



OPEN SCHOOLING FOR DIGITAL EDUCATION WITH SCIENCE AND TECHNOLOGY - REFLECTIONS ON THE EUROPEAN AND BRAZILIAN PUBLIC POLICY PLANS.

ESCOLARIZAÇÃO ABERTA PARA A EDUCAÇÃO DIGITAL COM CIÊNCIA E TECNOLOGIA - REFLEXÕES SOBRE OS PLANOS EUROPEU E BRASILEIRO DE POLÍTICAS PÚBLICAS.

SCHOOLING ABIERTA PARA LA EDUCACIÓN DIGITAL CON CIENCIA Y TECNOLOGÍA - REFLECTIONS ON THE PLANS OF EUROPEAN AND BRAZILIAN PUBLIC POLICIES.

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SUMMARY

How can we enhance projects and initiatives in international partnerships in the area of digital science education? This study examines two current plans of digital education, the European and the Brazilian, identifying differences and similarities highlighted in an analytical framework. The methodological approach was based on the inductive thematic analysis of the gray literature, combined with the documentary analysis of reports of digital educational practices of the Europe-Brazil CONNECT project of open schooling. The results highlight the relevance of three factors: 1. digital scientific educational opportunities with socio-scientific approaches; 2. participatory science and technology such as *design-thinking* and *inquiry mapping*, including emerging hybrid environments with technologies from the clouds (management services) to artificial intelligence (OpenAI - ChatGPT); and 3. local and global partnership to empower digital and scientific skills in the path to sustainability of life and the planet.

KEYWORDS: open schooling. digital education. *design thinking*. artificial intelligence. educational policies.

RESUMO

Como potencializar projetos e iniciativas em parcerias internacionais na área de educação científica digital? Este estudo examina dois planos atuais de educação digital, o europeu e o brasileiro, identificando diferenças e similaridades destacadas num quadro analítico. A abordagem metodológica baseou-se na análise temática indutiva da literatura cinza, combinada com a análise documental de relatos de práticas educacionais digitais do projeto Europa-Brasil CONNECT de escolarização aberta. Os resultados destacam a relevância de três fatores: 1. oportunidades educacionais científicas digitais com abordagens sócio científicas; 2. ciência e tecnologia participativas tais como *design-thinking* e *inquiry mapping*, incluindo ambientes híbridos emergentes com tecnologias das nuvens (gerenciadores) a inteligência artificial (OpenAI - ChatGPT); e 3. parceria locais e globais para propiciar habilidades digitais e científicas rumo a sustentabilidade da vida e do planeta.

PALAVRAS-CHAVE: escolarização aberta. educação digital. *design thinking*. inteligência artificial. políticas educacionais.

RESUME

¿Cómo potenciar proyectos e iniciativas en asociaciones internacionales en el área de la educación científica digital? This study examines the current plans of digital education, the European and the Brazilian, identifying differentials and similitudes highlighted in an analytical framework. The methodological approach is based on the thematic inductive analysis of literature gris, combined with the documentary analysis of the reports of digital educational practices of the Europe-Brazil CONNECT project of schooling abierta. The results highlight the relevance of three factors: 1. digital scientific educational opportunities with socio-scientific approaches; 2. ciencia y tecnología participativas, como el *design-thinking* y el mapeo de indagación, incluyendo entornos híbridos emergentes con tecnologías de la nube (gestores) hasta la inteligencia artificial (OpenAI - ChatGPT); y 3. Local and global associations to foster digital and scientific skills has the sostenibilidad de la vida y del planeta.

PALABRAS CLAVE: abierta schooling. digital education. *design thinking*. artificial intelligence. educational policies.

INTRODUCTION

2023 European Year of Digital Skills.

In today's society and economy, digital proficiency has become essential. It is crucial for social inclusion, personal well-being, civic engagement, career opportunities, productivity, security, and growth. Digital skills are necessary for all citizens, including students from elementary school to higher education. These skills enable them to stay informed, exercise their rights, access online services, communicate, produce, and share digital content.

During this decade, characterized by the transition to social, economic, and environmental sustainability, amplified by digital advancement, we argue in this article that digital education policies should not only embrace technology but also science. By promoting digital science education, we can foster the creation of innovative and creative learning environments that serve as drivers of research and innovation, enabling students to shape sustainable lives and futures.

In Europe, only 54 percent of the population between the ages of 16 and 74 possess basic digital skills, falling short of the European Union's target of 80 percent. The disparities between and within countries underscore the urgent need to take action and improve skills in the green and digital transition. In recognition of this, 2023 has been designated as the European Year of Skills, aiming to catalyze collective efforts for skills development (EUROPEAN COMMISSION, 2023).

