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Applicability of Information and Communication Technologies: Tics in the Teaching-Learning Process of Environmental Education

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***Abstract*—** *This work is part of a descriptive narrative bibliographic review based on the investigation and critical analysis of relevant retrospective research to provide the construction of ideas and concepts about Information and Communication Technologies – ICTs in their evolution and in environmental education. It is evident that, in addition to the Covid-19 pandemic moment, the incorporation of ICTs in the teaching process brings many advantages, such as making the classroom more attractive for the student and stimulating their interest in the contents taught, in this context that we realize the importance to think of a new teaching practice in which teachers rethink their attitudes in educational relationships and make new suggestions for schools. Based on the studies surveyed, in addition to promoting a new teaching environment, educational technology also provides adequate educational practices for people who have lived in parallel with society for a long time.*

I. INTRODUCTION

The world has gone through a series of technological advances, reflecting the emergence and progress of technology and its effects on education. Globalization has had a significant impact on people's lives and society has increased the demand for goods and services derived from the planet's environmental resources, as well as technological resources, alerting the world to the need to look at environmental education. Society is constantly evolving, this is a fact, but these changes are happening faster and faster, with Information and Communication Technologies (ICTs) as the main responsible.

In this research, considering the current scenario, the impact of digital transformation in education is studied, especially in the field of education and teaching practice. Therefore, the 21st century is characterized by technological advances, with faster resources and access to information, inserted in an environment with different needs from the past, which leads us to the most active and participatory education of today.

ICTs have great potential in the relationship between teaching and learning, in this sense, the classroom environment needs to follow the emergence of these technologies to use them in everyday life to meet students'

expectations. However, this is not a complete reality, as some teachers resist using these resources [1].

On the other hand, the National Curricular Common Base (BNCC) assumes responsibility for individual training and global development, safeguarding the application of technical resources in the construction of knowledge and the democratization of digital culture and encouraging schools to materialize the shared meaning of new model's students and educators [2].

Pereira [3] is aware of the existence of 19th century schools with 20th century educators and 21st century students. Therefore, even knowing that students are not whiteboards, teachers still adhere to traditional teaching models and resist innovative suggestions. Therefore, this research seeks to investigate the situation of ICTs in the context of contemporary social education.

In this sense, a narrative literature review was carried out with research related to the topic. However, this work is divided into three different but closely related moments. Initially, some aspects of contemporary society were introduced to understand their needs.

Second, it is about the prominence of ICTs in terms of their contemporaneity and their applicability in teaching and learning. Finally, it reflects the importance of reconstructing teaching practice from an Information and Communication Technologies perspective. It is necessary to be aware of the challenges of using new technologies in the teaching process, with a view to improving the level of development of students, allowing them to perceive that they are the main instance that understands their own history and social reality and those responsible for its transformation, including in adverse contexts, such as the current Covid-19 pandemic.

Education includes the relationship between specific production work and human social reproduction on the material and spiritual plane, in this case, participants in a teaching situation interact with each other and with the natural and social world [4]. School education, characterized by material basis and other social practices, constitutes learning with a transformative purpose.

In this context, Oliveira [4] affirmed the existence of scientific-technological points of view, pointing out that technology includes the connection between man and matter, also including the use of production methods to act on matter, based on energy, in knowledge and information. Nowadays, information becomes easily accessible and changes quickly, combined with new technologies such as social work networks: Google Meet, Ava and Zoom.

Given this reality, Mercado [5] pointed out that in addition to a series of activities with teaching interest, teachers also have new methods that can be applied to the teaching process. For example, exchanging different types of scientific and cultural information and creating a teaching environment centered on student activities, social interaction, and autonomy.

The teacher also guides the student to the place where he can get information, how to handle and use this information correctly, to help improve the quality of teaching. However, Souza and Souza [6] warn that the accumulation of knowledge acquired through the Internet, if not properly managed, can lead to a reversal of the main objective, which is based on the use of this technological tool to improve the quality of teaching and education. learning.

In other words, students can read news without analyzing them, that is, the congestion of multiple theories about a given content. This is because the contact with the information is too hasty, in this case, the students are not free to make value judgments on the topic, resulting in a punctual knowledge that has been erased and a little forgotten. Therefore, the application of technology in education aims to encourage students to learn and promote changes, thus altering the relationship between students and school [6].

