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INCLUSIVE EDUCATION IN NATURAL SCIENCES TEACHING: EXPLORING TECHNOLOGY, ICTs AND ENVIRONMENTAL SUSTAINABILITY AS TOOLS FOR EDUCATIONAL TRANSFORMATION

***Alexandra Maria de Carvalho Alves*[1]**
***Elyne Cavalcante de Santana*[2]**
***Geisla*[3]**

Introduction

Freire (2011, p. 30) emphasizes that through school inclusion we perceive an urgent need to think about a more just and egalitarian society. In this way, based on the participation of all students, without exceptions, who seek to build knowledge. Freire (2011) also explains that this integration through the discipline of natural sciences must meet differences without discriminating or separating students in the classroom. Consequently, the topic is still little investigated, since researchers who deal with this subject usually focus on one or two limitations arising from deficiencies, producing techniques and/or pedagogical materials that meet the needs of a specific audience. In this way, disregarding other needs.

The "Salamanca Declaration" (1994, p. 3-27) reaffirms that, through this investigation, we will analyze and quantify the study based on a review of updated publications and teacher training focused on school inclusion and sustainability for the teaching of Natural Sciences in basic education. To this end, a theoretical, quantitative and bibliographical review on the topic addressed in this study was necessary. The document Brasil (1998, p. 46) emphasizes that inclusive education began to have greater importance from the 1990s onwards, with the implementation of the Federal Constitution of 1988 and, consequently, with the Law

[1]Postgraduate in History of Africa from (UNIFESP) and Teaching for Professional and Technological Education (IFTM). Graduated in Pedagogy from UNIPAC Special Education from (UNISANTA), Geography from UNOPAR and History from UNIUBE. Professor at the State Secretariat of Education of Minas Gerais (SRE). < alexandarcarvalho7@gmail.com >
[2]Graduated in Literature from the State University of (GOIÁS) and Postgraduate in English Language (UNIUBE). < elynenebsb@gmail.com >
[3]Master in Mathematics from (UFU). Graduated in Mathematics and Physics from (UNIPAC). Professor at the State Department of Education of Minas Gerais. < geislacarvalho@gmail.com >

of the 1996 National Education Guidelines and Bases, which consolidated inclusive education in the regular public education system.

Melo, Sampaio (2013 p.6), and Santos. AM T (2008 p.9), through the document: "Autism: a challenge in literacy and school life", state that, in this sense, the challenges are many, however, the inclusion process is not established only in the classroom practice, but also in the various relationships between the subjects, developed in the formal and informal context of the daily life of the disabled. Thus, the question that guides this investigation is to discuss the relevance of the integration of the discipline and the challenges that public school professionals face in the insertion of inclusive proposals, with a focus on Sustainable Development in natural sciences.

It is therefore necessary to rethink the current scenario and seek a political-pedagogical restructuring, accompanied by ongoing training, that will allow a new format for approaching content in the classroom. This paper aims to discuss the relevance of inclusion and the challenges of inserting methodological proposals adapted for students with multiple disabilities, seeking to promote an education based on the sustainable development of sciences in the school environment. This study shows that natural science has always been linked to the transformations that occur in space, time and matter, configuring itself as a school environment that should encourage students to observe, analyze and understand its changes over time.

In this way, scientific research involves deepening the fundamental concepts of natural sciences to interpret ideas, phenomena and processes to be used in investigation procedures aimed at dealing with everyday situations and local and collective demands, and proposing interventions that consider local development and improving the quality of life of the educational community. According to Santos, M. (2008, p. 74), through the article: "Space and Method", the National Curricular Parameters (PCNs), the National Common Curricular Base (LDB) and (BNCC) for natural sciences, the author highlights, through research, a proposal for the study of environmental issues, which favors a clear vision of local, regional and global problems. This helps in the understanding and explanation of pedagogical content and provides elements for decision-making, allowing necessary interventions in the educational process.