In Brazil, the number of people with internet access experienced significant growth between 2019 and 2021. In rural areas, the percentage of households with connectivity increased from 57.8% to 74.7%, while in urban areas, it rose from 88.1% to 92.3% (IBGE, 2022). However, comprehensive digital skills are still primarily accessible to the middle and upper classes.

Law 14.533, enacted on November 1, 2023, establishes the National Policy of Digital Education - PNED, which encourages the development and continuous training of digital skills. Its aim is to enhance the accessibility and utilization of information and communication technologies (ICTs) in education while strengthening digital literacy.

The guidelines of this policy emphasize that digital transformation should prioritize the well-being of individuals and contribute to a fair society and economy. This article argues that educational systems need to support the cultivation of scientific and digital competencies among all citizens. The approach of open schooling, emphasized by these policies, plays a crucial role in providing educational opportunities to people of all ages, including future generations. It prepares them to learn collaboratively and engage in investigative activities,

leading to better decision-making, action, and the overall enhancement of life through science and technology.

Open education through Open Schooling - Definition and Fundamentals.

The concept of "Open Schooling," according to Okada and Gray (2023), focuses on establishing partnerships among various stakeholders, including educators, scientists, professionals, family members, community representatives and policymakers. The objective is to facilitate students' engagement in reflecting on and solving real-world problems that directly impact them and their communities. This approach utilizes existing knowledge acquired in the school context, promoting participatory and democratic technologies and methodologies. Its aim is to enhance students' knowledge, skills, attitudes, and values. This perspective underscores the importance of collaborative work, partnerships, and cooperation for meaningful and authentic education.

The "Open Schooling" approach entails schools, in collaboration with other stakeholders, becoming agents of community well-being. Families are encouraged to actively participate in school life and activities. Professionals from companies, civil organizations, and society at large contribute by introducing real-life projects into the classroom. The goal is to transform individual, collective, and global life for the better, focusing not only on the current generation but also on future ones. This approach aligns with the 2030 AGENDA (UNITED NATIONS BRAZIL, 2015), which aims to improve well-being, sustainability, and a desirable future for all.

The definition of "Open Schooling" was introduced in the report "Science Education for Responsible Citizenship" by the European Union in 2015. It emphasizes the importance of cooperation between schools, families, universities, and companies, enabling students to learn through real-life projects related to issues such as health, environment, safety, and climate change. Initiatives in Europe and Brazil have driven this approach, empowering present and future generations through science and technology (OKADA et al., 2023; OKADA, 2023).

Given the post-pandemic environment and the green digital transition, new priorities have emerged for open schooling. These include establishing partnerships in science and technology across diverse learning environments, building inter-community networks to promote inclusion and diversity, and encouraging engagement in business-funded innovation by supporting startups, SMEs, and entrepreneurs. While open schooling initiatives have fostered tangible partnerships, the CONNECT project, funded by the European Union's Horizon 2020 Research and Innovation Programme, argues for the integration of more opportunities into the national curriculum. All students have the right to engage in digital inclusion integrated into

scientific areas, understanding the impact of science and technology on the world (CONNECT-SCIENCE, 2023a). Okada (2023) highlights four fundamental skill sets for open schooling: scientific inquiry skills, internal (OSI) and external (OSD) sustainability, responsible research and innovation, and the digital transition to innovation.

The objective of this study is to compare and contrast emerging themes between Brazilian and European digital education policies and explore how existing practices in both contexts can be integrated. This exercise will help identify gaps, conflicts, and convergences between policies and practices, as well as between different cultural and geographical contexts. The analysis of open schooling practices conducted within the CONNECT project will contribute to understanding that, despite the differences between the Brazilian and European realities, both are aligned with digital education policies. To provide educational activities that encompass integrated skill sets, it is crucial to understand catalysts and gaps in national and continental action plans.

In this article, we examine recent documents related to policies for digital education: the Brazilian version and the European version. Our findings highlight an integrative framework that offers insights for the context of open schooling. Through a documentary analysis of open schooling practices within the scope of the CONNECT project, we discuss how the integrative framework of policies can assist in proposing and analyzing practices while presenting recommendations.

METHODOLOGY

This study employs a methodology that combines inductive thematic analysis of grey literature with documentary analysis of reports on open digital educational practices. Thematic analysis helps identify patterns and themes within the collected data, while documentary analysis provides access to diverse materials that complement the research. The analysis corpus encompasses the National Digital Education Policy of Brazil (BRASIL, 2023) and the Digital Education Plan of the European Union (EU) Member States (EUROPEAN COMMISSION, 2018; EUROPEAN COMMISSION, 2023). The inductive thematic analysis of grey literature documents was conducted in six phases: data familiarization, initial code creation, theme exploration, theme review, theme definition and naming, and a comparative report between the Brazilian and European versions of the documents (BRAUN; Clarke, 2006).

