enable the adoption of proactive and effective educational strategies and methods.

One of the most basic principles of education for sustainability is to train critical individuals who can question the social logic that rules their time. This characteristic enables it to break apart from traditional educational models that only focus on developing technical skills, aiming to train the workforce to feed the market (Dubey et al., 2017; Smith & Stevenson, 2017; Springett, 2005).

Although there are several mutual characteristics and principles, such as critical training, education for sustainability and environmental education are different educational models. The latter has a narrow focus on preserving the environment, whereas education for sustainability has a broader scope and tries to train individuals that can conciliate environmental preservation with meeting the needs and desires of society. Thus, while environmental education only emphasizes the environmental dimension, education for sustainability adds up several dimensions to its teaching/learning processes, such as economic, social, environmental, cultural, and territorial dimensions, among others (Jacobi et al., 2011; Springett, 2005).

Unlike the traditional educational models, EfS focuses on the development of a teaching/learning process that is adapted to the characteristics of each student where, despite the constant development of collective activities, the process of building values happens heterogeneously, at a different pace, and form for each student (Felgendreher & Löfgren, 2017).

Along with students, EfS tries to create a way for them to view themselves as parts of an ecosystem. At the same time, it discourages the idea that the human being occupies a central and privileged position in this ecosystem (Gadotti, 2008).

EfS must be developed in formal contexts, such as school or college, and in informal contexts, such as family environments and other groups or organizations (Palma et al., 2013). The presence of EfS in multiple environments, whether formal or informal, contributes to more effectiveness in the attitudes developed. When developed in the formal learning environment, in teaching institutions, EfS must not be dealt with as one subject. It should overreach other school subjects by discussing their issues and lead students to a critical and interdisciplinary reflection on the topic (Melo, 2012).

To consider factors such as territoriality and culture and the social aspect as pillars of sustainability and sustainable development, EfS practices must always fit local contexts, regional peculiarities, and the historical aspects of the society where it is practiced (Baggio & Barcelos, 2008). Moreover, the ethical dimension should always overreach the learning/teaching processes, for this dimension is also seen as a pillar of sustainability (Lopes & Tenório, 2006).

Besides the general EfS principles presented and discussed so far, it is important to emphasize and talk about EfS principles and specific characteristics for its application in elementary schools (Silva et al., 2019).

Although the general principles of EfS are similar to adults and children, it is important to highlight that the EfS practices and models aimed at elementary schools are adapted to the characteristics and potentials of this audience. Adults and children learn

very differently; this does not change in the context of education for sustainability. For EfS practices to be effective for children, they need to be planned and developed in a way that fits the specific characteristics of this audience (Kjørholt, 2012).

Within the EfS context, children must be seen as citizens who can act not only in defense of the environment but to reflect on their actions and consequent impacts. Moreover, they must be seen as agents of change who hold rights and duties to the environment and society. If this is not implemented, EfS practices will have little effect on them (Davis & Elliott, 2014). Still, on this topic, many adults do not trust children's capacity to understand economic and social-environmental issues, and such behavior must be avoided at all costs, for it tends to suppress the development of children's comprehension of such topics (Engdahl, 2015).

Education professionals who work with EfS for children must encourage them to gradually take on the role concerning the activities developed by giving and applying support ideas and actively contributing to the development of the actions suggested by the instructor. Besides cooperating with more effectiveness of the EfS practices, this incentive for participation and leadership also helps train individuals who are engaged, creative, and able to take on responsibilities (Davis, 2008; Engdahl, 2015; Jenkins, 2015; Jensen, 2002).

There is a trend of EfS aimed at elementary school to emphasize environmental issues, in the face of economic and social problems. This imbalance must be avoided, because by directing emphasis only to the environmental aspect, several other issues, closely linked to each other, and to the environmental aspect are disregarded, making it impossible to achieve sustainable development (Busatto, 2015; Engdahl, 2015).

A key element for the effectiveness of EfS practices aimed at elementary schools is the creation of physical spaces available for its development and support facilities. In schools with distinguished physical environments, with access to machinery to practice sports, social activities, and natural elements, and where teachers have the chance to use these resources and areas wisely, EfS practices will certainly be richer and more effective (Green & Somerville, 2015).

Besides school areas, the effectiveness of EfS practices turned to elementary schools also depends on the availability and use of extra-school physical areas that are typical of each region, such as rivers, creeks, groves, gardens, wet areas, mangroves, forest reserves, beaches, and rock formations, among several other possibilities that are available and can offer practical experiences to teach/learn. In these areas, children can learn about and feel the environment (Engdahl, 2015; Green & Somerville, 2015; Norddahl, 2008).

Teachers and other education professionals involved with EfS in elementary schools must create partnerships with other local actors besides school to enrich students' experiences and practices. Such partnerships may give access to places beyond school, for example, or give children access to local knowledge that native communities have cultivated, old residents in a given area, and sports and culture machinery, among several other similar opportunities (Green & Somerville, 2015). This way, besides access to places and machinery that can enrich the teaching/learning process, the teaching institution will be giving children the opportunity to interact with several people and cultures and enable them to develop a feeling of respect for what is different and to these people (Engdahl, 2015; Norddahl, 2008).

A great part of the human population resides in urban environments nowadays, which, in turn, causes them to distance themselves from the natural environment, fauna, and flora. As people hardly defend what they do not know, the interaction between children and the natural environment becomes important for the effectiveness of EfS developed in

elementary schools so that, by knowing their treasure, they can cherish the desire to defend and preserve it (Engdahl, 2015; Norddahl, 2008).

Besides enabling interaction with the natural environment, EfS at the school level discussed so far must try to develop children's perception of how nature works and the origin of the resources we depend on. This perception is essential for children to understand nature's pace better and respect through it. They also understand that we depend on it to meet our needs and desires. Several actions can be developed for this perception to come to life: seedling typical, regional plants; following up on the insects' life cycle; gardening; visiting ecological reserves at different times of the year; animal nursing; and experiencing composting, among several other possibilities (Engdahl, 2015; Green & Somerville, 2015; Norddahl, 2008).

The EfS practices developed at elementary schools must challenge children to think for themselves, critically reflect on real life and the problems we face, think in ways that are different, better, and more sustainable to solve these problems, and, based on that, be able to identify, suggest and apply solutions to complex and interdisciplinary problems, as well as to choose the more sustainable options. Children must be watched and guided over this process, and the focus must be much more on the process of raising children's awareness and capabilities than on the practical and final resolution of the problems addressed (Davis, 2015; Green & Somerville, 2015; Jenkins, 2015; Jensen, 2002; Norddahl, 2008).

Concerning EfS in elementary schools, transversality must be reached through the use of important concepts that deal with topics that are broad, transversal, and full of possibilities when it comes to critical reflection, which enables it to be used in several school subjects and, thus, promotes the integration between these subjects and EfS, such as citizenship, ecological sustainability, human rights, justice, conflict, cooperation, and social justice, among several other possibilities (Jenkins, 2015).

When trying to develop broad concepts of sustainability in children through EfS, one cannot forget that the professionals responsible for developing EfS practices with these children at school, that is, the teachers need to be constantly trained and monitored in order to so that they can first expand their concepts of sustainability and thus can help students to build their own (Evans et al., 2012; Kennelly et al., 2012).

According to the study developed by Miedijensky and Abramovich (2019), several factors can contribute to the successful implementation of an education model for sustainability in an elementary school. The research by Miedijensky and Abramovich (2019) investigated three Israeli public elementary schools (first to sixth grades), each with 218, 320, and 450 students, respectively. Among the success factors identified, one of the most highlighted by the researchers is the importance of the gradual implementation of EfS in the institution. According to Miedijensky and Abramovich (2019), EfS should be implemented gradually and systematically, over at least four stages, namely initiation (planning), implementation (activities and protocols), institutionalization (change becomes part of an integral part of the organization), and result (focusing on the results to improve the process in the future).

The study by Petrou (2018) indicates that community gardens can be a great alternative to implementing EfS in elementary education. The first strand of the study investigated the characteristics of community garden projects in six primary schools in Cyprus and the records of children's participation in them, interviewing 95 pupils aged 8 to 10, their teachers, and their school directors. The other dimension of the research approached forty-one children, from 8

to 9 years, along with their teachers, while their parents had a small involvement in this project, which lasted almost a year. Interviews, participants' notebooks, and the researcher's diary were used as sources of data collection. The results of the studies by Petrou (2018) show that school gardens attract children's interest, their willingness to support them, and their appropriation, regardless of the level of participation and the type of relationship with the adults involved in the projects. Creating a 'space' for critical thinking and reflection proved important in helping the participating children make sense of their role in the project.