Researchers Guimarães, R. Fontoura (2012 p.508-532), Leff, E. (2001 p.31), Libâneo (2015 p.629), and the UNCMAD document (1991 p. 46), emphasize that through the guiding documents, the Geography teacher has reinforced his/her teaching process, integrating learning focused on environmental sustainability. Thus, it is clear that education can and should play a decisive role in preparing students, providing them with knowledge, skills, abilities and values that enable them to understand the current reality. This is based on the premise of learning "Natural, Inclusive and Technological Sciences TDICs" and the possibilities of the concept of "environmental sustainability" for regular education.

The objective of this study is to critically analyze the educational practice of Natural Science through inclusion and technology from the perspective of environmental sustainability and to verify its impacts on teacher training and, especially, on school learning. In addition, it seeks to discuss more effective alternatives for evaluating student performance, resulting from this systematic process. Pletsch (2020, p. 57), conceptualizes the etymology of the word "inclusion" and states that:

> [...] is related to the act or effect of including people who do not fit into the molds of normality standards imposed by society. There are several types of disorders defined as "disabilities", such as physical, motor and visual disabilities, as well as disorders such as ADD (Attention Deficit Disorder), ADHD (Attention Deficit Hyperactivity Disorder), Dyslexia, Dyscalculia, Dysgraphia, Autism Spectrum Disorder, and high abilities, thus covering multiple disabilities.

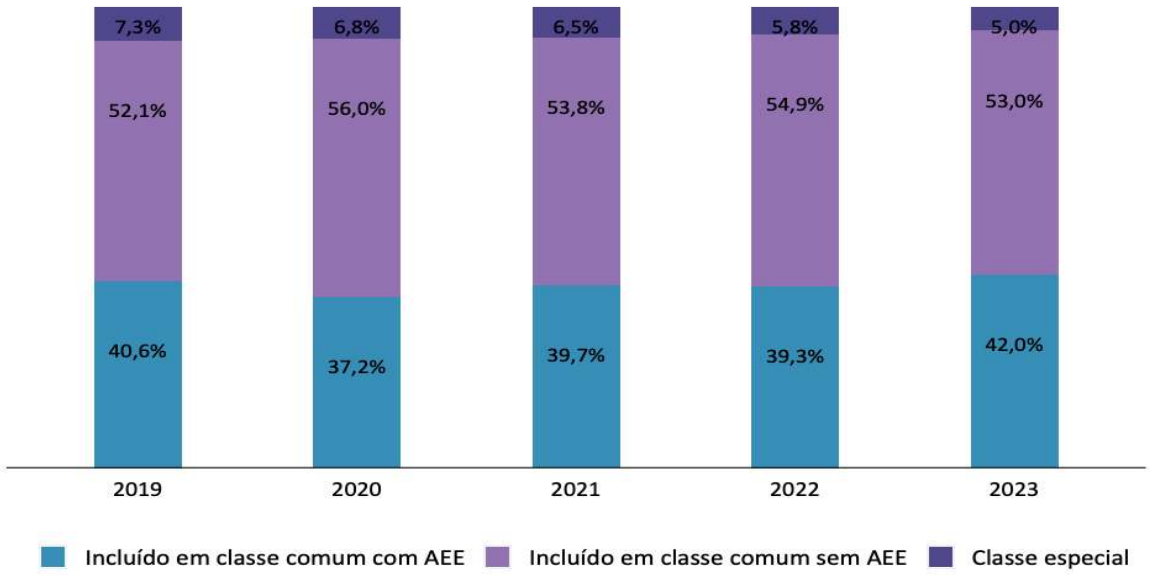
That said, Pletsch (2020 p.70) reaffirms that these limitations mean that students with various or multiple disabilities need to be included in any discipline, including Natural Science, so that they can complement their learning through educational curricular intervention, in an integrated context of school-age subjects. Based on this educational premise, the practice of sensitivity in the classroom is essential, because in a school class, regardless of the level or type of education, there are individuals with varied specificities. From this perspective, there are always teachers who can identify students' difficulties even before their families realize it.

Mantoan (2015, p. 16) highlights that the school's main objective should be to train a new educational generation in regular classes, complemented by Specialized Educational Assistance (AEE). In this context, the National Education Plan (PNE), in its Goal 4, reinforces the commitment to education

special inclusive for students aged 4 to 17 with disabilities, autism spectrum disorders and high abilities/giftedness.

