

ARTICLE

EDUCATION FOR SUSTAINABILITY IN THE FINAL PAPERS OF A BIOLOGY BACHELOR DEGREE COURSE IN THE AMAZON REGION OF PARÁ¹

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ABSTRACT: Education for Sustainability in higher education is considered to be a challenge that demands the integration of a training method based on values, attitudes and principles that reflect on the professional formation. That said, this research intended to analyze the approach that Biology Bachelor Degree students in the Amazon region of Pará take on Education for Sustainability in their Final Papers. The exploratory study with documental analysis considered the Final Papers written by students from five different HEIs, prepared between the years 2017 and 2021, using an analysis instrument based on seven categories that investigate the approach to the principles of Education for Sustainability in three phases. By analyzing 145 papers, it was found that the most discussed principles are related to the right to education and the right to biodiversity. The study provides contributions of a theoretical-scientific, practical-instrumental and social nature, highlighting formative principles that HEIs should consider in the training of their students so that we have professionals concerned with the socio-environmental problems that destroy humanity.

Keywords: Education, initial training, academic work, socio-environmental responsibility.

EDUCAÇÃO PARA A SUSTENTABILIDADE EM TRABALHOS DE CONCLUSÃO DE CURSO DE LICENCIATURA EM BIOLOGIA NA REGIÃO AMAZÔNICA PARAENSE

RESUMO: Considera-se que a Educação para a Sustentabilidade no ensino superior é um desafio que requer a incorporação de uma formação pautada em valores, atitudes e princípios que reflitam na formação profissional. Isto posto, esta pesquisa objetivou analisar a abordagem que discentes de cursos de Licenciatura em Biologia da região amazônica paraense fazem sobre a Educação para a Sustentabilidade em seus TCCs. O estudo exploratório com análise documental considerou os TCC produzidos por alunos de cinco IES diferentes, elaborados entre os anos de 2017 e 2021, utilizando um instrumento de análise pautado em sete categorias que investigam a abordagem dos princípios da Educação para a Sustentabilidade em três fases. Ao analisar 145 trabalhos, foi verificado que os princípios

¹ The translation of this article into English was funded by the Fundação de Amparo à Pesquisa do Estado de Minas Gerais - FAPEMIG, through the program of supporting the publication of institutional scientific journals.

mais abordados estão relacionados com o direito à educação e o direito à biodiversidade. O estudo apresenta contribuições de caráter teórico-científico, prático-instrumental e social, evidenciando princípios formativos que as IES devem considerar na formação de seus alunos para que tenham profissionais preocupados com os problemas socioambientais que assolam a humanidade.

Palavras-chave: Educação, formação inicial, produção acadêmica, responsabilidade socioambiental.

EDUCACIÓN PARA LA SOSTENIBILIDAD EN TRABAJO DE FINALIZACIÓN DE CURSO DE LICENCIA EN BIOLOGÍA EN LA AMAZONÍA DE PARAENSE

RESUMEN: Se considera que la educación para la sostenibilidad en la educación superior es un desafío que requiere la incorporación de una formación basada en valores, actitudes y principios que reflejen la formación profesional. Dicho esto, esta investigación tuvo como objetivo analizar el abordaje que los estudiantes de los cursos de graduación en Biología, en la Región Amazónica de Pará, hacen sobre la educación para la sostenibilidad en su TCC. El estudio exploratorio con análisis de documentos consideró el TCC producido por estudiantes de cinco IES diferentes, elaborado entre los años 2017 y 2021, utilizando un instrumento de análisis basado en siete categorías que investigan el abordaje de los principios de la Educación para la Sostenibilidad en tres fases. Al analizar 145 obras, se encontró que los principios más discutidos están relacionados con el derecho a la educación y el derecho a la biodiversidad. El estudio presenta aportes teórico-científicos, práctico-instrumentales y sociales, destacando principios formativos que las IES deben considerar en la formación de sus estudiantes para que tengamos profesionales preocupados con los problemas socioambientales que molestan a la humanidad.

Palabras clave: Educación, formación inicial, producción académica, responsabilidad socioambiental.

INTRODUCTION

In the face of so many environmental disasters, controversies in public administration and the evident need for human intervention for improvement and global welfare currently experienced, it is certain that the actions practiced by human beings are as capable of accelerating the planet's environmental problems as they are of mitigating them and even providing a future with better quality of life.

In this context, educating for sustainability means developing critical awareness in society and encouraging sustainable practices that transcend the walls of schools and Higher Education Institutions (HEIs), either through teaching or through examples, assigning the teacher a relevant role in this very instigating and challenging mission (MELO et al., 2018).

According to the United Nations Educational, Scientific and Cultural Organization - UNESCO (2017), Education for Sustainability seeks a learning that understands the multiple interactions, provides convergence between the integration of the parts, besides being considered as a transformative education. Such purpose seeks not only to integrate content such as climate change, poverty, and sustainable consumption in the curriculum, but also enables the creation of teaching and learning contexts that are interactive and directed to the learner, requiring a change of focus in the educational process practiced by teachers and educational institutions.

With this, HEIs, which are propitious spaces for multidisciplinary and interdisciplinary actions and can enable the confrontation and exchange between the various knowledges and actors, have the current challenge of creating an institutional mechanism that assists in the solution of local problems in a multidisciplinary and integrated way with the academic community, besides enabling a training incorporated to the reality of the students (BARBOSA et al., 2019). In corroboration, Pantaleão et al. (2018) also highlight that HEIs have an important role to play as an example to society, which occurs through the development of studies and projects that must prioritize sustainable actions and practices, applied to the very infrastructure, organization, and performance of their campuses.