Even if there is some consensus about the importance of EfS for the construction of a more sustainable and prosperous society, as well as about its development in the first school years, several aspects of EfS turned to elementary schools have not been explained yet due to a lack of studies on this topic (Davis, 2009; EPSD, 2010; Siraj-Blatchford et al., 2010; Somerville & Williams, 2015). The next subtopic will detail and discuss this gap.

2.3 EfS research in elementary schools

Despite the relevance of educational development over sustainability turned to children, or elementary school students, to enable the creation of foundations for a sustainable society in a literary survey that was done for 12 years (from 1996 to 2007), Davis (2009) identified a considerable gap in the research about environmental education and education for sustainability in childhood.

According to Somerville and Williams (2015, p. 103), "researchers of child education were not involved with environmental and sustainability matters, and the researchers of environmental education did not focus their attention on very young children and their educational contexts." Davis (2009) shares the same thought concerning this gap in research about education for sustainability in childhood.

Upon corroborating these authors, Siraj-Blatchford et al. (2010) state that child education for sustainable development is excessively under-researched, and that "this must be amended to provide the area with a base of critical evidence, reflection, and creativity" (Siraj-Blatchford et al., 2010, p. 12).

From the very little scientific research about education for sustainability in elementary schools, the European Panel on Sustainable Development (EPSD) defends that "institutions have paid little attention to improve accessibility and education content for the sustainable development in childhood" (EPSD, 2010, p. 7).

However, it should be mentioned that, more recently, upon revising some literature material similar to that of Davis' (2009) but ranging from 2008 to 2012, Somerville and Williams (2015) stated in their results that there was some advancement in the corpus of the research related to education for sustainability in elementary schools, but that this field is still emerging and lacks more attention and quality of scientific research, considering its relevance to reach a sustainable society.

Therefore, the results of this study can contribute to decreasing the theoretical gap identified by these authors and institutions in the research related to EfS in elementary schools (Davis, 2009; EPSD, 2010; Siraj-Blatchford et al., 2010; Somerville & Williams, 2015), for, upon identifying how the process of building sustainability conceptions in these students takes place, it can enable the choice of strategies, models and methods that are more appropriate for children at this learning stage.

3 Materials and methods

This topic will discuss the epistemic and methodological details considered for the operationalization of this research by presenting and discussing data collection methods and processes, as well as the analysis strategy of this research's findings.

The first subtopic deals with defining the paradigm that led this study. The second subtopic will present the research's objects and subjects and detail the sample of students who participated in the research. The third subtopic describes phenomenography's main method that guided the entire research. The fourth subtopic presents the tools and processes used to collect the study's data. Then, in the fifth subtopic, the strategy and the analysis of the data collected to reach the research's objective will be discussed.

3.1 Research type

This study was developed in compliance with the interpretive paradigm (Burrel & Morgan, 1979; Merriam, 1998) and through the qualitative approach. According to Godoy, "qualitative researchers try to understand the phenomena under study from the perspective of the participants" (1995, p. 63), and this was the study's objective as it tries to look at sustainability from students' view.

Merriam's explanation (2009) about the nature of qualitative research also shows that this is the most appropriate approach for achieving this study's objective. The author states that, in research of this type, the researchers try to understand the individuals' experiences from the meanings these individuals give them and the researchers' concern to see how the research individuals see and experience their life events and which are related to the problems investigated in the research.

As Merriam (2009) suggested for qualitative research, this research focuses on picking children's sustainability conceptions from their experiences and ways of describing them.

3.2 Study objects and research subjects

Sustainability is the phenomenon in this research whose study object is sustainability conceptions from elementary school students in a private Brazilian school named Pessoense Institute of Integrated Education (IPEI).

According to its managers, IPEI, founded on May 12th, 1980, is a school that is under a constant process of construction and deconstruction, both physically and methodologically and is always trying to provide the best there is for its students by trying to keep the constant feeling that it has not finished, that it is always necessary to search for something new, something more, and, according to the managers, this characteristic has always guided the school decisions since its foundation to the current days.

According to the managers, when the school opened, they were already trying to be different from conventional models, where the focus is only on the cognitive-disciplinary development of the students. As pointed out by the principals, since its foundation, which happened at the same time as the foundation of the Bancários neighborhood in João Pessoa, state of Paraíba, Brazil, and due to the demand of several families of college professors who moved to that part of the city, the school has tried to develop a different pedagogical proposition, one that focuses on the training of human beings as a whole, on their development, autonomy, identity, and the ability to express themselves in the search to create a happy and capable human being.

Over the years, and according to the current principals, the school has aimed at continuous perfection, both structural and methodological. Concerning the structural dimension, the school went through several expansions and improvements in its physical infrastructure, which is wide and well-structured and meets the needs of the school in the present day.

Concerning methodological improvement, in the first years, the school based its approach on the most modern theories and research then by adopting methodological works from educationalists and theorists, such as Maria Montessori, Piaget, and Paulo Freire.

Around 1992, the school partnered with the Mater Christi School from Recife, State of Pernambuco, Brazil. This partnership led to the adoption of the Constructivist methodology. Later on, in 1999, with the experience acquired over the years, the school started to abide by the social-interactionist methodology as a theoretical foundation to lead its activities and, since then, this methodological guide, along with theoretical innovations acquired year after year, has been leading the way of teaching–learning at school.

To put into practice the item from the pedagogical suggestion that aims to promote students' comprehension of natural processes and ecological awareness, since 2011, the sustainability issue has become increasingly present in school life.

In a given moment of its history, the school established a distinguished method to deal with relevant, interdisciplinary, and transversal topics during the school year. This proposition was entitled 'the generator topic,' and this is how it works: according to the school managers, every year, based on the social-political and economic context and the problems faced worldwide, principals and teachers outline a topic that will be discussed along the whole year through various activities in every class offered by IPEI, from pre-school to the end of middle school.

In 2016, the school adopted the generator topic called "Our planet, our home," through which several activities turned to Education for Sustainability were developed to emphasize the observance of the item concerning its pedagogical suggestion aimed to promote students' comprehension of natural processes and ecological awareness.

This way, due to its outstanding commitment to human being's full training, and with the development of the students' critical sense and autonomy, together with the adoption of the generator topic "Our planet, our home," through which several activities turned into EfS were chosen, IPEI was chosen as the locus for the research.

Data collection started in August 2016. According to the principals, the school then had 300 students, 189 elementary school students, from first to fifth grades.[1] The research subjects comprise students from the second, third, and fifth grades. Each grade is composed of 26, 17, and 26 students, respectively. Most of these students participated in the drawing workshop developed during this study, except those who missed class that day or did not wish to participate since the activities were optional. From those who participated in the drawing workshop, nine students from each grade were drawn to share and explain the meanings of their drawings and participate in interviews.

The definition for nine students in each grade was due to the idea that this would be the highest number of students possible to enable the interviews and explanation of the

[1] In Brazil, elementary school encompasses students between 6 and 10 years, from first to fifth grade. As the educational system changes from country to country, like in the USA, where the same age group encompasses students from second to sixth grade, and for technical reasons, this research will follow the Brazilian classification.

Table 1 Distribution of second-, third-, and fifth-grade students. *Source*: Designed by the authors, 2017

	Second grade		Third grade		Fifth grade	
Gender	Male	Female	Male	Female	Male	Female
	9	17	8	9	16	10
Total number of students	26		17		26	
Average age	7 years		8 years		10 years	

Source: Research Data, 2017

drawings and to observe the time limit imposed by the school to have these activities done, along with the limitations of the researcher to hear and interview a higher number of children in the short time provided by the school for this purpose.

Table 1 shows the detailed distribution of IPEI students from the second, third, and fifth grades. It is possible to see gender and average age by grades, in a total of 33 boys and 36 girls.

Students from first and fourth grades could not participate in the research because they had no authorization from the school since they were taking part in another research when this study was being carried out. However, we understand that this did not interfere with the research results since the students who participated in it represent the beginning, the middle, and the end of the elementary school years.

3.3 Research's core method: phenomenography

Phenomenography was the core method chosen for the development of this qualitative research, which complies with the interpretive paradigm and, thus, guarantees this work's epistemic/methodological coherence.