According to data from the 2023 School Census, released by Inep (2023), and observed in Chart 1 below, the percentage of enrollments of students with multiple disabilities included in regular classes has shown consistent growth over the years. In 2019, 92.7% of these students were included in regular classes, while in 2023 this percentage rose to 95% (Inep, 2023).

Graph 1-Multiple Disabilities found in the Inclusion process in public schools.



Source: Inep.*Basic Education School Census 2023*

When comparing the provision of inclusive education by administrative dependency, it is observed that the state (97.8%) and municipal (97.3%) networks have the highest percentages of included students. However, in the private network the reality is still different: of the total of 263,874 special education enrollments, only 148,308 (56.2%) are in regular classes. (INEP, 2023).

Furthermore, these students' access to Specialized Educational Assistance (AEE) classes also increased, from 40.6% in 2019 to 42% in 2023 (INEP, 2023). These advances indicate a gradual but significant movement towards more inclusive education.

Based on these data, this research proposes the inclusion of Science teaching in a sustainable and inclusive way as an essential aspect to be worked on in basic education schools in Uberaba, MG. This pedagogical paradigm will be structured based on the analysis of graphs and contextualized data, focusing on

teaching process as an integrative discipline, which seeks to articulate environmental, social and economic issues. In this sense, the curriculum will be adapted to offer a facilitating approach that promotes equity and inclusion in classrooms, ensuring that all students, regardless of their conditions, can actively participate in the learning process.

Methodology

Amaral (2013, p. 6) investigates the discrepancies between the rates of automatic promotion of learning in natural sciences, through sustainable inclusion and TDICs, of students attending basic education. The objective of this panorama was to perceive the impacts of the learning of these students once the activities were contextualized in the premise of environmental sustainability.

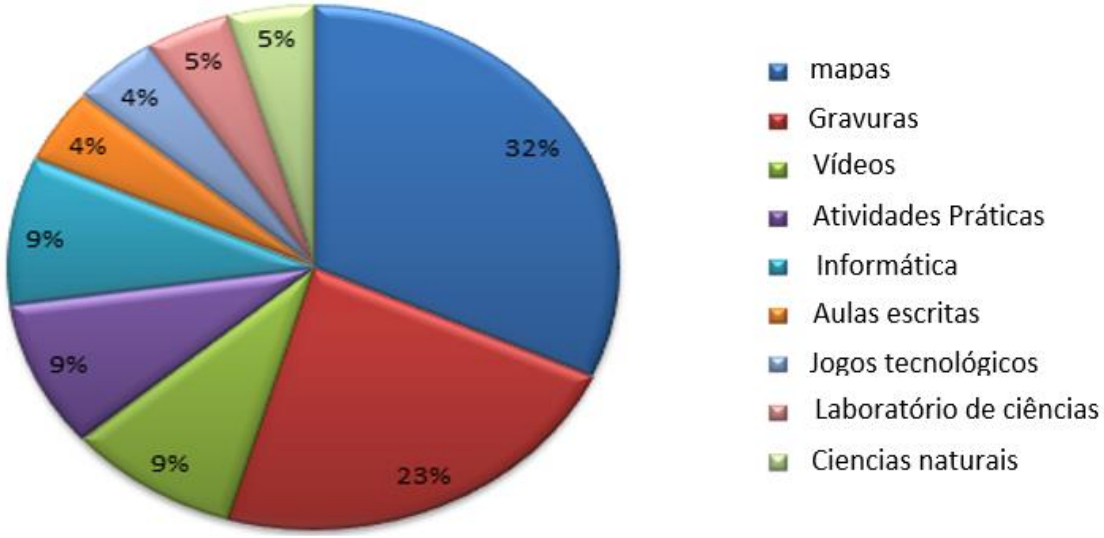
This research was based on the bibliographic, quantitative and literature review methodological approach of the following authors: Almeida (2013), Amaral (2013), Barreto (apud Moreira, 2000), Brasil (1998), (2017, LDBEN and BNCC), (2019 PCNs), (2021, LDB), Boff (2012), Capra (2002), Pastoriza and Orlando (2015), Caiado (2015), Cnumad (1991), Salamanca Declaration (1994), Freire (2011); Gadotti (1996), Guimarães R. Fontoura (2012), Fernandes (2016), Libâneo (2015), Leff, E. (2001), Mantoan (2015), Melo; Sampaio (2013), Santos (2008), Pletsch (2020) and Rodrigues (1998). Therefore, the study raised the following problem: “What are the viable solutions for inclusive teaching that we seek to overcome, considering the difficulties encountered by teachers in the systematic process of teaching Natural Sciences to students with varied or multiple disabilities?"