Among the possible studies and projects developed by students of a HEI, we highlight here the Course Conclusion Work (TCC), whose investigation's themes may be essential for the dissemination and scientific communication in society and for the consolidation of the epistemology acquired during graduation (NASCIMENTO; NASCIMENTO, 2020).

In this perspective, the research conducted for the TCC allows students to deepen their knowledge in a given theme and/or area, besides inferring that their choice often reflects a personal identification between the researcher and the researched object and that, in most cases, the guiding problem of the research comes from observations and/or local needs. As an example, the concern with the preservation of nature resources (ANDRADE, 2021). Thus, the question is: Do students in the process of initial formation in the Biology Degree in the Amazonian region of Pará address the principles of Education for Sustainability in their TCC? Which principles are being addressed? What does this mean and how does it influence the education of these professionals?

Therefore, investigating how the notes and perceptions of these students relate to the principles of Education for Sustainability in their TCC can generate guidelines in the teaching and learning process by teachers, coordinators, and directors of the HEIs that offer the courses, leading to changes and improvements in the teaching and learning process that permeate the training of professionals in the area.

Thus, the objective of this research was to analyze the approach that students of undergraduate Biology courses in the Amazon region of Pará have taken about Education for Sustainability in their TCC.

EDUCATION FOR SUSTAINABILITY IN HIGHER EDUCATION INSTITUTIONS

It is estimated that the building of a society concerned and committed to sustainability and ethics in human actions requires action from several social agents, such as: public and private agencies, the third sector, leaders and employees of educational institutions, international organizations and the

population as a whole. It becomes substantial, thus, that all these agents are involved with the creation of policies that enable the development of values for sustainability through education (SANTOS, 2019).

At this juncture, educating for sustainability in higher education is not easy, especially because of the plastered behavior of students (MELO et al., 2018). Given this problematic, as a way of demystification and breaking paradigms, HEIs should conduct sensitization and awareness of the entire academic community about the importance of topics such as Education for Sustainability, through mutual cooperation between leaders, students, teachers, and employees of the educational space.

Such actions are necessary and urgent in the educational space, especially when we consider that Education for Sustainability in higher education still represents a challenge for the academic system (BARTH; RIECKMANN, 2012). From this perspective, even with some advances already made explicit through documents and guidelines already achieved in recent years, many HEIs have still faced difficulties in carrying out new methodologies and activities for the implementation of the theme in their practices and curricula.

Oliveira et al. (2011) show, for example, that Education for Sustainability has been incorporated into the agenda of academic and political reflections and is increasingly inserted in schools through the subjects of the curriculum, suggesting discussions of various natures and regulating proposals that underlie the Common National Curricular Base (BNCC) (BRASIL, 2017). Regarding the Undergraduate Courses in Biological Sciences, the National Curriculum Guidelines (DCN) establish, among other competencies, that the professional in this area must work in basic and applied research in the different areas of Biological Sciences, committing to the dissemination of research results in appropriate vehicles to expand the dissemination of knowledge (BRASIL, 2001). This already includes, even if indirectly, the execution of competences and approaches related to Education for Sustainability.

When talking about research, it is important to highlight, also, its great relevance during graduation and in teaching, because professionals in the educational field contribute to the training and cognitive development of other people, performing questioning in front of educational issues not yet researched, as well as producing methodological innovations in the various levels of education (SILVA; SANTOS, 2017). Thus, as a form of appropriation and deepening of a theme, the TCC are instruments that can be primordial for the realization and expansion of research during graduation, being, furthermore, one of the main means for the students to be inserted into the scientific world, showing and defining their critical and investigative sense in their professionalization (NASCIMENTO; NASCIMENTO, 2020).

Trindade, Bachur, and Oliveira (2018) argue that the TCC represents an excellent moment of professional training for the qualification and subsequent insertion of the academic in the labor market, as it highlights the theoretical and practical foundation of the future professional. In this context, one cannot fail to think that the TCC can also express the marks left during the course by the various disciplines of the curriculum, which contribute to the professional constitution of the students during their graduation (SOUSA; LEMOS, 2018).

It is evident that education, at all levels, plays a key role in the process of necessary changes for sustainable development, which requires the inclusion of environmental and social dimensions to the economic one. In this sense, HEIs, which are trainers of professionals in the field of education, represent a fundamental space for the discussion and expansion of principles and ideas related to Education for Sustainability (BRONZERI; CUNHA, 2020).

The HEIs are, among all those that offer training in some degree of education, representatives of excellence highly specialized in the Sciences and prepared to train students through systemic, ethical and interdisciplinary principles. Thus, it is essential that the engagement of the actors of the academic community, starting from its administration and coordination, have awareness based on the principles of Education for Sustainability as a way to remain active and balanced in its management (PANTALEÃO et al., 2018).

Guerra et al. (2014) draw attention to the fact that HEI students, in order to incorporate in their education, attitudes, values and sustainability criteria in the professional practice, improve in a broad and multidimensional perspective of concepts and principles, resulting from the construction and transposition of knowledge, procedures and technological innovations, made available during their education. With this thought, it is necessary that the HEIs create, in their educational environment,

democratic spaces where their students feel at ease and free to reflect, criticize, re-signify concepts and rethink lifestyles and responsible consumption, facing an increasingly interdependent and globalized world.

It is also necessary that HEIs, whether public or private, value the social responsibility inherent to their activities, as they are responsible for generating knowledge and training the professionals of the future. This can be done through the implementation of actions based on the principles of sustainability, serving as good examples of social and environmental responsibility for society as a whole (ARAÚJO; FREITAS; ROCHA, 2017). In this sense, teacher training, scientific initiation and TCC produced by students (and which in most cases is the most accessible among these options), show themselves as relevant research activities within the HEI, by which students can express their ideas, practices and questioning on the most diverse topics (ANDRADE, 2021).