This method comprises the interest in describing the world's phenomena, how others see and experience them, and showing and describing their moves, especially in an educational context (Marton & Booth, 1997), thus fitting the research's needs and objective.

According to Cherman (2013), phenomenography is not focused on a phenomenon, let alone on the subjects investigated but on the correlation between subjects and phenomena. By analyzing the different ways, each student experiences or sees a given phenomenon, phenomenography enables the identification of the different ways to experience this phenomenon. Therefore, through phenomenography, the present research tries to identify the different ways elementary school students from a school in Paraíba, Brazil, see or experience the phenomenon concerning sustainability and analyze variations in these conceptions.

In phenomenography, the different ways the individuals researched conceive phenomena lead to description categories, and the variation dimensions are the differences between these categories, which show how the correlation between several categories takes place. According to Lopes (2012), there is a structure named space of results, composed of categories of description and the compound of variation dimensions.

The spaces of results, which are formed by the set of categories and the dimensions of variations, have three criteria of quality through which they must be analyzed (Marton & Booth, 1997). The first criterion says that each category defined must express a different way of experiencing the phenomenon under analysis. The second concerns the need for a

logical relational structure between the categories. Then, the smallest number of categories must be suggested and explained acceptably.

3.4 Data collection

Data collection took place between August 25th and November 3rd, 2016.

To start data collection, a meeting was held on August 25th, from 2 to 3 p.m., to present the research project to the school principals and supervisors to sensitize the managerial/pedagogical body and get their authorization to develop the research. During this meeting, one of the principals explained how the school deals with the matter of sustainability among students, and the objectives and methods of the research to be developed were presented to the principals and the supervisors. Some explanations also showed that the research would only include elementary school students. It is important to emphasize that the principals and the supervisors authorized the development of the research only with second-, third- and fifth-grade students since students from the first and fourth grades were already participating in another research.

After permission from the management and supervision for the development of the research, a second meeting was held on the same day, from 5:00 pm to 5:30 pm, however, this time, with the 2nd, 3rd and 5th grade teachers. The meeting aimed to explain the research objectives and methods, as well as outline a plan for the implementation of the necessary activities, in order to reconcile them with the school routine.

As a result of this meeting, everyone agreed that each class researched would have a free afternoon for the drawing workshop and the interviews with the students.

The researcher spent around 4 months, or approximately 17 h and 32 min, of research time in the field of research.

Next, the data collection steps will show how the research was developed.

3.4.1 Drawing workshop

The option to have this drawing workshop together with interviews with second-, third-, and fifth-grade students was due to some aspects:

According to Serrano et al. (2016), using visual aids (photographs in their suggestion and drawings in this research) and interviews diversifies the data collection methods used in the research, enabling a better data triangulation during research analysis.

Another point is that, according to Serrano et al. (2016) and Natividade et al. (2008), some individuals in the research have greater verbal difficulties in expressing and answering the questions in the interviews and questionnaires, including children who are the subjects of this research. Thus, the authors suggest using visual aids during the interview to enable the expression and communication of the individuals investigated.

The use of visual aids together with the interview aimed to serve as an "ice-breaker" to make children more comfortable to share their conceptions about sustainability during the interview steps, which is also pointed out as an advantage that comes from using this methodological strategy by Serrano et al. (2016) and Natividade et al. (2008).

Therefore, for these reasons, we chose the drawing workshop, which was divided into two steps. Firstly, all the second-, third-, and fifth-grade students were invited to draw what sustainability represents to them. This activity took place on pre-scheduled days, times, and places; each student had 20 min to do so. Secondly, groups of three students from each

Table 2 Number of drawings produced in the workshop. *Source:* Designed by the authors, 2017

	Second grade	Third grade	Fifth grade
Number of students	26	17	26
Number of drawings by class	24	15	25
Total number of drawings	64		

Source: Research Data, 2017

grade presented their drawings to the researcher in a separate room to explain why that drawing represented sustainability and the meaning of each detail in their drawings.

It should be mentioned that students were completely free to make their drawings and had no parameters or rules to follow. Moreover, following the teachers' suggestions, every student in every grade took part in the first step of the workshop so no students would feel they had been left out in case the researcher limited the number of students, which was suggested at first, that is, the realization of the workshop with only nine students from each grade.

However, the teachers' suggestions were accepted, and all the students who showed interest could participate in the first step. Notwithstanding, as the number of drawings in the workshop was high, 64 in total, as seen in Table 2, and since almost every student took part in it, it was impossible to keep all the students from each grade in the second step of the drawing workshop. So, nine students from each grade were drawn to participate in the second drawing workshop and, later on, in the interviews.

Therefore, for the step concerning data analysis, only the drawings made by the students who took part in the second step of the drawing workshop were selected to enable the analyses since those were the only students who had the opportunity to explain the meaning of their drawings. However, the drawings made by the students who could not participate in the second step of the workshop were stored and will be able to serve as material for further analyses beyond the scope of this research.

It should also be mentioned that the concept of sustainability was neither presented nor discussed by the researcher with the students before or after the workshop. This procedure was done to avoid biasing the student's drawings and answers to the interview questions right after the drawing workshop, based on the researcher's perspectives or opinions about the topic.

In the end, all the drawings from the first workshop step were digitized, and the researchers filmed and transcribed each student's presentations in the second step.

3.4.2 Interview with second-, third-, and fifth-grade students

The interview with second-, third-, and fifth-grade students was done during the drawing workshop, and this is how it was done: At first, the researcher introduced himself and presented the research to the students in each grade on different days, times, and places. Then, he explained that the research would be divided into two moments: the drawing workshop (which served as an ice-breaker to engage students with the research topic and have the debates start) and the interviews. After that, the drawing workshop, which was described in the previous topic, started.

After the drawing workshop in the classes lasted for around 20 min, the researcher explained in detail how the interviews would take place and then started.

Interviews were done during the second drawing workshop step as follows: Those nine students drawn from each grade to participate in the second part of the drawing workshop were also selected to participate in the interviews. The teachers led them in groups of three to another room, where they met the researcher and an assistant who had a handheld camera to help record the interviews. Upon arriving there, the students were welcomed, and the second step of the drawing workshop would start, followed by the collective interviews.

The interviews happened through a conversation, followed by the second step of the drawing workshop, as previously mentioned when students first presented the drawings they had made about sustainability and shared their meaning (second step of the drawing workshop). Then, they were asked a series of questions about the topic. As soon as the interview was over, the students returned to their classrooms, and the next three students were called out to participate. Then, the cycle would be repeated until all three groups of students from each class participated.

The interviews were done through a semi-structured script, adapted from Farias (2016) (Appendix), who researched with similar objectives but on a higher teaching level. All the interviews were filmed to minimize data loss. The researchers then transcribed them to make the analyses easy.

3.5 Data analysis

At first, it should be pointed out that the material to be analyzed involves the drawings, the transcriptions of the explanations about them, and the interview transcriptions. An important point to mention concerns the analysis of the drawings through the phenomenographic method and the role this analysis took in the research.

There are at least two main approaches to analyzing children's drawings in the scientific research context. The first approach analyzes the lines in the drawings in a way that suffices the identification of children's understandings and conceptions, besides the fact that the drawings can be analyzed directly by the researcher through the evaluation of graphical elements, such as the colors chosen, the characteristics of the lines applied, the presence of the absence of constitutive elements, and types of lines to represent facial expressions, among others (Eloranta & Yli-Panula, 2005; Fávero & Salim, 1995; Garrido & Meirelles, 2014; Motta & Enumo, 2002).

However, an alternative trend sees that the drawings enable communication between children and the researcher, but that should not be the only interpretation. It is necessary to analyze them along with the explanations of those under investigation, both about their details and their meanings (Alerby, 2000; Gibson et al., 2010; Horstman et al., 2008; Massimo & Zarri, 2006; Natividade et al., 2008; Pereira, 2005; Profice et al., 2013; Rollins, 2005; Soanes et al., 2009).

This second trend understands that, since the drawings are a recreational and inviting tool, they are used as a method to access information that would hardly be displayed through conventional methodologies, such as interviews. However, to these authors, the drawings must be analyzed with the children's oral explanations about them, making drawings and comments one analysis unit (Natividade et al., 2008).

Concerning the analyses of the drawings in this research, we chose to follow the second approach discussed so that it was not based on the researcher's understanding of what children tried to express through their drawings but on the explanations they gave about these drawings and their details in the second part of the drawing workshop.