Thus, when researching the subject of this study, we noticed the gaps that were presented by teachers arising from the needs, mediations and limitations of the subjects in learning. Therefore, see below the activities that were worked on with natural science students in the AEE resource room, on the premise of digital technologies, used for the development of natural science learning in the process of inclusion of students with multiple disabilities.

In this sense, Almeida (2013 p.110) emphasizes that, in order to meet the methodological activities of this research, the school mobilized efforts so that its members focused on building sustainable societies. In this way, it sought to

direct teaching towards an approach that contributes to the comprehensive education of basic education students.

Graph 2 -Activities to support students with difficulties in Science



Source: Prepared by the Authors (2023).

Almeida (2013) concludes that, to ensure the validity and reliability of the data, procedures such as triangulation were adopted, verified through multiple sources to ensure their accuracy and consistency. In addition, these analyses and interpretations were reviewed by experts in the field of education to validate the conclusions and ensure the accuracy of the results.

Development:*Reflections on the possibilities of the concept of environmental sustainability in Natural Sciences through Inclusion and Digital Technologies*

Gadotti (1996) and Caiado (2015) emphasize that it is important to understand that Education constitutes a call for the reorientation of existing educational policies, programs and actions. In this way, it must be guided by the interdisciplinary learning process in the most diverse areas of knowledge, enabling the insertion of themes that aim to apply concepts within the reality in which the subjects are involved and inserted, collaborating in decision-making and in improving the quality of life.

In this context, the author. Leff (2001 p. 31),corroborates the reflection that This interdisciplinary process of inclusive learning, guided by the Sustainable Development Goals, through the 'global agenda' for the period 2015-

2030, must ensure that all students acquire the knowledge and skills necessary to promote human rights, gender equality, global citizenship and the appreciation of cultural diversity for peace.

This is a constant and prolonged process of reflection-action-criticism by the professionals who make the educational act possible. Leff (2001 p.191) states that this methodological process of learning in 'natural sciences and inclusion' has thus broadened discussions, being perceived as a new strategy for the development of individuals with disabilities. Therefore, he makes it clear that many believed that no human activity could influence the balance of the planet. In turn, Libâneo (2015) supports the analysis of this pedagogical-curricular panorama of learning and emphasizes that:

> [...] there was a new understanding of the influence exerted by man in relation to the limit of our planet's capacity and the very continuity of life on Earth. Several adaptations were proposed to the concept of sustainable development in the natural sciences, with the aim of making it more understandable for everyone Libâneo (2015 p.650).

Based on the assumption of understanding this strategy for developing the learning of individuals with disabilities,Lebanese (2015),proposes the application of an Education focused on Sustainability that is interdisciplinary and holistic. It assumes that this knowledge must be based on the school curriculum, in a proposal contextualized with the local reality, which enables the development of critical thinking and the ability to find solutions to the problems and challenges of their community. In this sense,Amaral, (2013), explains that

> [...] The teaching of natural sciences in Inclusive Education faces several challenges, ranging from teacher training to classroom practice. However, the definition of the term 'sustainable development' can lead to contradictory interpretations and is constantly evolving. It is necessary to understand its concepts and meanings to ensure success in educational proposals Amaral (2013, p. 8).

Boff (2012, p. 21) reports that in this process of educational praxis, it was noted that the challenges encountered in the educational context were diverse, especially in the inclusive teaching of sustainable natural sciences combined with ICTs. The conception of education for all involves mainly the promotion of equality and the fight against discrimination. It is in the initial training that these values are learned. The teacher plays an essential role in this process. In addition, all of this requires that the educator be prepared to deal with adverse situations, where there are

Individuals with different levels of learning are present. The educator must encourage debate among students about the discrimination that marks social relations, helping them to realize that they are part of groups and that, within them, there are differences. Note the word cloud that highlights the premise of this investigation.