This type of stimulus occurs mainly in the insertion of new learning content and promotes the teacher's role not only to disseminate knowledge, but also to acquire knowledge through new methods. The use of these technical teaching tools can not only stimulate students' creativity and form new concepts in different ways, transforming difficult tasks into dynamic and easier processes, but also materialize new knowledge concepts.

Analyze how technologies are being used in education, their historical evolution, and the uniqueness of use in schools in the country, also explaining their contributions as tools for integration in the classroom, including in the current context of social isolation in the pandemic.

II. MATERIALS AND METHODS

This work is part of a descriptive narrative literature review based on investigation and critical analysis of relevant retrospective research to provide the construction of ideas and concepts. The narrative literature review involves the steps of topic selection, literature search, selection, reading, analysis, and writing [7] and consists of introduction, development, reflection, and references. Sampaio and Mancini [8] explain that narrative reviews do not exhaust the sources of information and the choice of research depends on the author's enthusiasm. This is interesting because it can establish connections with

previous research and propose new perspectives on the topics discussed.

The data were collected from the search system on "*Google Acadêmico*", available within the Portal Periodicals CAPES/MEC. From this, a filter was carried out to select articles only from the last five (5) years, that is, articles between the period 2017 and 2021. After this filter, articles that were related to the theme were searched, obtaining If a total of 3,240 articles, consequently, there was the exclusion of articles that did not have the keywords determined as necessary for data collection and research constitution, these were: "application", "technology", "tool", "teaching", "environment", "learning" and "communication". Then, the titles and abstracts of the remaining articles were read and those that did not reach significant relevance for the realization of the research and their possible relationships with the theme were excluded. As a result, a total of seventeen (17) articles were obtained that contributed as an informative constructive basis for this article.

In the qualitative-quantitative analysis, environmental education is a comprehensive field of research, being considered an important tool for the formation of citizens who are concerned with the protection of the environment, a necessary element for the survival of our planet. These surveys were obtained online and printed, and, after data collection, the survey was critically evaluated for the selection of works that will be used for review. In this sense, research can acquire and update knowledge on specific topics in a shorter period and is related to continuing education [9].

III. RESULTS AND DISCUSSIONS

History and evolution of technologies in teaching

According to Toschi [10], scientific theory emerged in the 17th century to solve technical problems and promote technology, where the author translates it into knowledge about how it is used and how to achieve its goals. Furthermore, technology changes the environment, both positively and negatively. In Brazil, as in other countries, the use of computers in education stems from the experience of universities in the 1970s.

According to Alonso [11], even if there are differences between Brazil and other countries that have started to use information and communication technologies (ICTs) in education, the progress of teaching through technologies is very similar to that of other countries. According to Blanco and Silva [12], the development of technology and media in the educational system has three characteristics: Modernization of teaching; optimization of the educational process to improve learning; systematic methods, which have the particularity of change.

However, after this characterization, the Internet brought new challenges to education. The author highlights that these new technologies were introduced in schools in the 1980s, namely: overhead projectors, portable recorders, camcorders, photocopiers, televisions, video recorders and computers. In addition, the author lists three aspects of this insertion: the use of the media in the context of school curricular projects, the training of teachers and the work environment, the integration of the media in teaching and the school updating policy [12].

Oliveira [4] highlighted that from the second half of the 1980s to the first half of the 1990s, including the period before the approval of the National Curricular Guidelines (DCNs) and the Law of Directives and Bases for National Education (LDB) in 1996, in addition to the retreat from criticism in this regard, people returned to defend the use of technology as a fair means in teaching practice.

However, the proposal is still a discussion of school informatics, and is mainly related to the pilot center for educational informatics designated in 1984 in five universities in the country. In 1990, technology reappeared in the context of schoolwork, whether in the classroom or in management and administration.

Almeida [13] also comments that, with the creation of SEED / MEC in 1990, plans for the use of technology in education and distance education were promoted through cooperation between the Federal, State and Municipal governments, and these plans were affected. Political power does not always interest them, as Gilleran [14] said, along with the purchase of equipment, software, and other artifacts, plans and projects for teacher training have been developed with the aim of changing school daily life.