Therefore, educational sectors, as well as HEIs, assume a prominent role in the context of creating a sustainable and fair society, due to their responsibility in preparing the decision-making citizens of tomorrow (HENCHEN; MOURA-LEITE; LOPES, 2019). To this end, several HEIs have sought to incorporate environmental education and sustainability actions into their elementary systems, such as teaching, research, campus operations, community outreach, self-evaluation, and reporting (LOZANO et al., 2014).

From this perspective, considering the current context in which environmental issues increasingly assume notoriety and relevance, it is essential to acknowledge the role that HEIs play in society, disseminating knowledge and enhancing the appropriate way to promote social, economic and environmental development (SERAFINI et al., 2021). Furthermore, it is necessary to know and reflect on the role of each individual as a citizen responsible for the consequences facing the environment, not blaming and/or holding HEIs responsible for actions inherent to all, nor exempting them from their duties and obligations.

METHODOLOGICAL PROCEDURE

Research characterization

This study is characterized as qualitative-quantitative research of exploratory nature, in which one of the procedures used consisted of document analysis. This method is based mainly on the ideas of Bardin (2008) and Gil (2018), when they state that exploratory research has a very flexible planning and, most of the time, involves bibliographic and documental research, involving practical experiences with the researched problem, or even the analysis of examples that stimulate understanding.

As a research location, we used HEIs that offer the undergraduate Biology course and are located in the Amazon Region of Pará. The selection criteria were: a) To be a public institution of higher education located in the Amazon Region of Pará, which actively offers undergraduate courses in Biological Sciences, Biology, Nature Sciences with majors in Biology, or similar terminology; b) To offer the course for at least 5 years; c) To consider it obligatory for its students to produce an end-of-course research project at the end of their studies, either a TCC or a monograph; and d) To make the end-of-course work available in an institutional library and/or free-access electronic media. It is also worth mentioning that the choice for undergraduate courses in Biology is based on the visualization of the research potential to contribute to teacher training and Basic Education, beyond Higher Education.

For the sample to be considered in this research, five institutions that met all the criteria described above were selected, and institutions located in the same municipality were excluded in case of duplicity; that is, when two or more institutions located in the same municipality met all the criteria, only one of them was selected for the study. In this way, we selected five institutions located in different municipalities within the same region, believing that we could achieve greater diversification and representativeness of the data collected.

As a way of preserving the nominal image of the HEIs and complying with ethical aspects related to the research, the participating institutions were not identified and the analysis of the data collected was carried out considering the quantity of papers found per year and category of analysis established, and not per educational institution.

Data collection

The collection instrument produced (table 1), was inspired by an instrument used by Ramineli (2021) and classifies, in seven categories, actions that we consider represent the principles of Education for Sustainability, as presented by the author. Each category was detailed in key terms (contexts that represent them) and these in isolated entries that served as a search record in the selection and analysis phases of the TCC. In addition, for each category we associated the Sustainable Development Goals (SDGs), which we considered to be more addressed by the theme of the category, thus substantiating the principles of Education for Sustainability.

Chart 1 - Documentary analysis instrument, considering categories formed by actions and isolated terms that represent principles of Education for Sustainability

Categories	Key Terms	Isolated Terms	Associated SDGs
1 Right to Life	Social welfare/human rights.	Welfare; right; social; human; quality; life.	1 - Eradication of poverty. 2 - Zero Hunger. 3 - Health and welfare.
2 Right to Education	Quality education (aspects related to the teaching and learning process).	Education; teaching; learning; methodology; inclusion; resources.	4 - Quality education.
3 Right To the Environment	Socio-environmental sustainability/education for sustainability.	Sustainability; socio-environmental; SDGs; environment; environment; development.	7 - Clean and accessible energy. 13 - Action against global climate change.
4 Right to culture	Promotion of endogenous popular culture (balance between respect for tradition and innovation).	Culture; popular; respect; tradition; innovation; urbanism.	16 - Peace, justice, and effective institutions.
5 Right to equality	Promotion of social quality (social homogeneity).	Equality; social; inequality; poverty; hunger; extreme.	10 - Reduction of inequality.
6 Right to respect	Respect for gender diversity.	Diversity; respect; gender; representation; minorities; groups.	5 - Gender equality
7 Right to Biodiversity	Environmental concern and respect (preservation and conservation actions for animal and plant species).	Preservation; conservation; animal; plant; species; protection.	14 - Life in water 15 - Life on land.

Source: Elaborated by the authors (2022).

Although it is evident that Education for Sustainability has a broad and dense concept and application context, the ideas of Gil-Perez et al. (2003) are considered in the construction of this analysis instrument when they state that it is essential for education to act in the face of multiple problems of