Figure 1: Word Cloud Inclusive and Technological Education in Natural Sciences

Source: Santos, M. (2008, p. 74), Volume 1 of the Work: "Space and Method".

In this way, Fernandes (2016 p.107) analyzes education and confirms that it must provide all students with the conditions to become subjects, capable of reflecting on their own destiny. In this sense, Fernandes (2016 p.114) explains that the main challenge encountered in working with students with disabilities is inclusive curricular practices. Often, there is a lack of adequate technological resources for the full development of the work, which further increases the difficulties for the educator. However, it is necessary that the classroom and the teaching work plan have content that is appropriate for all students. It is essential that changes and adaptations occur in the classroom, in which there is mediation and inclusion of teaching materials such as books, maps, computers, and games, involving the flexibility, respect, motivation, and creativity of the teacher.

Based on this premise, Rodrigues (1998 p. 133) emphasizes that despite the constant concerns about the methodology used in the classroom to work with students with disabilities, this should not be the only factor to be analyzed to implement inclusive teaching, since other elements are extremely important. The author Rodrigues (1998 p.138) also reports that the National Common Curricular Base, through the documents (BNCC, 2017), (LDB 2021 p.46-51) and (PCNs 2019 p. 325), advises that these individuals require individual adaptations. However, focusing excessively on the specificities of students, instead of implementing more significant adaptations, such as teacher training and the organization of classrooms and the school for service, can lead researchers to believe that changes in methodology alone are sufficient to effectively include people with disabilities in science classes.

Discussion and Results

To answer the guiding question of this study: What are, according to the teachers participating in the research, the contributions that natural and inclusive sciences bring to professionals who work with the discipline from the perspective of sustainable and technological development of students with disabilities in public education?

And to achieve the goal of critically analyzing these educational practices, the research played an essential role in examining both the positive aspects and the challenges associated with promoting the inclusion of these students.

Furthermore, we sought to evaluate pedagogical practices and significant learning, considering their implications as mediating tools in the educational process. The critical analysis of the theme of inclusive education, especially in recent decades, has gained relevance in various contexts and circumstances. In this scenario, schools have been repeatedly called upon to offer appropriate responses to contemporary demands, adapting to the needs of their students and incorporating practices that promote equity.

The current historical moment demands active and effective participation from the school institution and its professionals, who must be prepared to face the challenges imposed by inclusion, especially in public education. The natural sciences approach, within this context, emerges as an integrative perspective, which not only facilitates teaching and learning, but also reinforces the

commitment to sustainable development and the promotion of a fairer and more inclusive education. Critical analysis of the theme of inclusive education over the last few decades has emerged in different contexts and circumstances, and the school institution has been called upon to provide appropriate responses. The current historical moment demands effective participation from the school and its professionals. Caiado (2015) states that

> [...] the teaching of Natural Sciences plays a fundamental role in helping to educate any citizen, as it develops a greater understanding of reality by studying directly with the socially produced space, and also plays a significant role in learning, whether by providing the development of observation, description, analysis skills, such as learning to observe, describe, compare, establish relationships and correlations, draw conclusions and make syntheses of the living space; or by enabling the appropriation of content that allows us to read the world and the place in its contradictions Caiado (2015 p. 782).

That said, Caiado (2015, p. 783) emphasizes that pedagogical mediation for these students requires specific preparation on the part of teachers, because the more diverse the work carried out in the area, the greater the understanding and improvement of activities aimed at this audience. However, the data point to the need to diversify the themes related to different disabilities, based on sustainability projects.

Therefore, as discussed in the research, it was noted that teacher training has been a key way to overcome the challenges of teaching people with disabilities in regular classrooms, without having had specific training in the area. Proposals for training natural science and biology teachers that take disabilities into account, in addition to methodological adaptations for teaching, are scarce. In this context, we conclude this discussion and propose that further studies be carried out on the practice of teaching sustainable sciences through inclusion and technological tools, as this will enable quality education for both professionals and students in general.