Therefore, the incorporation of ICTs in schools has stimulated major changes in student learning. However, according to Borba and Penteado [15], all these technical tools may have affected schools and school education parameters, as the new generation is affected by different styles of reading and writing, leading to the development of other languages and online methods in schools. schools.

In this context, Bauerlein [16] commented that children and young people in this technological environment no longer focus on reading, as they only absorb the information that interests them and rarely use sets of contents. In contrast, Silva et al. [17] highlighted that the use of new technologies is conducive to the generation of meanings related to the reading and writing process, as their methods are carried out in a school environment.

However, Sancho [18] emphasized that all processes involving the use of ICTs in educational environments are affected by the mechanical and effective use of existing economic models, which diminishes their potential for more creative uses. From the point of view of teaching, the use of information and communication technologies has changed the role of the teacher in the school environment, which is not only disseminator of knowledge, but also places him as a protagonist in this case. However, Alonso [11] pointed out that the problem is that the school, as an institution, is marked by the logic of transmission, which conflicts with the logic of ICTs and with the school logic.

Therefore, Blikstein [19] questioned the more "closed" school education models, which ignore the combination of various media and generate new languages, and therefore require a better understanding for their use. Furthermore, the author commented that the integration of social emotions, interactions, motivations, and knowledge relationships with life experience is the content that increasingly influences the education and training process.

Therefore, the pedagogical activities of the teaching process using information and communication technologies are conducive to the development of students and teachers. In this sense, Freitas [20] highlighted that the importance of integrating ICTs does not represent only the tool itself, but also what it makes available to the discipline, that is, its contributions in relation to the content worked. Knowing how to use them to benefit students is essential. Therefore, one of the challenges of incorporating technologies into the school environment is that they cover all students, as well as all teachers and the existing school environment, on an equal basis.

For Almeida [13], the use of educational technology must be integrated into the curriculum, teaching and active learning, to transform schools and classrooms into an environment for citizen education and democratic experience. Therefore, Selwyn [21] emphasized that the use of information and communication technologies is not limited to survival conditions in 21st century society, but constitutes an important part of today's social progress, which applies better to education and learning than any other field.

Contemporary society needs to discuss the importance and advantages of technological tools in the construction of knowledge, as considering the current teaching process that does not use technological resources is a setback for human evolution [22].

Santos and Silva [23] analyze technology in basic education from two complementary aspects. Firstly, technical literacy refers to how to teach to use computers and technical methods. In addition to understanding them as part of society, culture, and productive practice, they are inseparable from language, art, and scientific knowledge, which makes technology increasingly vital to society. The second chain refers to the understanding of the scientific and technological basis of production, a mechanism that favors the incorporation of the curriculum into the real world of the production of goods and services, necessary for survival. The Educational Guidelines and Fundamental Law (LDB) do not aim to establish technical education in isolation, but to establish technical education in each subject of the curriculum so that students can acquire knowledge of the principles of science and technology necessary for modern life in an integrated way.

Considering the moment of paradigm transformation, this view that the fragmented world is no longer idealized, and a new paradigm is installed that encompasses the whole world and changes frequently [24]. As everyone knows, ICTs allow the democratization of educational opportunities.

However, considering the situation we live in, traditional teachers need to be aware of the relevance of using ICTs. In the school environment, students often understand new technologies better than teachers, which reflects their generation. In this sense, continuing education actions are important for

Santos [25] believes that education has not kept up with the technological advancement of society, as traditional methods, techniques, and theories still exist in teaching practice and are considered the only way to acquire knowledge.

A study by Vilarinho-Rezende et al. [26] analyzed the relationship between the use of ICTs and creativity in an educational context. Furthermore, by evaluating the literature composed of empirical articles and reports, they found that the deliberate and pedagogical use of technologies in the educational process can improve the measurement of quality and creativity.