This was the approach chosen for, according to Natividade et al. (2008, p. 12), concerning the analysis of children's drawings aiming at the attribution of meanings, "to understand a child's drawing and what the artist means through the lines and colors employed on a sheet of paper, it is necessary to listen to what the artist says about their production." According to the authors, the researcher must not be tempted to try to understand children's drawings only through what they see on the paper because the feelings placed there by children can only be understood through their explanation of their production.

Thus, they state that

> interpreting a drawing is not a simple task since the signs employed there do not speak for themselves: we need to understand them and listen to what they say, which can, frequently, be done with the help of words. This is particularly necessary when there is the intention to know/explain a given situation (Natividade et al., 2008, p. 12)

Another reason to analyze drawings based on the children's explanations about them is the intention to keep the essence of the phenomenographic method, which, according to Marton and Booth (1997), aims to understand the phenomena as others see or look at them.

Therefore, even if we know the validity of the analyses developed through the first approach, or the analysis of the drawing in itself, we know that, due to the subjectivity of the graphical elements in the drawings, the second approach, which employs the analysis of the children's explanations about the meaning of their drawings, enables a more trustworthy analysis of the conceptions and understandings of the subjects investigated.

Concerning the role that the analysis of the drawings had on this research, that is a complementary function to the analysis of the interviews with the children, so that the children's explanations about their drawings were added to their speeches during the interviews to qualitatively enrichen the set of data obtained to enable a better analysis of the students' sustainability conceptions.

The next section will discuss how the phenomenographic analysis of children's sustainability conceptions took place based on their drawings and interviews.

3.5.1 Mapping sustainability conceptions based on the interviews and drawings analysis

At first, students' names were coded to protect their identity according to the following codification: SYGXAZ, where S represents the school year, Y represents the student's school year number, G represents the group, X represents the student's group in the interview, having in mind that there were three groups by school year, A represents the student, and Z represents the student's sequence number.

The children's explanations about the meanings were then transcribed, and each detail in their drawings from the second step of the drawing workshop was added to the transcripts of their speeches in the interviews. Afterward, the researcher went through each child's transcript to identify different meanings attributed to sustainability in their reports based on the question: What does this account tell me about what he/she understands of sustainability?

A spreadsheet was created to organize selected parts with notes for each part. Then, the understandings were compared to identify a correlation between them until the researcher reached the definition of the description categories and, consequently,

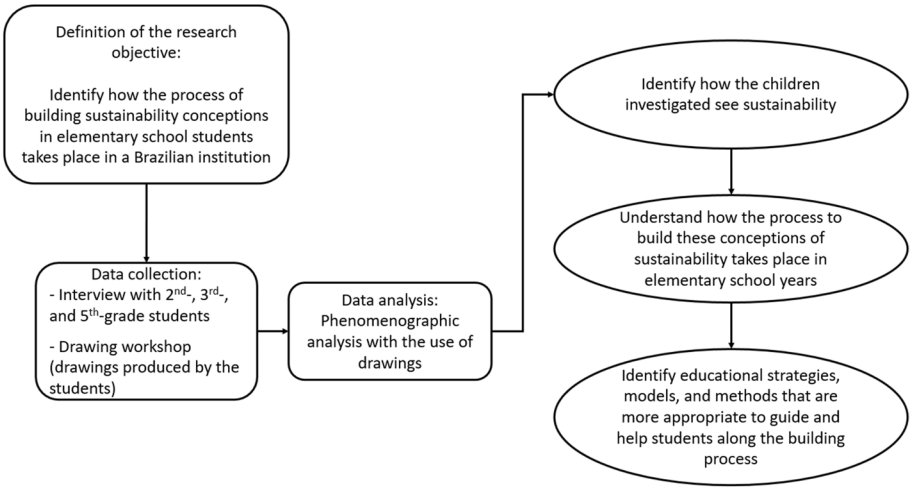


Fig. 1 Research design. *Source*: Designed by the authors, 2021

the sustainability conceptions based on the analysis of each child's drawings and analysis. As previously described, the sustainability conceptions identified in this study concern a posteriori categories. That is, they come from data and not from the previous theoretical framework.

It should be mentioned that during the process of drawings interpretation and based on the explanations that the children gave about them and on the interview transcripts, we made a joint analysis of the data that came from these two sources to enable a more trustworthy categorization of the children's sustainability conceptions, which was confirmed after data analysis, for the children might have different understandings about sustainability through two data collection tools, which was better identified with the joint data analysis,

3.5.2 Conceptions analysis from the interviews and drawings

The concepts about sustainability obtained from the analysis of drawings and interviews were analyzed through two prisms. First, how these conceptions relate to each other; that is, it was analyzed whether the conceptions are linked to each other and how these links occur.

These conceptions were then separated into three groups related to the second, third and fifth grades. We checked whether they varied over elementary school years and had an overview of how this variation took place.

3.5.3 Research design

Figure 1 presents the main research steps, including objective definition, discursive sources, the data collection tools used to access the discursive sources mentioned, the data analysis method, and the results and contributions of this study.

4 Results and discussion

Lankoski (2016) states that, due to the interdisciplinary nature of the term sustainability, one of the characteristics of this concept is its plurality of understandings. The drawings, their descriptions and meanings, and the children's speeches during the interviews revealed the existence of different ways of conceiving sustainability on the part of the investigated students, although they study at the same school and participate in activities that work on the theme together, even among those in the same grade.

The phenomenographic analysis qualitatively highlighted five ways that sustainability is seen by the students who participated in this research. These five different conceptions were labeled (1) Preservationist, (2) Interventionist, (3) Social-environmentalist conciliatory, (4) Social-economic-environmentalist conciliatory, and (5) Inter-generational. We noticed that these categories range from flat, or superficial, to more extensive, or broader.

In the most basic school year that took part in the study, the second grade, we identified the presence of the following categories: Preservationist, Social-environmentalist conciliatory, and Social-economic-environmentalist conciliatory.

In the third school year, an intermediary grade between those that took part in the study, we identified the presence of the following categories: preservationist, interventionist, social-environmentalist conciliatory, and social-economic-environmentalist conciliatory. It should be mentioned that no children with conceptions that belong to the more extensive category were present in this school year.

In the fifth school year, the most advanced grade to take part in the study, we identified the presence of the following categories: preservationist, interventionist, social-environmentalist conciliatory, social-economic-environmentalist conciliatory, and inter-generational. It should be mentioned that this school year encompasses children with sustainability conceptions that range from flat to more extensive.

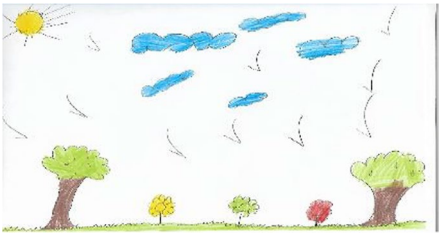
The plurality of how the children investigated conceive sustainability complies with Lankoski (2016); this plurality is linked to the concept due to its interdisciplinary nature. It is relevant to note that, even though this is natural, especially in the children's education context, it is important that these conceptions evolve over the years. We wish that the highest possible number of children have more extensive, or broader, sustainability conceptions by the time they finish elementary school.

By turning this diversity of conceptions into a more solid conception, we avoid taking the risk of leading a whole generation of children to conceptual confusion, which, according to Taylor (2014) and Sartori et al. (2014), is one of the difficulties that emerge from the multiple ways of conceiving sustainability. It also avoids vague conceptions that, according to Barros et al. (2014), Ratiu and Anderson (2015), and Lankoski (2016), jeopardize the operationalization of sustainable practices or the transformation of concepts into social practices.

It should be noted that the five sustainability conceptions mentioned by the children who took part in the study came from the data; that is, they are a posteriori categories and were defined based on the research data analysis. The authors defined the labeling based on the mutual conceptions of each category.

The next topics will detail the sustainability conceptions identified in the study. According to the children, they will include their drawings, descriptions, and meanings and the explicit citations taken from the interview transcripts, which served as the basis to define these categories and represent them. Moreover, through this material, it will be possible to have a first impression of the correlation between these categories.

Table 3 Preservationist sustainability conception. *Source:* Research data, 2017

Drawing	Description of the drawing
	The student drew some natural scenery, composed of the Sun in the upper-left corner, clouds and birds in the middle, and trees, flowers, and grass on the bottom **Why does it represent sustainability?** "[…] Because I like nature. […]"
Parts of the interview that shows what sustainability means to the student "[…] The sky. It's endless. […]."	
Student	S2G3A2

4.1 Preservationist

The preservationist conception of sustainability was identified in children from all the second, third, and fifth grades, especially in the first two grades. This category encompasses the children who present the flatter conceptions of sustainability and connect them to preserving and keeping nature only.