Final Considerations

Capra (2002, p. 55) shows that the inclusion of students with disabilities in the regular education system was a historic achievement for these individuals who are in school. In this sense, the mandatory resources and methodologies, specified in laws such as the LDBEN (1996) and article 59-III of the LDBEN (2017). It should serve students with disabilities and their specificities, described in the document Brasil (2021).

Ministry of Education (MEC), National Education Council (CNE), Full Council (CP) and Resolution CNE/CP No. 2, of August 5, 2021 on page 46. Furthermore, the question to be debated in this educational and specialized panorama is: "whether schools considered inclusive really promote an effective inclusion process or whether these students are just included in regular classes".

In this context, teaching natural sciences, like other school subjects, presents some challenges. Reflecting on the premise of this panorama, it is clear that an essential factor for overcoming the existing barriers in inclusive and technological educational practices in science is the initial and ongoing training of teachers, in addition to the improvement of studies in the area, for the development of methodologies that, in fact, provide meaningful learning for these students. However, based on this assumption of learning in science, it is important to emphasize that the process of inclusion is not limited to classroom practice, but also encompasses the various relationships developed on a daily basis. These keywords summarize the main concepts addressed in the study and facilitate the indexing and search of the material in academic databases.

Keywords: Inclusive and Technological Education. Teaching of Natural Sciences. Environmental Sustainability. Teacher Training. Sustainable Development.

References

ALMEIDA, JP A Reflection on the Teaching of Geography and the Inclusion of Deaf Students in Regular Classes.**Brazilian Journal of Geography Education**. Campinas, v. 3, n. 5. Jan./Jun. 2013. Available at: https://doi.org/10.22481/rg.v4i3.6997. Accessed on: Nov. 29, 2024.

AMARAL, CN; et al. Geography and inclusion: educational practices for inattentive students. In:**MEETING OF GEOGRAPHERS OF LATIN AMERICA**, 14., 2013, Lima. *Electronic Annals*. Lima: EGAL, 2013. Available at: http://observatoriogeograficoamericalatina.org.mx/egal14/Ensenanzadelageografia/Investigacionydesarrolloeducativo/55.pdf Accessed on: November 15, 2024.

BOFF, L.**Criticism of the Standard Sustainability Model.**2012. Available at: https://leonardoboff.org/2012/01/29/critica-ao-modelo-padrao-de sustentabilidade/#comments Accessed on: October 8, 2024.

BRAZIL. Law no. 9,394, December 20, 1998. Establishes the guidelines and bases of national education.**Official Gazette of the Union**. Brasilia, December 23, 1998.

BRAZIL. Ministry of Education.**National Curricular Parameters:**curricular adaptations strategies for the education of students with special needs. Brasília, DF, 2019.

BRAZIL.**Common National Curriculum Base**. Brasília: MEC, 2017. Available at: http:// basenacionalcomum.mec.gov.br/a-base. Accessed on: March 1, 2018.

BRAZIL. Ministry of Education.**National Council of Education**. Full Council. CNE/CP Resolution No. 2, of August 5, 2021.*Official Gazette of the Union*, Brasilia, DF, August 6, 2021. Section 1. Available at: http://portal.mec.gov.br/index.php?option=com_docman&view=download&alias=199151-rcp002-21&category_slug=agosto-2021-pdf&Itemid=30192. Accessed on: October 19, 2024.

PASTORIZA, TB; ORLANDO, RM; CAIADO, KRM Production of knowledge about teaching geography to people with disabilities.***Ibero-American Journal of Studies in Education*,**Araraquara, v. 10, n. esp.1, 2015. Available at: https:// periodicos.fclar.unesp.br/iberoamericana/article/view/7924. Accessed on: October 17, 2024.

CAPRA, F.**The Hidden Connections**. Trans. Marcelo Brandão Cipolla. Available at: Available at: https://seer.ufu.br/index.php/sociedadenatureza/article/view/ 9214/5673 . Accessed on October 28, 2024.

UNITED NATIONS CONFERENCE.**ABOUT ENVIRONMENT AND DEVELOPMENT** UNCED.*Agenda 21*. São Paulo: State Secretariat for the Environment, 1992. Available at: https://antigo.mma.gov.br/estruturas/agenda21/_arquivos/cap01.pdf 12/12/2024.