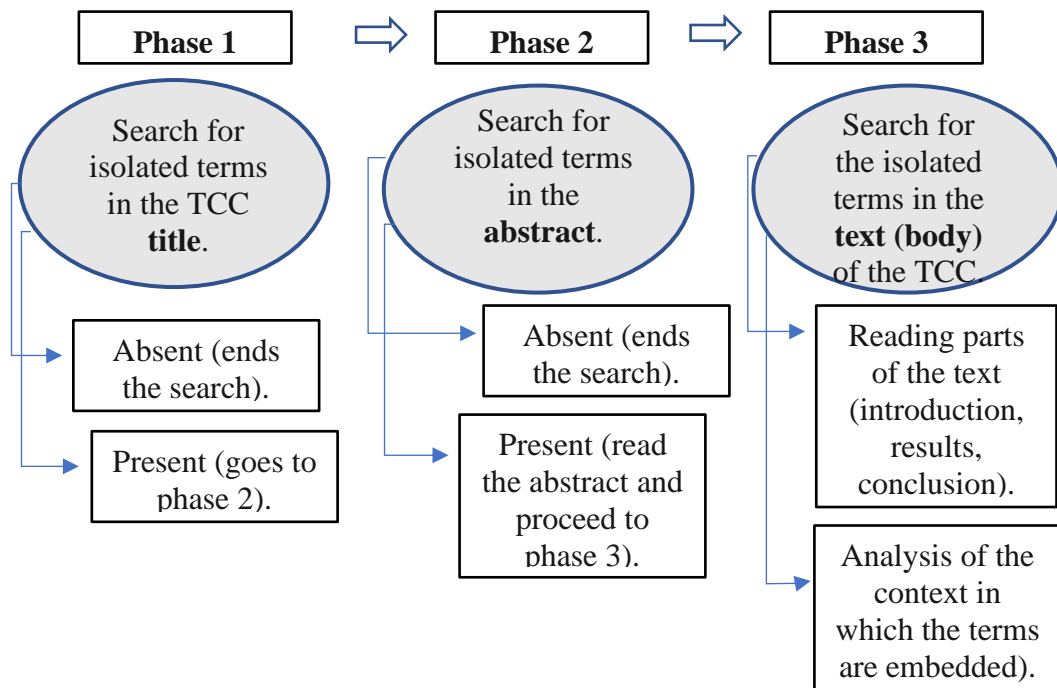
various natures, such as: the accelerated urbanization process, demographic growth, depletion of natural resources, pollution, ecosystem degradation, loss of biological and cultural diversity, extreme poverty, among others.

We also consider the need for an education that contributes to a correct perception in the preparation of citizens to make decisions, with responsible attitudes and behavior, oriented towards the achievement of a culturally plural and physically sustainable development. Thus, the categories of analysis described here are valid insofar as they cover social, educational, and environmental issues, and may reveal the conceptions that the object of study has about Education for Sustainability. The dismemberment of these categories in isolated terms was justified by the practicality of searching for the categories within the text (TCC), directing the analysis to an effective reading and subsequent interpretation of the context in which they were found.

Data analysis

The documents analyzed in the five-year time frame (2017-2021) followed three phases of analysis (Figure 1).

Figure 1 - Diagram representing the sequence and phases of the analysis performed in the TCC



Source: Elaborated by the authors (2022).

Following the analysis phases, it was considered "absent" when no isolated term from any of the categories was found in the search, or when only one term from a single category was found (because we considered it insufficient to continue with the analysis of the document). In these cases, the TCC was not counted in any of the search phases.

The cases in which more than one term was found in the same category, more than one term in more than one category, or even a single term, but in more than one category, were considered "present" and, therefore, sufficient to continue with the analysis of the document and accounted for in the respective research phase.

In phases 1 and 2, the documents were analyzed and represented quantitatively, using tables and graphs produced in the statistical program Past version 4.07b (phase 1); and qualitatively by means of the representation of a cloud of words that provides a grouping of the isolated key terms most found in the abstracts of the papers (phase 2).

In phase 3, a qualitative analysis was performed using the Iramuteq software version 0.7 alpha 2, which is free and open source, developed by Pierre Ratinaud and licensed by GNU GPL (v2). The program allows one to perform statistical analyses on textual corpus and on individuals/words (LAHLOU, 2012). The qualitative representation produced with the software was the similarity tree, which highlights the proximity between the categories considered.

RESULTS AND DISCUSSION

General assessments about the analyzed CBTs

With the analysis performed, 145 TCC were found deposited for public consultation in the physical or digital library of the participating institutions in the period considered (Table 1).

Table 1 - Number of TCC found per year and per phase of research analysis.

Papers (TCC) analyzed in the research						
Year	2017	2018	2019	2020	2021	Total
Total	36	18	49	16	26	145
TCC selected by title (Phase 1)	24	15	43	14	23	119
TCC selected by abstract (Phase 2)	24	14	41	11	23	113
TCC selected by body text (Phase 3)	22	12	39	10	21	104

Source: Research data (2022).

This number of TCC represents a significant number of works for an investigation such as the one proposed in this study, since, in other works, such as the study by Nascimento and Nascimento (2020), when conducting an analysis of the thematic profile of the TCC of students of the Biology Degree course at a Federal Public University, they found 81 investigations, considering an interval of 7 years and having 3 campuses of the course as research locus.

By producing their final work to conclude the course, it is believed that the student had access to several stages, levels and forms of knowledge, and may have built the pillars necessary for their professional performance in accordance with the ethical and formative principles of the institution and the course offered. This leads to the fact that access to information is essential for sustainable and balanced human development, and HEIs are essential vehicles for the democratization of knowledge (PANTALEÃO et al., 2018). Such knowledge, when offered in a democratic manner, can generate the advancement of the academic community, as well as the personal and professional development of the student, assisting in the expansion of human sustainability initiatives to the community outside the educational environment.

It was possible to verify a decrease in student productions in the years 2018 and 2020. In an attempt to understand the reason for this decrease, a reading of the Pedagogical Course Project (PPC) of all the institutions involved was carried out, and it was possible to observe that 3 of the 5 participating institutions did not offer classes for the Degree in Biology course in the year 2014. Thus, considering that the duration of the courses is 8 semesters, the classes that began in that year would have completed their higher education in 2018, thus resulting in a greater number of completed TCCs. As for the year 2020, it is believed that, because it was the first year of the pandemic caused by SARS-Cov-2, one of the consequences for education being the adaptation to the remote teaching format, there has been an influence on the delay of completion and consequent defense of the students' final papers, which generated a lower number of papers available in the period.