To these students, sustainability is limited to keeping nature untouched only or taking care of the fauna and flora present in the environment. These children do not see nature as a source of resources that can be harmoniously explored to enable the maintenance and expansion of human life quality.

The visual aids and the materials that substantiate the definition attributed to this category will be presented below. They come from second-grade students (Table 3).

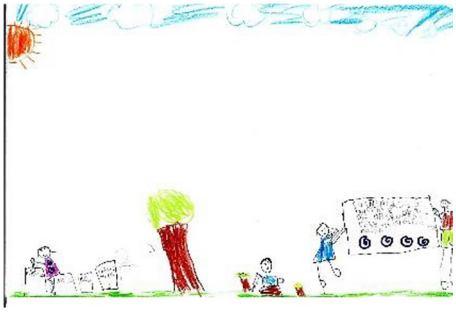
The visual aids and the written materials produced by this second-grade student (S2G3A2) show an overly flat sustainability conception, connected to nature and its continuity only.

These children's conceptions comply with what is defended by researchers from the sustainability and sustainable development areas, such as Jacobi (2003), who mentions the existence of a "need to improve life quality levels and make them compatible with environmental preservation"; Cavalcanti (1998), who defines sustainability as "the possibility to reach continuous life conditions that are equal to or higher for a group of people and their successors in a given ecosystem"; and Jones et al. (2010), who see sustainability as the conciliation between human and natural systems, so that they exist indefinitely, besides meeting the quality needs of social lives.

In other words, while these children see sustainability as something connected to preserving nature only, the researchers understand that it is connected to a harmonious exploration of natural resources to maintain and expand human life quality and nature protection concurrently.

Besides being superficial, this sustainability conception becomes distorted and unreal, for, according to Benfica (2012), it is impossible to establish and develop any human society without generating environmental impacts. To the author, we cannot limit sustainability to the idea of preserving nature and its resources. We must expand the sustainability

Table 4 Interventionist sustainability conception. Source*:* Research data, 2017

Drawing	Description of the drawing
	The drawing aimed to give three tips on sustainability. In the lower-left corner, a girl is practicing selective waste disposal; in the middle, a boy is planting a tree; and in the lower-right corner, there are a boy and a girl holding a sign with the third tip, which says "Sustainability is also about using the other side of the paper for drawing." Moreover, the sun, clouds, and a blue sky are on the upper part **Why does it represent sustainability?** "[…] I think that sustainability means that people must recycle and plant trees. […]."
Parts of the interview that shows what sustainability means to the student	
"[…] care for the environment and respect nature […] we used to plant many things […] respect the planet. […] people should recycle more. […] don't throw trash on the ground. […] preserve the water because lots of sewers run into them. […] go for a walk, plant things outside school, and help the environment. […]."	
Student	S3G1A3

conception to include the possibility of exploring natural resources harmoniously and, thus, enable a balance between society and the environment.

Therefore, by considering the superficiality and distortion of this sustainability conception and taking into account that eight children from all the elementary school years, including the fifth grade, presented this conception, the school needs to review its practices concerning education for sustainability to identify which actions, or lack of them, may be collaborating to the creation of such conception and act to implement improvements on EfS actions to minimize the existence of such a limited conception, especially in the most advanced school grades.

4.2 Interventionist

This category includes third- and fifth-grade students, children whose sustainability conception focuses on environmental issues only but, like children who see sustainability as preservation, they see the possibility of existing a balance correlation between human beings and the rest of nature so that the individual may use natural resources in their favor but in a harmonious way.

By analyzing the visual aids and the writings shown in Table 4, which a third-grade student did, we can see the similarities and differences between this category and the previous one. The actions practiced in the drawing and explained by the student show concern for nature and preserving it. The materials are also present in the previous category. However, unlike the preservationist category bias, the students who comprise the interventionist category see nature as a set of resources that can be explored to expand human life conditions, as long as this exploration is balanced and guarantees environmental preservation.

This conceptual difference can be seen in the drawing and speech of student S3G1A3, for, besides simply keeping nature untouched, recycling, not throwing trash on the ground, observing sanitation, and reusing paper, which are actions turned to preserve the environment, and it also denotes the use of its natural resources.

While the previous category limits sustainability to preserving nature only, the students in this category have an interventionist sustainability perspective and see it as the harmonious exploration of nature, where the limits imposed by the natural cycles of ecosystems are respected by humankind so that they can keep on supplying us with their valuable resources for human welfare.

Therefore, although it is flat, we can see that the sustainability conception presented by the students in this category complies with the idea that, for sustainability to exist, it is necessary to have a balanced correlation between society and the environment, where people explore its natural resources by respecting the limits imposed by nature (Benfica, 2012; Cavalcanti, 1998; Jacobi, 2003; Jones et al., 2010), and not only the mere contemplative preservation of the environment.

Thus, the definition by Jones et al. (2010) illustrates the way to conceive sustainability identified in this category, for the authors who state that it can be seen as a set of conditions that enable harmony and conciliation between human and natural systems so that they can coexist indefinitely, besides supplying life quality needs.

However, although it is less superficial than the previous category, this category can still be considered flat, for it only focuses on the environmental aspect, even as a source of resources, and not only mere observation, as it discards other relevant aspects as sustainability components that are considered by students who presented more extensive sustainability conceptions, which will be presented in the next categories.

4.3 Social-environmentalist conciliatory

As in the preservationist category, and unlike the interventionist category, the social-environmentalist conciliatory conception of sustainability was identified in every child from the second, third, and fifth grades, especially in the first 2 years.

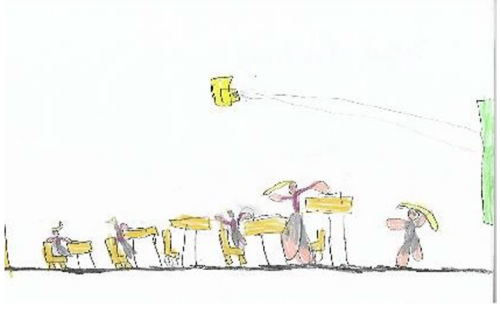
This category comprises children who see sustainability both as the individual-nature balance, which is essential for the interventionist category, as well as the social balance; that is, for these children, a sustainable world is, besides a place with a harmonious exploration of natural resources, a place of social balance, where people consider the social impact they will cause, besides the environmental impact of their decisions.

Therefore, it is clear that these children's conception is a little broader than that of the children in the last category, and it encompasses the concerns in the two categories above, adding the social aspect to them. This is highlighted by the drawings, descriptions, meanings, and speeches of the third-grade students in the interviews, as described below (Table 5).

Besides including himself in this drawing, the materials produced by this student from the third grade serve as an example of the relevance of the methodological path defined in this work to analyze the drawings and the categories.

Firstly, concerning the choice to analyze the drawings from the children's explanations about them and their meanings, it would be impossible to interpret the drawing plainly without moving away from the meaning the child gave it, besides the fact that the elements in the drawing are more complex than those by other students, upon hearing the child's

Table 5 Social-environmentalist conciliatory conception of sustainability. *Source:* Research data, 2017

Drawing	Description of the drawing
	The child drew a timeline where he depicted a student in different moments of his school years, from the start, when he is sitting down, in the lower-left corner, to the end, when the student becomes a teacher, in the lower-right corner. It represents the evolution of respect through education. According to the child, as a student, the character in the drawing was not respected by the others. However, when he became a teacher, he started to be respected **Why does it represent sustainability?** "[…] It means respect and education. […]"
Parts of the interview that shows what sustainability means to the student "[…] Help people, help nature by taking the trash out, help animals. […] selective disposal […] collaborate more to this issue about trash […] throw trash in the trash […] sanitation […] clean water and distribute it […] don't pollute […] Respect, help […]."	
Student	S3G2A2

description and confronting it to an initial analysis done by the researcher (plain drawing analysis), we realized the meanings were completely different.

Secondly, concerning the decision to categorize the children by using the content that comes from the collection of their visual productions (the drawings) and their speeches in the interviews as a basis, since, in the specific case of this third-grade student, for example, a simple drawing and description analysis could lead to a superficial categorization for, in the drawing, the student shows no concern with the environmental aspect, only with social issues. However, upon analyzing his speeches in the interview and the drawing, we can see, in his lines, that he also has environmental concerns about sustainability conception.