UNCED - **WORLD COMMISSION ON ENVIRONMENT AND DEVELOPMENT**.*Our common future*. 2nd ed. Rio de Janeiro: FGV, 1991. Available in: https://edisciplinas.usp.br/pluginfile.php/4245128/mod_resource/content/3/ Nosso%20Futura%20Comum.pdf. Accessed on: October 27, 2024.

SALAMANCA DECLARATION.**On Principles, Policies and Practices in the Area of Special Educational Needs.**Salamanca-Spain.1994. http://portal.mec.gov.br/seesp/arquivos/pdf/salamanca.pdf. Accessed on: November 10, 2024.

FERNANDES, JV Inclusion: Teaching Geography to Deaf Students, with a Look at the Landscape from a Freirean Perspective.**Geography Teaching & Research**, v. 20, n. 3, 2016. Available in: https://periodicos.ufsm.br/geografia/article/view/21068/pdf . Accessed on: October 22, 2024.

FREIRE, P.**Pedagogy of Autonomy:**Knowledge Necessary for Educational Practice. São Paulo: EGA, 2011.

GADOTTI, M. Practice at the Height of the Dream. In: GADOTTI, M.***Paulo Freire:****a bibliography.*New York: Routledge, 1996.

GUIMARÃES, R.; FONTOURA, Y.**Sustainable Development at Rio+20:** Speeches, Advances, Setbacks and New Perspectives.*EBAPE.BR Notebooks*, v. 10, n. 3, 2012. Available at: https://doi.org/10.1590/S1679-39512012000300004.

INEP.**Basic Education School Census, 2023.** https://download.inep.gov.br/ Available at: censo_escolar/resultados/2023/apresentacao_coletiva.p df. Accessed on: February 22, 2023.

INEP.**Basic Education School Census, 2023.**Administrative Dependency and inclusion. Available in: https://download.inep.gov.br/publicacoes/institucionais/estatisticas_e_indicadores/resumo_tecnico_censo_escolar_2023.pdf Accessed on: October 26, 2024.

*LEFF, E****. Environmental Knowledge: Sustainability, Rationality, Complexity, Power****.* Translated by Lúcia ME Orth. Petropolis: Vozes, 2001. Available at: https:// www.revistaea.org/artigo.php?idartigo=3239. Accessed on: October 26, 2024.

LIBÂNEO, JC Teacher Training and Didactics for Human Development.**Education & Reality,**Porto Alegre, v. 40, n. 2, Apr./Jun. 2015. https://www.scielo.br/j/edreal/a/GB5XHxPcm79MNV5vvLqcwfm/abstract/?lang=pt Accessed on: Oct. 26, 2024.

MANTOAN, MTE**School Inclusion:**What is it? Why? How to do it? São Paulo: Summus Editorial. 2015.

MELO, A.A.**Trajectories of Geography Teaching in Brazil:**1978-1996. 2013. 176 p. Dissertation (Master in Geography) – Institute of Geography, Federal University of Uberlândia, Uberlândia, 2013.

PLETSCH, M.D.**What is Special about Brazilian Special Education?***Moment - Dialogues in Education*, v. 29, n. 1, Jul. 2020. Available at: https://doi.org/10.14295/momento.v29i1.9357.

RODRIGUES, A.M.**. The Utopia of Sustainable Society Notes on the Concept.** *Environment and Society*, Campinas, n. 2, 1st sem. 1998. Available at: https:// www.uniedusul.com.br/wp-content/uploads/2021/12/E-BOOK-DESENVOLVIMENTO-SUSTENTAVEL.pdf Sustainable Development pdf . Accessed on: June 13, 2024.

SANTOS, AMT**Autism:**a challenge in literacy and school life. São Paulo: CRDA, 2008.

SANTOS, M.**Space and Method**. 5th ed. São Paulo: Nobel, 2008. (Spaces Collection). Available in: https://edisciplinas.usp.br/pluginfile.php/7893239/mod_resource/content/1/SANTOS_%20ESPA%C3%87O%20E%20M%C3%89TODO.pdf. Accessed on: December 2, 2024.