In phase 1 of the analysis, 119 papers were presented within the criteria established (TCC filter by title) for the study. This corresponds to 82.06% of all the papers found. This data is considered quite expressive. However, it is still insufficient for in-depth interpretations. In phase 2, 77.93% of the papers found were selected. This means that the great majority of the TCC presented the isolated key terms considered in the analysis instrument in their abstracts.

With these results, it was possible to infer that the Biology Undergraduate courses in the Amazon Region of Pará present end-of-course research that considers aspects related to the principles of Education for Sustainability regarding a general approach to the theme. In this sense, regardless of whether a HEI has a public or private character, presenting sustainable practices can be a relevant characteristic that stands out from other HEIs (DE OLIVEIRA; DE OLIVEIRA; ROHRICH, 2016). Therefore, it becomes essential the active participation of institutions in society's decision-making processes, promoting ethics and meeting the social and environmental demands, to which individuals are involved.

Silva, Caputo and Veras (2021) reiterate that becoming a teacher is a complex process, since the training is articulated with the purpose of the official curriculum, with the educational laws and, also, with the experiences of the various realities found in the school environment. It is inferred, therefore, the need for the HEI to stimulate their students to carry out research, aimed at solving problems that affect the society in which they are inserted, without, however, disregarding social and environmental issues of a global nature.

The isolated key terms found in phase 2 of the research (figure 2) revealed that the words "education", "teaching", "species" and "animal" were highlighted in the word cloud. This data already points to the presence of categories 2 (right to education) and 7 (right to biodiversity) in the works to be analyzed in the next phase of this study.

Figure 2 - Word cloud representing the isolated key terms found in the abstracts of the TCC, analyzed in phase 2 of the research.



Source: Research data (2022).

Given these data, it is idealized that the proposal of Education for Sustainability must go beyond the disciplines related to social, economic, and environmental issues studied by students in higher education. This occurs when the HEI fosters constant debates on the theme, concomitantly with the adoption of sustainable practices in educational environments. Thus, the institution promotes the encouragement to students and teachers in the occurrence of the transformation of their consumption habits and, thus, the agents involved (students and teachers) become elements propagators of the idea for all their personal, professional, and family relationships (DE MELLO, 2022).

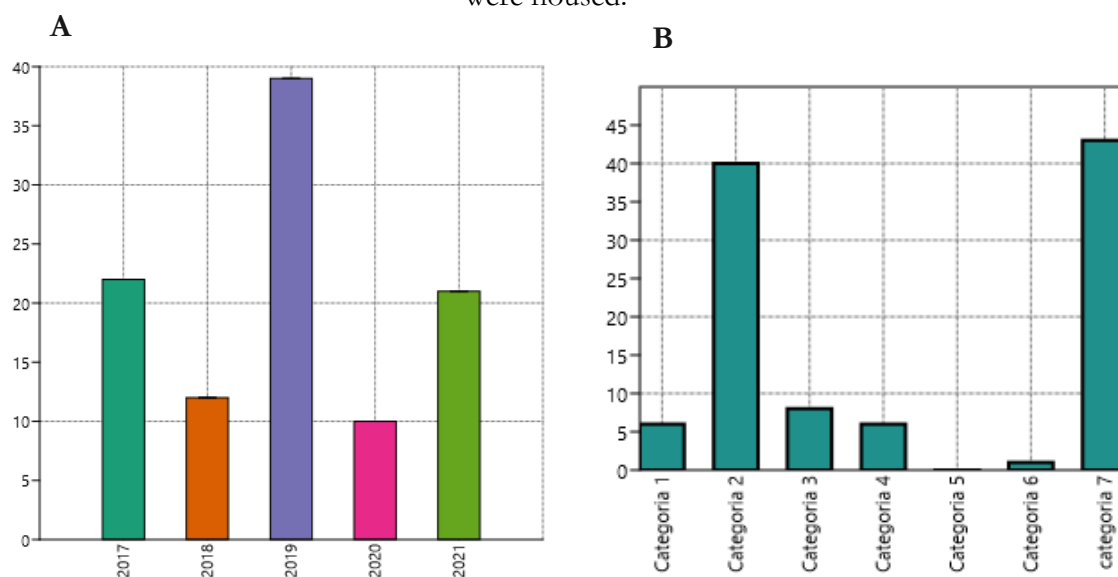
When conducting research with the density of a TCC on themes that highlight the principles of Education for Sustainability, both the main agent involved (the student), as well as the institution and the academic community, can be positively influenced by the results obtained, leading to attitudinal changes in face of the socio-environmental problems that the world is currently facing.

This student action reinforces the central role to be played by educational institutions, which must mirror good practices and demonstrate that sustainability is a desirable and viable alternative. Universities are, therefore, indispensable players in the transformation of this way of using natural resources, and their experiences can serve as a model to be followed by other institutions (SERAFINI *et al.*, 2021). This occurs mainly through the dissemination of the results of practices and investigations carried out in the educational environment, thus contributing to the advancement of scientific knowledge.

Approaches to the principles of Education for Sustainability in the analyzed TCC

In phase 3 of the research, 71.72% of the total number of works found were considered, representing a high volume of productions that address at least one of the seven categories analyzed. When comparing the time interval considered, the year 2019 presented the highest number of selected papers in this phase of the study (Figure 3A). As for the comparison between the number of TCC selected and the category in which each one was housed, it was possible to verify that the most represented categories referred to 2 (right to education) and 7 (right to biodiversity) (Figure 3B), as previously evidenced in the previous phase.

Figure 3 - A - Representation of the number of TCC analyzed in phase 3 of the research by year; B - Relationship between the number of TCC analyzed in phase 3 and the category in which they were housed.