As previously mentioned, the student's drawing connects sustainability to a social concern related to respect and education, and, besides reinforcing this connection of social issues to the meaning of sustainability in the interview, he also brings the environmental issue into his conception through his concerns with sanitation, selective disposal, and how to reduce pollution, among others.

The perception of students with a sustainability conception defined as social-environmentalist conciliatory is similar to that suggested by Gadotti (2008). To the author, sustainability is seen through a balanced bias. However, not only the environmental balance but the social-environmental balance as well, where its surroundings, such as people and the environment, are considered, aiming at the mankind-nature coexistence.

Based on this social-environmentalist conciliatory conception, we can see a concern with preserving the environment and its harmonious exploration, besides the existence of a sense of collectivity in the students, which, according to Silva et al. (2014), is one of the main characteristics and conditions for sustainability, the development of collective minds, and the detachment from individualistic notions.

According to Silva et al. (2014), an individual can only be sustainable if he thinks about others besides himself, both in the present and in the future. Otherwise, what would motivate someone to give up certain environmental or economic resources on behalf of society? This dilemma is frequently faced in the process of making sustainable decisions.

Although this category is broader than the previous ones concerning depth and amplitude defined in this study, it has an intermediary position because, even after adding the environmental and social aspects to its sustainability conception, these children still cannot see the economic/financial aspect as one of the fundamental sustainability aspects, as defended by Sachs (1993) and Elkington (1997), and, therefore, have a limited perspective of the factors that must be taken into account in their daily decisions for a sustainable life.

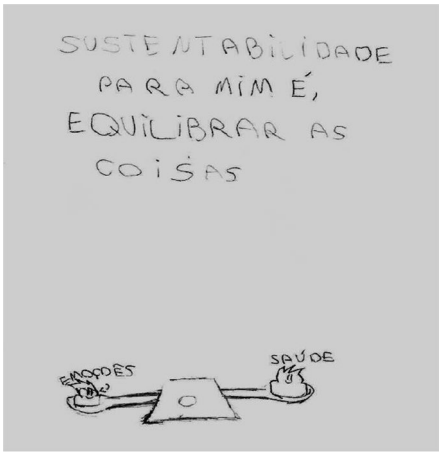
4.4 Social-economic-environmentalist conciliatory

The social-economic-environmentalist conciliatory conception of sustainability was seen in all the school grades researched. Its presence was equally identified in every school year with a low frequency.

This category comprises children who presented a sustainability conception that encompasses the need for an economic balance besides the individual-nature balance and the social balance. This is the second broader and more extensive category after the inter-generational category.

To the children with this conception, a sustainable thought is based on three dimensions at least: environmental, where they place their concerns with natural resources, their harmonious exploration, and preservation; social, where they discuss the social balance

Table 6 Social-economic-environmentalist conciliatory conception of sustainability. *Source*: Research data, 2017

Drawing	Description of the drawing
	At the bottom of the sheet of paper, the student drew a weighing scale with a person on each side – one representing emotions and the other representing health. According to the child, the scale is even, and sustainability is the balance between health and emotions **Why does it represent sustainability?** "[…] Because, to me, sustainability is about balancing things. […]"
Parts of the interview that shows what sustainability means to the student "[…] we have to help one another […] I think sustainability is important for the future; for example, I have to balance my money to spend it on something important, something very important, and not to spend it all. […] each one of us should plant a seed […] sustainability means sustaining a friendship, a forest. […]."	
Student	S5G3A3

issue and their concerns with others; and economic, where they reflect on how to use their resources decently.

This broader conception is highlighted in the visual and writing aids produced by fifth-grade students (Table 6).

Through the materials he produced, this fifth-grade student showed he is aware of the three-dimensional sustainability conception, which means that sustainability has to do with the balance between these three dimensions: environmental, economic, and social. Although these dimensions are not very clear in the drawing, they are mentioned in the student's speech during the interview when he, for example, ponders about using his money (economic aspect), when he is concerned with helping others (social aspect), and when he mentions the possibility to plant trees (environmental aspect).

This three-dimensional conception of sustainability complies with Elkington (1997), Cavalcanti (1998) and Jacobi (2003), who see sustainability as the decisions that consider social, economic, and environmental aspects.

Therefore, we can see that these children have a conception of sustainability that is more thorough than the previous categories for, besides seeing environmental and social issues as components of a sustainable decision, they can even see that the economic aspect is related to sustainability.

4.5 Inter-generational

This category is composed of fifth-grade students only, and it comprises the children who have a conception of sustainability that encompasses the three dimensions of sustainability suggested by Elkington (1997), Cavalcanti (1998) and Jacobi (2003), which are environmental, economic, and social, a concern with keeping the balance between these three pillars for future generations.

By analyzing the materials, it is possible to identify a conception of sustainability that is even broader and more extensive than the previous one, which already considered the "sustainability tripod" in its way of seeing sustainability. It is possible to identify a concern that reaches beyond the balance present in these elements, aiming not only to make decisions that bring harmony between these three dimensions in the present but to keep this balance to ensure the welfare of future generations. It is about children who think of not only today's children but those of tomorrow, their children and grandchildren.

Therefore, this group of children stood out from the other groups because of their inter-generational view, which considers the consequences of making decisions in the present for future generations, besides considering the need to balance the three basic pillars of sustainability (Table 7).

If analyzed by the drawing only, this fifth-grade student could have easily been inserted into another category that is flatter than this one, since he encompasses only one sustainability conception connected to the harmonious environmental exploration. However, as we link the drawing to his speech in the interview, it is obvious that this child has one of the broadest and most extensive conceptions of sustainability.

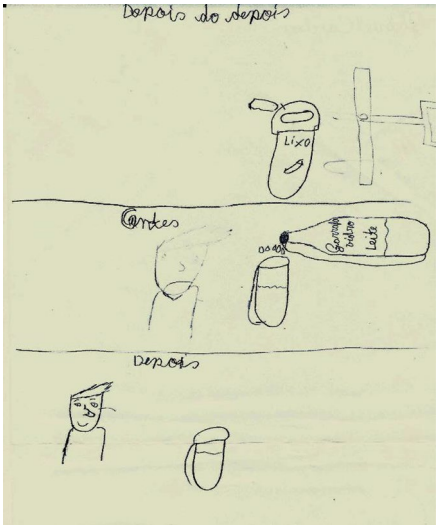
Over his speeches about the meaning of sustainability, the child goes through concerns that involve other issues, such as social, when she talks about the need to think not only about ourselves but also about those around us; environmental, when she defends that water and wood must be used wisely; and economical, when she states that making money is necessary because everything comes down to it, and she even criticizes this social habit, where money is the center of it all. Besides encompassing these three essential aspects through her speech, she also mentions a special concern for future generations when she talks about the welfare of her children and grandchildren.

Although the conception of sustainability from the students in this category and the previous category does not encompass some of the sustainability dimensions suggested by Sachs (2002), that is, cultural, ecological, territorial, and national and international policies, the idea of sustainability from these students is seen as the most extensively identified in this study.

Besides the basic pillar of sustainability defended by Elkington (1997), Cavalcanti (1998) and Jacobi (2003), the conceptions of sustainability from these students comprise an inter-generational view that aims to balance not only now but also tomorrow, confirming the statements by McIntyre et al. (2016) and Böhme et al. (2018), who criticize the conception of sustainability turned to the dimensions only.

To McIntyre et al. (2016) and Böhme et al. (2018), the understanding of sustainability must be essentially linked to the inter-generational concept of Brundtland's commission (Brundtland, 1987). Otherwise, individuals and organizations may be coated with sustainability even if they do not act to guarantee the development of future generations. Meeting requirements in each sustainability dimension, pointed out by

Table 7 Inter-generational sustainability conception. *Source*: Research data, 2017

Drawing	Description of the drawing
	The drawing is a sequence of actions from a character. First, a boy pours some milk into a cup in the middle. Then, on the bottom, the boy drinks the milk, and, on the upper part, he throws the bottle into a bin **Why does it represent sustainability?** "[…] to keep the city clean because, otherwise, the world can get very dirty […]." **Parts of the interview that shows what sustainability means to the student** "[…] To me, sustainability means thinking about others, you think about others and not only about yourself, but about everything around you. Some children starve as you have food and waste it. Instead, you should be thankful for eating, it doesn't take much. Giving is also important. And respecting the planet, like, water, it's all important because today everyone wastes a lot, they use a lot of water; wood, they cut wood to make furniture and paper, and this uses up the environment, and we could change that. This could be helpful in the future so that our grandchildren and children don't have to go through this problem we face today: the lack of resources. […] this problem with children who have no food and we waste food even when we have it. […] there used to be this abandoned house, and now they are making a building there instead of remodeling the house, and there is another stadium, they should give it to the homeless. […] making money, of course, because everything today comes down to money because if you don't have the money, you can't buy food, you can't buy water… Actually, this is wrong. […] we should care for everything around us, people, friends… […] save water, throw paper in the bin, reuse it […] always thinking about the future and how it would be if there were no sustainability **Student** S5G2A1

whichever theoretical model is chosen, is all it takes, and this does not guarantee the maintenance of resources to provide for the needs of future generations.