Documentary analysis, as emphasized by Gil (2007), plays a crucial role in contributing elements to understand diverse contexts. In this research, this approach is employed to examine public documents on open schooling practices in the Sustainable Regional Community of Tupé

in the Brazilian Amazon (CONNECT-SCIENCE, 2023b). Additionally, it includes studies conducted on the Yanomami indigenous community in the Amazon, developed by students in the United Kingdom and summarized in the poster "Protecting Life in The Amazon," presented at the Open University (UK) for the European Community and Countries on March 28, 2023 (CONNECT-SCIENCE, 2023c). This documentary analysis serves as a valuable tool for comprehending the guidelines of digital education and their implementation across various contexts. By conducting inductive thematic analysis and documentary analysis, connections and differences between digital education policies and their effective application in different geographical and cultural contexts can be highlighted. This encompasses topics such as digital inclusion, technology integration in education, access to open digital resources, and student engagement with digital technologies.

The interpretative analysis of the results employed the 5W2H method (what, why, when, who, where, how, how much) to enhance understanding of the policies, addressing questions such as: What is it? Why is it needed? Where were they implemented? Who are the actors and beneficiaries? How were the objectives achieved? And how much or what resources are involved?

To analyze policy documents, a SWOT analysis was conducted to identify strengths, weaknesses, opportunities, and threats. The gaps between Brazilian and European policies were examined, and recommendations were formulated for public managers. Additionally, a documentary analysis of Brazilian and European practices was carried out, discussing their alignment with digital education policies.

Ethical Considerations

The gray literature and the documents analyzed in this study are comprised of publicly available materials. The identification and handling of sensitive empirical data have been carefully maintained to ensure privacy and confidentiality.

Methodology Limitations

It is important to acknowledge certain limitations in our methodology. The gray literature from the European Union may contain inherent biases, as the latest version analyzed was published in 2018, and significant technological advancements have occurred since then, particularly due to the global pandemic. Additionally, a new document published by the European Union that complements the original document in force has been considered, which provides additional insights.

FINDINGS

European Document

According to the document titled "Communication from The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions," which pertains to the Digital Education Action Plan, dated 18/01/2018 and updated on 18/04/2023, the European Commission has outlined comprehensive digital education policies in a roadmap for Europe. The objective of this plan is to leverage the potential of digital technologies in the field of education (European Commission, 2018; European Commission, 2023).

One of the key priorities of the policies is to develop a robust Information and Communication Technology (ICT) infrastructure, while empowering students with essential digital skills. The objective is to ensure that all students, regardless of their demographic and socioeconomic background, can benefit from technological advancements in education. This involves enhancing access to ICT infrastructure and improving internet connectivity in schools. The European Union (EU) plans to release a significant study to evaluate the progress made in integrating ICT into education.

Another crucial focus is on fostering digital skills among both students and teachers. Empowering teachers is essential for the successful integration of digital education into existing curricula. The aim is to equip educators with the necessary skills to effectively utilize digital tools in teaching and learning, as well as to guide students in acquiring digital literacy. This includes redesigning curricula to incorporate more digital learning and updating the Digital Competence Framework.

The policies emphasize the utilization of emerging technologies such as artificial intelligence and big data analytics, which provide new opportunities to capture, analyze, and leverage data for educational improvement. These technologies will be leveraged to enhance teaching and learning effectiveness through personalized learning initiatives that cater to individual student needs. To ensure the efficacy of these approaches, pilot projects and testing programs will be implemented to evaluate various digital teaching strategies.

The promotion of open science is strengthened through targeted training in higher education institutions for students, researchers, and educators at all levels. This measure aims to make the scientific research process more inclusive and transparent, fostering greater knowledge sharing and collaboration between the academic community and the general public. This can accelerate scientific progress and enhance public trust in science.

Regarding open schooling, the EU strategy involves the creation of a European platform for digital higher education and increased cooperation. Supported by the Erasmus+ program, this platform aims to serve as a comprehensive resource, offering online learning, blended mobility, virtual campuses, and the exchange of best practices among higher education institutions. This initiative underscores the EU's commitment to democratizing education by making it accessible to a wider audience, regardless of geographical location.

Educators play a crucial role in implementing these policies and integrating digital education into their teaching practices. To support them in this endeavor, the policies provide adequate training and support, enabling them to guide students in acquiring digital skills effectively.