LEGEND: Category 1 - right to life; Category 2 - right to education; Category 3 - right to environment; Category 4 - right to culture; Category 5 - right to equality; Category 6 - right to respect; Category 7 - right to biodiversity.

Source: Research data (2022).

Observou-se, também, que a categoria 5 (direito à igualdade) não apresentou nenhum trabalho no período considerado. Ademais, a categoria 6 (direito ao respeito) apresentou apenas um trabalho. Com estes resultados, destacamos que desenvolver uma educação sustentável vai além de estudos voltados ao meio ambiente, pois envolve mudanças de práticas e comportamentos. Além disso, o meio ambiente é um sistema que sofre influências de todas as esferas, exigindo, assim, o envolvimento de todos os indivíduos na busca de uma sociedade mais sustentável (MELO *et al.*, 2018), como apontado também pelos ODS descritos na agenda 2030.

Gomes e Ferreira (2018) afirmam que os ODS podem representar um notável avanço no que diz respeito à proteção ambiental, crescimento econômico, desenvolvimento social, proteção dos povos e promoção dos direitos humanos, a despeito de sofrer e serem criticados por desconsiderarem aspectos tidos como relevantes para o desenvolvimento das sociedades humanas. Sendo necessário, portanto, que graduandos da área biológica considerem e demonstrem preocupação na resolução destes problemas em seus TCC.

Em corroboração, Grandisoli *et al.* (2020) destacam a iminência de uma educação mais integral, transformadora e transgressiva. Com isso, colocam no centro da discussão a aprendizagem social, que no contexto da Educação para a Sustentabilidade compreende uma aprendizagem mais participativa, que cria vias de construção de conhecimentos mais contextualizados e, portanto, mais significativos.

A não abordagem das categorias 5 (direito à igualdade) e 6 (direito ao respeito), nos TCC analisados, pode representar uma fragmentação no processo de ensino e aprendizagem dos discentes envolvidos. Tal porque o ensino das Ciências Biológicas é tido, em alguns casos, como um estudo aprofundado de temas e/ou áreas separadas, onde não ocorre contextualização entre si. Além disso, destaca-se também a existência de preconceito e precariedade na abordagem de temas relacionados a estas categorias nos currículos institucionais como um todo, o que contribui para a formação de uma sociedade desigualitária e com fragmentação de classes sociais.

Nessa conjuntura, a formação de professores em uma época de mudanças, como a atual, possui a necessidade de preparar os alunos para uma sociedade global que exige atenção em aspectos distintos. As escolas estão cheias de alunos com expressiva diversidade de culturas e valores, fazendo-se necessário preparar esses discentes para uma sociedade global e plural. Para tal, exige-se uma mudança de paradigma, associando a investigação à prática letiva (FREIRE, 2007).

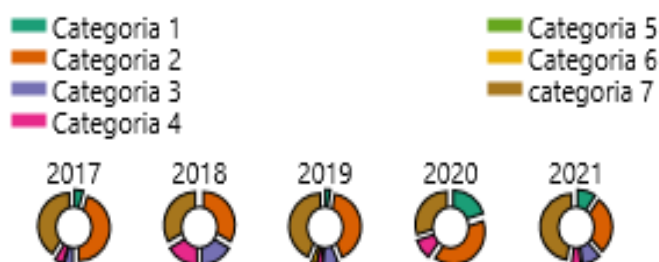
Acredita-se, com isso, que compreender as contribuições da natureza para as pessoas, pode melhorar a capacidade dos indivíduos em gerenciar os sistemas terrestres de forma eficaz, equitativa e sustentável (CHAPLIN-KRAMER *et al.*, 2019; BRAUMAN *et al.*, 2020). Isso implica dizer que a associação entre os diversos campos de estudo da Biologia, e a interligação desta com as demais áreas do conhecimento, fornecem maiores subsídios para o ser humano que busca melhorar a qualidade de vida com responsabilidade socioambiental, suscitando resultados significativos e condizentes com as necessidades humana e com o meio ambiente.

Por outro lado, considerando que o *locus* da pesquisa são produções de cursos de licenciatura em Biologia, situados na Região Amazônica Paraense, fica evidente que os graduandos demonstram preocupação, empenho e interesse na realização de estudos que venham a contribuir tanto para a qualidade e desenvolvimento do ensino de Biologia, quanto para a preservação e conservação do bioma e espécies que compõem a região onde estão inseridos.

However, the discrepancy observed in the approach between the analyzed categories distances the teaching and learning process of these students from what we consider to be essential for a broad and complete approach to the principles of Education for Sustainability. This happens because the interaction of all the categories listed here forms these principles, and not one or another in isolation. On the other hand, it was expected that individuals who graduated from a biology undergraduate course would show more concern with factors related to popular culture (category 4), quality of life and well-being (category 1) and gender diversity (category 6), since these topics are directly interconnected with human behavior and even with the socio-environmental relationships we develop, and which make up the objects and subjects of study of Biology.

When analyzed by year (figure 4), it is evident that category 3 (right to environment) and 4 (right to culture) were well represented in the year 2018, being this year the one that showed greater conformity between the categories with respect to the other years analyzed. On the other hand, category 1 (right to life) had a certain prominence in the years 2020 and 2021, which may represent some influence of the issues and social problems disseminated and evidenced with the advent of the pandemic in the period.

Figure 4 - Relationship between the number of TCC analyzed in phase 3 of the research by year and category.



LEGEND: Category 1 - right to life; Category 2 - right to education; Category 3 - right to environment; Category 4 - right to culture; Category 5 - right to equality; Category 6 - right to respect; Category 7 - right to biodiversity.