The next topic will discuss the correlations between the categories to understand how they relate to each other.

4.6 Correlations between the categories

According to Lopes (2012), the description categories, which, in this case, are the gathering of a group of similar conceptions from students about sustainability, and the various dimensions, which are the differences between these categories, are, within this research

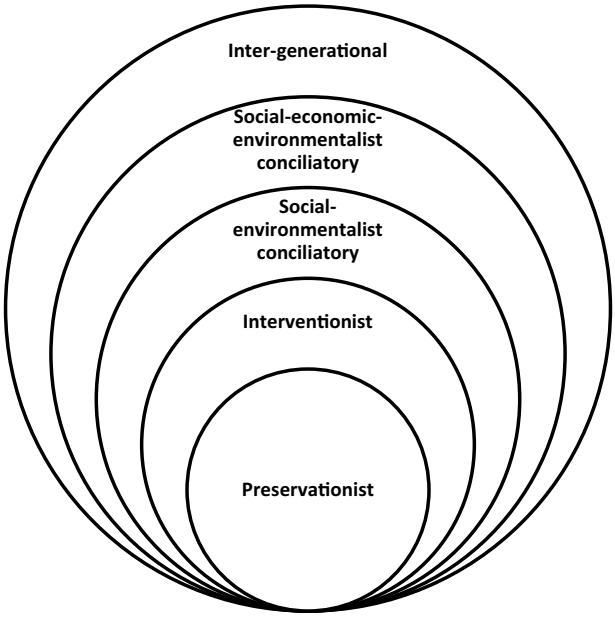


Fig. 2 Correlations between the Categories. *Source:* Designed by the authors, 2017

Scopus of the phenomenographic analysis, the two elements that make up a structure named "Space of Results."

Based on two reasons that will be presented, we understand that the conceptions of sustainability identified in this study, and which make up the space of results herein, are hierarchical and inclusive.

Concerning its hierarchical and inclusive nature in all the conceptions, this understanding is primarily based on the logical observation that the most extensive sustainability conception, the inter-generational, has a previous conception, the social-economic-environmentalist conciliatory, and so on, all the way to the flatter conception, the preservationist.

Secondly, the empiric evidence that, from the most extensive to the flattest dimension, it includes the previous one, as it can be seen in the drawing and the speech of student S5G2A3, which, although they fit the inter-generational, also contain words that highlight the social-economic-environmentalist conciliatory conception of sustainability, or in the drawing and speech of student S5G3A3, which, even if they fit the social-economic-environmentalist conciliatory conception of sustainability, also show the presence of elements that are characteristic from the previous conception, the social-environmentalist.

Figure 2 uses drawings to graphically show the correlations between the categories identified from this phenomenographic analysis.

Figure 2 highlights the hierarchic and inclusive correlation between the categories, which leads to the understanding that there is a gradual path of shapes to conceive sustainability in the elementary school investigated. Students should be guided through this path with school guidance and support from principals, coordinators, teachers, staff, and parents, going from the flattest conceptions to the broadest and most extensive ones. The next subtopic will analyze how the variations concerning the conceptions of sustainability over elementary school years take place.

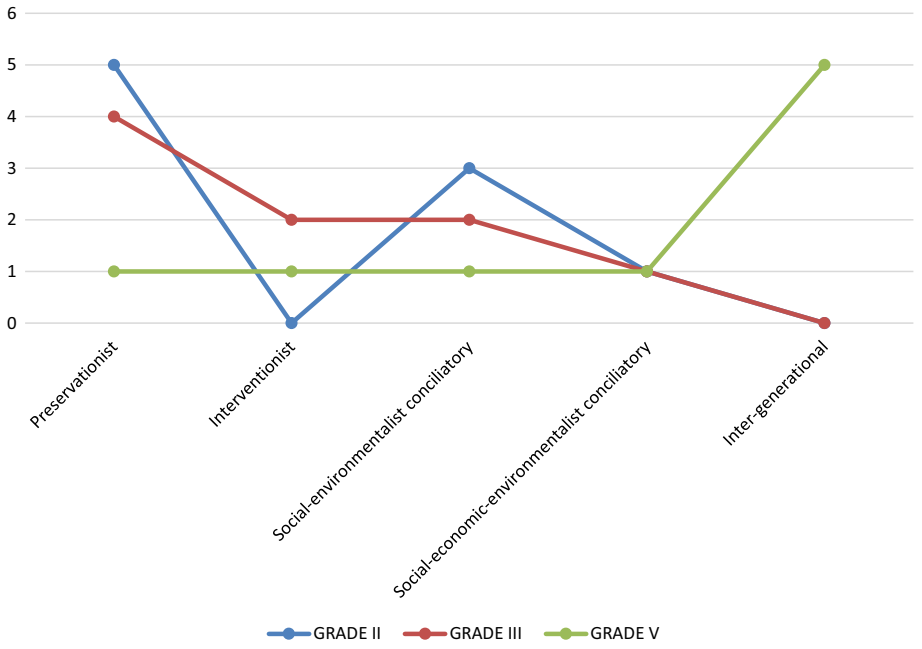


Fig. 3 Variation in the conceptions in the three grades researched. *Source:* Research data, 2017

4.7 Variation in the conceptions over elementary school years

To understand the process of building the conceptions of sustainability from students over elementary school, we analyzed the distribution of the different conceptions of sustainability in the three grades researched so that, based on the map this distribution generated, we can understand how these conceptions vary.

Figure 3 shows the incidence of the categories in each of the elementary school years investigated.

We should mention that, despite the use of charts and incidence distribution, this analysis still has a qualitative nature, for the numbers here are used only to understand how the categories identified in the study are present in each grade investigated and not to perform any statistical test.

By analyzing the data presented in Fig. 3, at first, it is possible to notice that the distribution of the conceptions in the three grades investigated is not consistent; that is, it changes from grade to grade. Thus, most students in the starting grades, second and third, have flatter sustainability conceptions: the preservationist and the interventionist conceptions. On the other hand, most of the students in fifth grade have a more extensive and broader conception of sustainability, which is inter-generational.

Therefore, although the variation in the conceptions of sustainability is not straight, since it is clear that there is no major progress concerning the enhancement of these conceptions from the second to the third grade, we can all see it rises, that is, it gets broader and more extensive over elementary school years. In this sense, when we compare the depth of the conceptions identified in the second and third grades to that of the

fifth grade, we can see that the latter has a more extensive and broader sustainability view than that of students in previous grades.

This result shows that, although we know that several other variables influence the construction of conceptions of sustainability from elementary school children, the school has a relevant role in this process, for it was possible to identify progress in the conceptions of sustainability, which corresponds to the grade of the elementary school students who took part in the research.

At the same time, it longs to acknowledge the credits of the school investigated concerning the efficacy of the EfS actions developed with its students, and it brings great responsibility to keep and improve these actions so that it will continue and expand its role as the protagonist in building the students' conceptions of sustainability.

However, even though we identified this ascending correlation on the level of sustainability conception along elementary school years in the institution researched, it should be mentioned that when we analyze the distribution of students as a whole, without considering the division by school year, in the categories, most students (13 of them) present flat conceptions, six present a medium conception, and only eight students present more extensive conceptions of sustainability.

Suppose we consider that the number of students investigated by grade was the same, nine in each grade. In that case, this global evaluation is worrying, for most students, including those in the third and fifth grades, still have very flat sustainability conceptions, which requires an effort from the school concerning the improvement of its EfS strategies and actions to reverse these figures to have more balance in the distribution of these conceptions throughout the total number of students and always focus on having the highest number of students possible with more extensive sustainability conceptions.