In addition, the application of technology in the classroom not only brings the language of students closer to the teacher, but also promotes greater student interest in learning, inclusion, and more meaningful learning, generating knowledge that was more difficult to obtain years ago. behind. However, it is important to correctly apply information and communication technologies in everyday school life, use technical tools in a complementary way to promote learning, that is, use them as strategies to activate mental processes and accelerate the acquisition of knowledge.

Pedagogical Reconstruction in ICTs

Silva and Correia [22] are genuine in proposing that educators need to reinvent themselves in the face of the dynamism of new technologies. However, this adaptation is still challenging for many. One of the main reasons is that not everyone has technical resources, in addition, the use of these resources in the classroom can cause insecurity and fear. It turns out that students are better at using technology than teachers because they belong to distant generations in chronological order.

Therefore, it is necessary to think about continuing education to provide teachers with "digital literacy" so that they can rebuild their teaching practice from the perspective of the use of ICTs. Many education professionals and educational institutions themselves rely on traditional teaching methods. Theorist Jean Piaget believes that the object must destroy the subject's structure to develop cognitively.

Therefore, he believes that it must also be the students' learning environment, that is, students must be able to interact with learning objects, breaking with the old paradigm that teachers are holders of knowledge and students are frameworks. white. The information is printed. Therefore, it is acceptable that the role of the teacher in contemporary society still needs the changes that occur with the insertion of technology in the educational environment.

In this case, the paradigm of teacher education has changed from a model in which teachers are just transmitters of information to a new model full of uncertainties. In this logic, teacher education must be process oriented. Continuously use their critical, reflective, and creative skills to promote their professional development [25]. The incorporation of ICTs in the teaching process brings many advantages, such as making the classroom more attractive to students and stimulating their interest in the contents taught.

According to the National Curricular Common Base - BNCC, personal experiences in the family, in the community, in the social and cultural environment and in the interaction with technologies can stimulate curiosity, creativity, critical capacity and debate, questioning and stimulate logical thinking. The use of ICTs increased students' understanding of themselves, the environment and the social world and the relationship between man and nature [2].

To perceive this reality in the classroom, Brito [27] believes that schools need a project of reflexive action to correctly use ICTs in the perspective of contemporary society and rebuild their teaching process. However, the school has three goals: “Reject technology and try to stay off topic; the race to deflect technology and turn life into new things; or master the process and develop skills to control the technology and its impact” [27].

The third way is to enable the integral formation of the discipline. Therefore, teachers need to master information and communication technologies and use them as a tool in teaching practice, always being cautious and having a clear objective, to provide learning situations, instead of transforming it into a teaching method.

It is in this context that we realize the importance of thinking about a new teaching practice in which teachers rethink their attitudes in educational relationships and make new suggestions for schools. The school assumes the role of training the students of the future and needs to be prepared for issues related to the current scenario and the world in which students live. These issues involve technological, behavioral, and social changes.

Digital Transformation in Education in times of Pandemic

The education sector is one of many sectors affected by the new coronavirus pandemic. According to the World Health Organization [28, 29], Covid-19 is a disease caused by the Sars-CoV-2 virus, which can cause infection, being identified in 2020, therefore, it was classified as a pandemic and due to its form. of fast-spreading infection when meeting an infected person, the security protocol aims to curb the spread of the virus, through the measure of social isolation a priori. However, the development of drugs and vaccines to control this virus are still being developed and studied, although there are already safe vaccines, the mutation of the virus has been a problem for the end of this pandemic, in addition, washing your hands correctly and with frequently, using alcohol gel and masks, help to maintain social isolation, being strategic measures taken as preventive methods to control the spread of the virus [30].

In this perspective, the Ministry of Health, following the criteria of the guidelines of the World Health Organization, presented the measure of social isolation, having a great impact on everyone's daily life. Suddenly, everything changed, and it was necessary to stay indoors. Outside during the quarantine measure, only essential businesses for survival were open, such as pharmacies and supermarkets, in addition, even schools were closed completely, including in Brazil [28].

In this way, Brazilian education has faced challenges in distance teaching and learning, and the implementation of ICTs is of great need, thus favoring the reduction of the impacts of the pandemic on education [31].