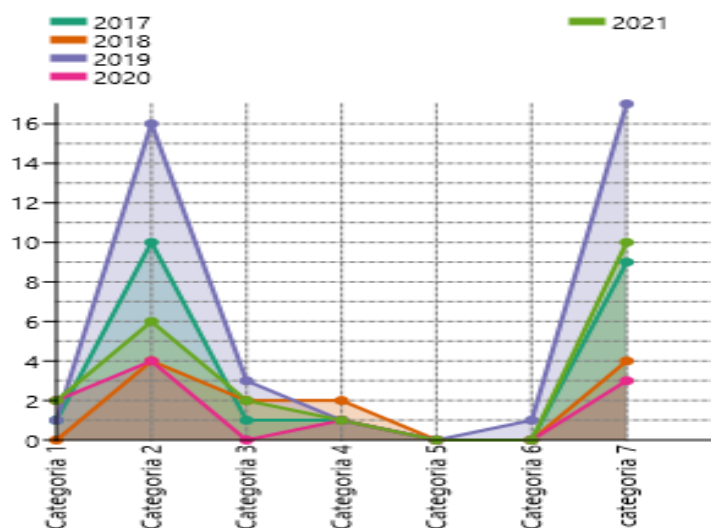
Source: Research data (2022).

Pereira (2022) draws attention in his research to the fact that sustainability was a fervently debated topic in the midst of the Covid-19 pandemic. The scholar observed that structural changes are needed in the economic, social, political, and cultural dynamics of the world community in order to ensure the continuity of life on planet Earth. According to the author, the scale of certain environmental problems is global, and all countries need to address them in order to find a plausible solution as quickly as possible.

This level of concern contemplated in category 3 (right to the environment), although it was observed with greater prominence in the year 2018, shows evidence again in the year 2021, thus corroborating the idea of the diffusion of the theme during the pandemic period. The fact that people in general, and especially the students of the undergraduate course in Biology, look at themes like this, may mean that there will be an evolution in research in this area in the coming years. Reason that leads us to believe that there will be significant advances in the construction of knowledge and dissemination of the ideas of sustainability for the community as a whole, both in the medium and long term.

The evolution in the temporal distribution of papers by category over the period considered (figure 5) confirms the comprehensiveness of the papers produced in 2019 with peaks in categories 2 (right to education) and 7 (right to biodiversity). Moreover, these categories, although in smaller quantity, are also noticeable in the years 2020 and 2021, which may mean that students are paying more and more attention to problems and approaches previously not evidenced. It is interpreted that this trend may remain and even be expanded in the coming years.

Figure 5 - Temporal distribution of the number of selected papers by year and category



LEGEND: Category 1 - right to life; Category 2 - right to education; Category 3 - right to environment; Category 4 - right to culture; Category 5 - right to equality; Category 6 - right to respect; Category 7 - right to biodiversity.

Source: Research data (2022).

It is possible to observe in the graph that category 4 (right to culture) was best represented in the selected papers in the year 2018, presenting a drop in the following years. In this sense, Souza (2016) highlights that education for the environment within HEIs needs to seek a balance between professional qualification for work and the formation of a citizen aware of his rights and duties towards society.

Thus, it was possible to verify that the guiding problems of the TCC, although they often start from local questions, with problems experienced by the students of the course, community or even municipality of residence, still leave social issues related to the history and popular culture of the students as secondary problems, presenting little approach and/or discrete importance in their research.

Studies show that in recent years, university-led community engagement initiatives are gaining momentum, driven by changing perspectives as well as students' demand for greater engagement with real-world actors and problems (AGUSDINATA, 2022). These problems, which are most often social and cultural in nature, when not addressed with due attention, can generate other even bigger problems with more negative and drastic consequences, reinforcing the need for engagement between the academic community and society.

Points and perspectives in dis(consonance) with Education for Sustainability

In the third phase of the TCC analysis, excerpts were taken (especially from the results and conclusions) that represent the contributions that the research brings to the academic and scientific community. The excerpts were selected according to the indication in the TCC text (that this was the contribution of the research), or through free interpretation at the time of reading the work.

Thus, it was possible to build a similarity tree (Figure 6) where it is evident the agglomeration of the main terms that compose the texts into seven groups. It is emphasized, however, that the groups evidenced do not represent the categories initially attributed through the collection instrument. But, rather, the natural and real existence of the comprehensiveness of the themes presented by the analyzed works that coincided (in parts) with the categories considered by the research.

It can be seen that the shaded groups that highlight the terms "knowledge", "education", "training", "science", "importance", "teacher" and "population" clearly present the themes inserted in category 2 (right to education). It can be noticed, therefore, that the works contribute with themes, such as: implementation and improvement of teaching methodologies, continuing education, education seen from different aspects (from traditional to innovative), use of diversified educational resources, and reflections on the teaching and learning process.

With this perspective, Gil-Perez et al. (2003) emphasize the need for education to question conceptions that are presented as "obvious" and "unquestionable", without alternatives, thus obstructing the possibility of making choices. Thus, Biology students show themselves to be sharp with the pedagogical issues that make up the pillars of their academic training, demonstrating preparation for the world of work and the ability to solve problem-solving issues they may face as teachers in the biological area.

Figure 6 - Similarity tree built from clippings of the main contributions presented by the TCC in phase 3 of the research.



Source: Survey data (2022).

In the shaded regions that highlight the terms: "species", "diversity", "environmental", "community" and "preservation" we can observe contributions related to category 7 (biodiversity rights). Thus, the works present solutions and perspectives that range from actions aimed at the knowledge of the region's fauna and flora, contributing to the preservation and conservation of species, to the presentation of new discoveries to the scientific world, through the cataloging of new species discovered both animal and vegetal in the ecosystem where they are located.