However, it is important to remember that there will always be those with intermediary and flatter conceptions due to the several other variables that influence this process of expanding conceptions, such as the student's age and maturity (Felgendreher & Löfgren, 2017).

4.8 Political and managerial implications

The research results lead to practical and relevant implications for schools, teachers, parents, and other actors collaborating with children's education for sustainability.

First, going from the evidence seen in the study that the level of sustainability conceptions grows as students advance into elementary school years, we understand that schools, teachers, and parents must try to balance their expectations concerning the deepening of sustainability conceptions from these children at the same time they put every effort possible to provide children with the best actions, experiences, and education for sustainability programs.

This way, the incidence of flatter conceptions in the initial years must not discourage the continuity of practices turned to education for sustainability over elementary school years since, as shown in the results of this study, the tendency is that these conceptions expand over these years. In this sense, it is worth mentioning that, although they tend to expand over elementary school years, the conceptions of sustainability from the students at this teaching level are built heterogeneously and on a different pace and shape for every child (Felgendreher & Löfgren, 2017).

Although we noticed an expansion of the conceptions of sustainability over elementary school years, the results also highlighted that most students, including those in the third

and fifth grades, present very flat conceptions about the topic. They focus on environmental concerns and ignore economic, social, or generational issues.

Such understanding means how important it is for schools and teachers to try to develop approaches concerning education for sustainability that are the most comprehensive possible and take into account the multiple dimensions of the problem, not only the environmental aspect, while a disciplinary approach, focused on the environmental aspect, tends to limit the students' conception of sustainability to environmental concerns, more holistic, interdisciplinary, and multidimensional approaches concerning education for sustainability tend to promote the appearance of conceptions that are broader and more extensive (Böhme et al., 2018; Busatto, 2015; Engdahl, 2015; Figueroa-García et al., 2018; Hawn et al., 2018; Jacobi et al., 2011; Jia et al., 2018; Onel et al., 2018; Silva et al., 2019; Springett, 2005; Wang et al., 2019; Yates, 2018).

Besides adopting holistic and multidimensional models of education for sustainability, other principles and initiatives can also collaborate to expand the conceptions of sustainability in elementary school students. Melo (2012), Palma et al. (2013), and Coelho et al. (2018) suggest that, to be effective, this type of education must be developed in formal and informal contexts through partnerships between school teachers and parents. Besides, Gadotti (2008) and Coelho et al. (2018) emphasize the need EfS practices have to lead children to see themselves as part of the environment and not as its center.

According to Davis and Elliott (2014), Engdahl (2015) and Silva et al. (2019), children must not be underestimated in the EfS context. To these authors, many adults, including parents and teachers, underestimate children's capacity to understand social-economic and environmental issues. They do not develop topics and discussions related to sustainability, thus creating flat conceptions, like some identified in the results of this study. Silva et al. (2019) say such preconceptions must be avoided. Otherwise, it will permanently harm these individuals' understanding of the topic.

According to Jensen (2002), Davis (2008), Engdahl (2015), Jenkins (2015), and Silva et al. (2019), besides not underestimating children concerning the development of EfS practices that lead to broad sustainability conceptions, teachers must also support students' initiatives about the topic to encourage them and turn them into the main actors in the learning process.

To be able to create holistic conceptions of sustainability, EfS practices in elementary schools must be applied through problem-solving methods that involve social, environmental, and economic aspects, at least, so that they can expose children to real-world, multidimensional issues that encourage analysis capacity and decision-making processes based on the several dimensions of sustainability (Davis, 2015; Green & Somerville, 2015; Jenkins, 2015; Jensen, 2002; Norddahl, 2008; Silva et al., 2019).

To lead to the further development of children's conceptions of sustainability, EfS practices must also develop competencies concerning 'self-knowledge' and 'environmental knowledge,' in which students and teachers live together and interact from a more dynamic perspective, and suggest integrative actions for the school and its surroundings (Engdahl, 2015; Green & Somerville, 2015; Norddahl, 2008; Silva et al., 2019).

5 Final remarks

Through this study, it was possible to map the conceptions of sustainability of elementary school students based on their experiences, especially in the school context. The phenomenographic analysis highlighted five qualitatively different ways the students who participated in this research see sustainability.

The preservationist conception is the most superficial one among the five identified. It comprises children who present sustainability conceptions linked to preserving and keeping nature only.

The interventionist conception gathers students who have a conception of sustainability that, although it focuses on environmental issues only, like the children who see sustainability in a preservationist way, see the existence of a balance correlation between humankind and nature so that the individual can use natural resources in his favor, but harmoniously.

The social-environmentalist conciliatory conception is composed of children who see sustainability as the balance between individual and nature, which is key for the interventionist category, and the social balance.

The social-economic-environmentalist conciliatory conception gathers children who present a conception of sustainability that encompasses the need for an economic balance, besides the balance between individual and nature and the social balance.

Then, there is the inter-generational conception, composed only of fifth-grade students. This category gathers children who have a conception of sustainability that encompasses, besides the three dimensions of sustainability suggested by Elkington (1997), Cavalcanti (1998) and Jacobi (2003), which are environmental, economic, and social, a concern with keeping the balance between these pillars for future generations.

We understand that the concepts of sustainability identified in the study, which make up the space of results herein, are hierarchical and inclusive.

Concerning the hierarchic and inclusive nature of all the conceptions, this understanding is based on the logical observation that the most extensive sustainability conception, the inter-generational, includes the previous conception, the social-economic-environmentalist conciliatory conception, and so on, all the way to the flattest conception, the preservationist.

The way the categories correlate to each other leads to the understanding that there is a gradual path of forms to understand sustainability in the elementary school years of the school investigated. Children must be guided along this path, going from flatter conceptions to more extensive ones about sustainability.

Concerning the objective of this research, which is to identify how the construction of conceptions of sustainability in elementary school students takes place in a Brazilian institution, the shreds of evidence in the study point to an ascending path, that is, it expands and deepens along elementary school years. In this sense, when we compare the depth of the conceptions identified in the second- and third-grade students with those in the fifth grade, we can see that the latter have a broader and more comprehensive sustainability view than previous grades.

The evidence acquired from this study that there is an expansion of sustainability conceptions, which corresponds to the grade of the elementary school students that took part in this research, provides the school with a great responsibility to keep and improve these actions at the same time it aims to acknowledge the credits of the school investigated concerning the efficacy of EfS actions developed with the students, to continue and expand its role as the main actor to mold the students' conceptions of sustainability.

However, concerning the general evaluation of the conceptions, we noticed that most students presented flatter conceptions without considering the class division. A minority of them presented extensive sustainability conceptions, which demands from the school an effort to improve its EfS strategies and actions and balance the distribution of these conceptions concerning the total number of students to have the highest number of students possible with more extensive sustainability conceptions.

In this sense, since understanding how students see physical and chemical phenomena is important for the development of scientific thinking, identifying children's conceptions about the phenomenon concerning sustainability and analyzing the variations in this conception is also important to help teachers promote culture turned to the sustainable development (UN, 2005) by guiding students in their own reality.

Therefore, besides using a playful methodological alternative for children to express their conceptions about the topic, which somehow enabled us to reach their conceptions, the results of this research provide teachers with the possibility to further develop these conceptions through the categories explained by bringing them closer to children's daily experiences and views, and, thus, avoiding the superficiality with which the topic is often addressed.

The results of this research can also reflect on the construction of educational practices in the Brazilian elementary school context. They need to be more articulated and integrated with actions that enable the student with a new look to seek some training that is more appropriate to planetary sustainability. Running campaigns, including curricular components, and employing holistic approaches can be a way to make these actions come true.

The main limitation identified in this study was that it was not possible to have first- and fourth-grade students participate in this research. However, we believe this fact did not undermine the results of this research since it comprises students from the grades that represent the start, the middle, and the end of elementary school years.

In conclusion, we emphasize that several other types of work can be developed to go further into the findings and the conclusions in this research, such as, for example, mapping the conceptions of sustainability from elementary school teachers and students in other institutions to identify possible correlations among the levels of conceptions presented by teachers and students.

Other possibilities of studies that can be developed include mapping and analyzing the variation in sustainability conceptions from elementary school students in public schools to compare the results obtained with those described here and in similar research, as well as replicating the study with children in different countries and comparing the results of such studies.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s10668-022-02860-z.

Funding The fund was provided by Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (Grant No. 001).

Data availability The datasets generated during and analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Conflicts of interest The authors declare that there are no conflicts of interest.

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