Relationship between Environmental Education and Information and Communication Technologies - ICTs

After a separate analysis of the selected category, we will now investigate what has been determined about the relationship between the two cores. Bene et al. [32] presented in their research how effective ICT-based learning strategies can generate a wide range of learning motivation among students, revitalize the educational process and open new ideas for environmental education based on closely related autonomous learning. with internal motivations.

To confirm this information, Bernini [33] brought us: They are optimistic about the integration and use of ICTs in teaching because they consider the motivational aspects, for example, the possibility of making the classroom more interesting, improving the presentation of teaching materials, increase the exchange of knowledge, reducing barriers of time and space, autonomy, and ease of access to information.

In fact, young people from all walks of life use ICTs quickly and carry out educational experiences to encourage the use of technology in environmental education, breaking the paradigm [34]. Morais and Cunha [35] showed that the technology courses of the distance model of the Instituto Federal do Piauí use VLE Moodle and proposed: Moodle is a learning management system (LMS) that facilitates the approximation of the assumptions of the method by providing easy resources learning and social constructivist that provides a user-friendly interface for teachers and students.

They introduce the use of forums and chat features in their research. These resources are socially relevant elements for sharing student records, discussions and resources, files, and links. “It intends to include reflection in the forum for students to express their reflections on the topic” [35]. ICTs have brought the possibility of proximity between subjects with the same goals in different places, allowing dialogue between different cultures and expanding students' horizons of knowledge. Information and communication technologies have been integrated into our daily lives, and the biggest challenge is to incorporate them into the educational process to take advantage of their enormous potential for educational innovation without reducing quality [36].

As shown in Table 1. and Table 2., from the eligible selection criteria for the research included in the method, four articles were selected that presented the main behaviors of adherence to Information and Communication Technologies, the first of ICTs in the pandemic and the second of ICTs in Environmental Education.

Table 1. Table of ICTs used in the Covid-19 Pandemic.

Title	TICs
Moodle System	It allows the creation of discipline pages, workgroups and learning communities, courses, and online classes, available in 75 different languages. The platform is free and accepts videos and various files.
Streamyard	Free online streaming and videoconferencing for lives with one or more professionals. Could be related to YouTube or Facebook.
Google Meet	Application to make online video conferences, with several participants, up to 100 in the free version, with a maximum time of 60 minutes per meeting, in this version.
YouTube	Streaming classes and video repository Platform for sharing videos and streaming content (live or recorded).

Source: [30].

Table 2. Table of ICTs used in Environmental Education.

Title	Author	Year	TICs
From the illusion of movement to the composition of animations: stop motion in the training of teachers.	[37]	2015	Stop motion
The use of educational games as a didactic tool for environmental education in a school in the surroundings of the ecological park of JI-PARANÁ/RO.	[38]	2016	Digital educational games
Use of the forum as a Space for Socio-environmental reflection: a Case Study in the Formation of the Technical Course in the Environment.	[35]	2016	Forum on the AVA platform
Environmental education mediated by Information and Communication Technologies at the Federal Institute of	[39]	2017	Digital educational games

Amazonas – Campus Humaitá.			
The use of information and communication technologies as a didactic resource for the promotion of environmental education.	[40]	2018	Environmental Robotics
Conscious Use of Water Through Information and Communication Technologies (Tics), as a presupposition for Environmental Education	[41]	2019	Video production
MEDIA EDUCATION AT SCHOOL: Challenges in the association between ICT and environmental education	[42]	2020	Podcast
Drones, digital social networks, and environmental education: a teaching-learning proposal in Geography	[43]	2021	Drones

Source: Own authorship.

As can be seen in Table 2, from the total of 17 articles, only eight articles were selected for the final product, due to greater relevance for this study, in addition, all of them are from Brazil, to identify which are the main tools of ICTs used in the scenario of national environmental education, being observed as teaching instruments: Stop motion, educational games, Environmental Robotics, Podcast and Drones.

The Stop motion tool makes use of a sequence of photos taken by a camera and edited on the computer, and a range of materials can be used in the production of images, being common the use of clay, pieces of wood recyclable and related materials, producing a final material rich in movement and environmental and biological knowledge, as in the research by Santos, Modesto and Araújo [36] and also having a similar objective to the production of videos, evidenced in the study by Castro, Ferreira, Cunha and Neto [41].