From this point of view, the HEIs seem to fulfill their duty to search for a better environmental quality and quality of life accessible to the whole society through the formation of citizens and professionals in relation to the environmental theme (RIBEIRO; MALVESTIO, 2021). This implies the need for HEIs to increasingly assume the duty and the challenge of improving and maturing their practices in relation to the insertion of the sustainability theme in the various areas of knowledge and performance spaces.

Such actions can be reflected in the work developed by their students, who contribute not only to the educational institution, but to the community in general. Furthermore, these studies show the importance of the local community getting to know its resources, biotic components, and the relationships they establish with them, verifying that this is a way to make the population aware of the need for harmony and care with nature's resources.

In the shaded region with emphasis on the terms: "fisherman", "artisanal", "health", "quality" and "water", it is possible to identify contributions that cover categories 1 (right to life) and 4 (right to culture). Such contributions are presented by works that value the way of life and the quality of life of rural dwellers, riverbank dwellers, and/or traditional peoples that are characteristic and still exist in the region. The works emphasize the importance of popular culture, customs, and traditions maintained by

these communities for the economy, the need for environmental preservation, and their importance for society as a whole.

This infers that an education for a sustainable society must be based on what can be reasonably understood by most people, even if their ethical values are more or less anthropocentric (GIL-PEREZ et al., 2003). This means considering and valuing ancient and traditional knowledge, adding to it a modern and technological perspective, but never superimposing one knowledge over the other or devaluing the first in favor of the second.

It was also observed that some regions of the similarity tree are overlapped, indicating the interconnection of the themes worked on, such as the branching in gray that runs through the entire region of the tree. This branching presents itself in a thicker manner when the analyzed texts appear with greater repetition of words from the same group, thus verifying that the theme education and teaching is the prevalent one in the analyzed TCC.

This configuration and proximity of themes and approaches is directly related to the need to improve our understanding of the man-nature relationship, considering this relationship of utmost importance so that we can reach approaches of environmental valuation, which largely depends on how people see it and interact with it (MANAGI et al., 2022).

Regarding the themes addressed in categories 3 (right to the environment) and 6 (right to respect), although they have been evidenced in the previous phases of the research and even in this final phase, through the presence of key terms isolated in the body of the text, they are not evident in the similarity tree. This fact may be related to the low representativeness of works in these categories, or even to the context employed by the authors of the texts produced, since it is not evident, in the contributions of the works, the resolution of problems related to these themes. The data show convergence with research conducted by Silva and Araújo (2022) with the PPCs of Biology Graduation in the Amazon region of Pará. In the study, the authors showed that some HEIs are basically concerned with growth and social perspectives in the education of students, without paying attention to the fact that social improvement depends directly on the care, respect and attention to the environment in which these individuals are inserted.

In corroboration, Souza and Andrade (2014) state that training professionals capable of criticizing, reflecting and proposing alternatives and strategies for solving and minimizing the problems experienced by society should not be dissociated from training citizens, given that promoting an effective education in the face of social, environmental, cultural and health needs is more than one of the functions of the university, in addition to passing through the need and right to quality of life that is reaffirmed in every discussion about education.

Thus, HEIs are challenged to review their teaching methods, the curricular plans of their courses and to reflect on what university they want to be (CERQUEIRA, 2016). HEIs cannot forget that they are training people who, in the near future, will assume responsibilities of all kinds. In addition to the need for awareness of the individual, who should know the role they have with the environment where they are inserted. Thus, it is important that HEIs have in their possession the tools and scientific knowledge necessary to go beyond what they already offer their students, encouraging them to be reflective citizens about their practices and actions.

FINAL CONSIDERATIONS

In this study, by analyzing the approach that students of Biology undergraduate courses in the Amazon Region of Pará take about Education for Sustainability in their TCC, we present the existence of a perspective based mainly on contributions related to the right to education and the right to biodiversity.

Moreover, the research verified the existence of an expressive number of TCC produced by the students of the course in the period of analysis, considering that they list the principles of Education for Sustainability in its complexity. However, not in their entirety. The approach identified is in accordance with the intended academic training and with the region in which the HEIs are located, failing,

however, to cover topics considered important for human formation and the composition of a fair and egalitarian society, such as the right to equality and respect.

There is also little approach to principles related to the appreciation of popular culture, gender diversity, social welfare, and socio-environmental sustainability. It is believed, therefore, that these themes need to be better worked on with the students during their training, so that there can be more emphasis and contributions in the TCC of future graduates, as well as in the exercise of their profession.

The contributions of this research encompass the theoretical-scientific, practical-instrumental, and social aspects, as it shows the theoretical and practical aspects that the undergraduate courses in Biology express through the TCC produced by their students and their conformity with Education for Sustainability. It also reveals the weaknesses and perspectives that students, teachers and coordinators of the HEIs in the Amazon Region of Pará may have about the theme addressed through the final works of the initial formation process.

As limitations, we can mention the fact that all the TCCs produced during the period considered by the research were not available for public consultation. However, we believe that the quantity considered as a sample was sufficient for the measurements described here.

The future perspectives are based on the comprehensiveness of the investigation that active teachers and students of undergraduate courses approach the principles of Education for Sustainability, as well as on the extension of this study to horizontal research, through which this investigation may be extended to the next years, in order to verify the possible comprehensiveness of the approach of the principles considered here.

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Submitted: 06/07/2022

Approved: 06/04/2023

AUTHORS' CONTRIBUTION

Author 1 - Active participation in the production of the research instrument, development, data collection and analysis, first writing of the text.

Author 2 - Data analysis, second writing of the text, revision.

DECLARATION OF CONFLICT OF INTEREST

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