The policies are applicable to all types of educational institutions within the European Union, including primary schools, secondary schools, universities, and vocational training centers. The goal is to ensure that all students, irrespective of their education level, have access to quality digital education. There is a particular focus on addressing areas and groups that are at risk of being left behind in the digital transformation. This includes rural and disadvantaged communities, schools with limited resources, and vulnerable groups such as the elderly and people with disabilities. Simultaneously, special emphasis is given to areas where digital education can have a significant impact, such as teacher training and personalized learning.

In the most recent document (2021-2027), which builds upon its predecessor, it is recognized that the Covid-19 crisis has had a profound impact on education and training, catalyzing change and presenting new learning opportunities. The pandemic has facilitated the strengthening of digital education by providing greater access to technology in teaching and learning. Technology is viewed as a crucial tool for promoting collaborative and creative learning that is personalized, flexible, and student-centered. It enables students and educators to create, construct, and share digital content. Moreover, it transcends the limitations of physical location and calendar, allowing learning to occur beyond traditional environments such as classrooms, conferences, or workplaces. Learning can be conducted entirely online or in a hybrid format, combining face-to-face and online elements, adapting to each student's individual needs in terms of time, place, and pace.

The document emphasizes the significance of a solid and scientific understanding of the digital world. It highlights two priority areas:

1. Promoting the development of a highly effective digital education ecosystem: This entails fostering an environment that nurtures digital education at all levels. It involves the integration of advanced technologies, pedagogical approaches, and

digital resources to create a comprehensive and efficient digital education system. This ecosystem aims to facilitate seamless connectivity, efficient information exchange, and collaborative learning opportunities among students, educators, and relevant stakeholders.

2. **Strengthening digital skills and competences for digital transformation:** Recognizing the importance of digital skills in the era of digital transformation, this priority area focuses on equipping individuals with the necessary competences to thrive in a digital society. It emphasizes the development of a wide range of digital skills, including but not limited to information literacy, critical thinking, problem-solving, creativity, digital citizenship, and cybersecurity. The goal is to empower individuals to effectively navigate, utilize, and contribute to the digital world, enabling them to adapt to evolving technological landscapes.

By addressing these priority areas, the document aims to foster a dynamic and inclusive digital education environment that prepares individuals for the challenges and opportunities of the digital era. It underscores the importance of leveraging technology to enhance learning experiences, foster digital competences, and promote lifelong learning in a rapidly changing world.

Brazilian Document

On January 11, 2023, the Government of Brazil (BRASIL, 2023) passed Law No. 14,533, establishing the National Digital Education Policy (PNED). The PNED aims to enhance public policies that facilitate access to digital resources, tools, and practices for all Brazilians. It is a collaborative effort involving multiple sectors of society, with the goal of fostering inclusion for all citizens. This legislation addresses the challenge that many students and educators currently face, as they lack the necessary digital skills and access to fully utilize Information and Communication Technologies (ICTs). In an increasingly technology-driven world, it is crucial for both students and educators to have adequate access to these tools and be able to use them ethically, efficiently, and responsibly to improve the teaching and learning process.

To address these issues, the PNED focuses on four key areas:

a) **Digital inclusion:** Ensuring equitable access to ICTs for all individuals, eliminating socioeconomic and geopolitical barriers, and providing equal opportunities for everyone to benefit from ICTs.

b) **Digital education in schools:** Incorporating digital education into all levels and types of educational environments, promoting digital literacy among students and educators. This

involves developing the necessary skills to effectively utilize ICTs for educational purposes, enabling greater autonomy and quality in knowledge construction.

c) Digital training and specialization: Empowering educators with the competencies required to integrate ICTs effectively into their teaching practices. This includes identifying the digital skills necessary for employability and offering practical workshops for teacher training to create new digital academic experiences.

d) Research and development in ICTs: Encouraging research and development in ICTs, particularly those applicable in the educational context. It is essential for education to keep pace with technological advancements and continuously develop new approaches to digital learning.

Implementing the PNED will require collaboration and coordinated efforts from various stakeholders. Students and educators, as the primary beneficiaries, will need to adapt to new digital teaching and learning practices. Educational institutions will be responsible for integrating this policy into their daily operations, which may involve implementing new technologies, organizing educator training, and promoting digital literacy among students.

The government at different levels (federal, district, state, and municipal) will provide the necessary funding for policy implementation and oversee its progress through supervision and evaluation. The ICT industry will play a vital role in providing technologies, conducting research and development, and forming partnerships with educational institutions and the government.