As digital educational games are programs developed ethically and critically with the aim of transmitting knowledge, such as environmental education through dynamic and fun ways, as in Helbel [38] and Lopes [39]. While Environmental Robotics would be a pedagogical practice of building robots, cars and other projects in a learning environment that uses or not recyclable materials, it is always beneficial for the community to use them in a positive educational way, generating social impact, corroborating with the study by Soares and Vasconcelos [40].

Regarding the use of Podcasts, this is an audio publication tool, which can be of various themes, such as sustainability, climate change and environmental policies, usually with daily or weekly updates for its users, such as Silva and Lima [42] present.

And the drone, this being an unmanned aerial vehicle (UAV) that can be operated remotely, like aircraft, also having a camera stabilization system, you can capture high quality images even in motion and at a considerable height, such as the view from above of a certain stretch of a degraded environment, or in environmental recovery, thus being one of the most useful tools in the teaching and learning of environmental education, as pointed out by Paula and Araújo [43].

Thus, revealing a relevance regarding issues related to the use of technologies in environmental education, noting that although research in the area is still timid, the role of ICTs in promoting environmental education has been expanded with a diversification of tools in a more effective teaching-learning process.

The importance of developing experiences and using new technological resources to diversify and promote changes in teaching is known, and these are not limited to the installation of computers or any other tools in schools. However, the use of technologies appropriates to the content, the dimensions of space and time and the transformation of the classroom into a place where teachers and students can carry out diversified works are related to the knowledge and interests of the students.

However, in addition to promoting a new teaching environment, educational technology also provides appropriate educational practices for people who have long lived in parallel with society. Through these new resources, it is possible to welcome and value differences in the classroom. In addition, we must insist on teacher training and insert these technical resources in a transformative way.

Today's society is surrounded by a high-tech environment, which allows quick access to information and facilitated communication. The new era imposes new requirements for the formation of subjects, which has triggered a reflection on the current education process, that

is, if the teaching methods currently used meet the needs of contemporary society.

In fact, we still have an impasse between schools and teachers who use outdated teaching methods and students from a more active and involved generation, which hurts the expectations of these students. In view of contemporary society, schools need to consider the new information and communication technologies in their teaching practices, as they are essential for the integral development of individuals, including their preparation for living in a high-tech and globalized society.

In short, the way of teaching must be in accordance with the development of society, in this context, teachers need to understand the impact of the correct use of information and communication technologies in teaching practice, strengthen the acquisition of knowledge by students and promote problematization.

From this perspective, it is effective to promote the continuing education of teachers and the improvement of ICTs so that they can rethink their teaching strategies and provide training to.

IV. CONCLUSION

In this sense, the importance of using ICTs currently is notorious, being even more evidenced by the Covid-19 pandemic, proving to be a very effective and diverse tool, with its arsenal of software such as Google Meet and Ava, and tools, such as drones, podcasts, and digital educational games, for example, and accessible in the continuity of education, even remotely. Thus, allowing the emergence of new proposals that minimize losses, due to the democratization of technical and planning resources, directly relating to these new dynamics of teaching and learning.

It is also evident that when we link the formal education process to the technological tools available in the market, the articulation between these centers becomes promising: having environmental education and ICTs, which helps in strengthening the understanding of environmental and social issues. Being stipulated in the National Environmental Education Policy (Law Nº 9,795/99) [44].

However, it is worth noting that the limitations found in the acceptance and recognition of new teaching methods in the subjects involved in the process are remarkable, which makes environmental education a challenge for innovative work in changing habits and cultivating ecologically correct behaviors. In this review, it is possible to notice that environmental education is not neutral, as it is a social practice that acts in the development of an activity with a sense of civic responsibility, therefore, the greater the level of importance of its role in the environment, the greater its impact on environmental education. Thus, promoting positive impacts and improving the relationship between people and natural resources.

Furthermore, science and technology permeate social and cultural relationships. When we link the formal education process to the technical tools available in the market, it becomes very promising to seek the connection between them, thus expanding the possibility of learning and exchanging experiences. Emphasizing the need for environmental education to achieve the proposed objectives in the classroom.

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