The implementation of this law will encompass the entire country of Brazil, covering all educational levels. Special attention will be given to groups that currently face limited access to ICTs, such as individuals from disadvantaged socioeconomic backgrounds, residents of rural and remote areas, and marginalized groups including the poor, elderly, and disabled.

To finance the implementation of the PNED, resources will be sourced from various outlets, including public administrations at all levels and private initiatives. The effective management of these resources will necessitate ongoing monitoring and evaluation, ensuring their efficient utilization and adapting resource allocation based on lessons learned.

Comparisons between the Brazilian and European versions.

The Brazilian (BR) and European (EU) policy plan documents are compared, and the essential information is presented and analyzed in the following tables (Tables 1, 2, 3, and 4). Additionally, these tables highlight supplementary elements from the latest European document, titled 'Action Plan for Digital Education 2021-2027,' dated 18 April 2023.

Table 1 - Comparative table: Digital Inclusion.

Policies	BR	EU
1. Promoting digital and information skills, raising awareness of their importance, and encouraging the use of online self-diagnostic tools to identify strengths and weaknesses in digital, technical, and pedagogical areas.	x	x
2. Providing training in digital, media, and information skills, promoting certification processes for digital competencies, and updating competencies, including those related to AI (Artificial Intelligence).	x	x
3. Supporting the development and accessibility of digital resource platforms and repositories.	x	x
4. Ensuring the implementation and integration of connectivity infrastructure for educational purposes, aiming for universal connectivity in schools with reliable equipment and quality internet access.	x	x
5. Addressing the connectivity gap by advocating for the adoption of high-capacity broadband in all schools and supporting initiatives like Connectivity4Schools.		x
6. Implementing and promoting an ecosystem of digital educational content, while emphasizing digital literacy and combating disinformation through education and training.	x	x
7. Advocating for data policies that include mobile access for teachers and students.	x	

Source: PNEB (BRAZIL, 2023), Digital Education Plan (EUROPEAN COMMISSION, 2018; EUROPEAN COMMISSION, 2023).

Table 2 - Comparative table: Digital School Education.

Policies	BR	EU
1. Developing digital skills for students in basic education to enable responsible performance in the connected society and in digital and online environments, with a focus on stimulating interest in careers related to innovation.	x	x
2. Promoting pedagogical projects and practices, including programming, ethics applied to the digital environment, media literacy, and citizenship in the digital age	x	x
3. Adopting accessibility criteria, with special attention to the inclusion of students with disabilities, including those from disadvantaged groups.	x	x
4. Diagnosing and monitoring Internet access conditions in education networks.	x	x

5. Addressing the connectivity gap among EU Member States concerning the adoption of very high-capacity broadband.		x
6. Creating a platform for digital higher education and enhancing cooperation.		x
7. Strengthening open science and citizen science, including artificial intelligence and providing training involving 45% of women.		x
8. Offering coding classes to all schools.		x
9. Addressing the challenges of digital transformation through an online security awareness and media literacy campaign.		x
10. Supporting measures to close the gender gap in the technology and entrepreneurship sector and combat gender stereotypes.		x
11. Promoting extension, undergraduate, and postgraduate courses in digital skills applied to the industry in collaboration with other sectors.	x	
12. Encouraging cooperative partnerships involving higher education, non-formal education, as well as industrial and educational research.	x	x
13. Promoting teacher training in digital skills for digital citizenship and technology use in various training areas.	x	x
14. Promoting digital technologies as tools and programmatic content in continuing education courses for managers and education professionals	x	

Source: PNEB (BRAZIL, 2023), Digital Education Plan (EUROPEAN COMMISSION, 2018; EUROPEAN COMMISSION, 2023).

Table 3 - Comparative table: Theme Training and Digital Specialization.

Policies	BR	EU
1. Identification of the digital skills needed for employability and the training of digital skills in education and professional career	x	x
2. Implementation of courses related to digital competencies, both in professional education and in higher education.	x	x
3. Compilation and dissemination of data and information to analyze and anticipate emerging competencies in the world of work.	x	x
4. Strengthening and expanding the network of master's courses and doctoral programs specialized in digital skills.	x	x
5. Consolidation of networks of training centers and laboratories that provide training in digital skills in various spaces.	x	x
6. Promotion of teacher training with a focus on computing fundamentals and emerging and innovative technologies.	x	x

7. Stimulating the creation of <i>bootcamps</i> and promoting digital literacy and combating misinformation through education and training	x	x
8. Creation of repository of good teaching and learning practices.	x	x

Source: PNEB (BRAZIL, 2023), Digital Education Plan (EUROPEAN COMMISSION, 2018; EUROPEAN COMMISSION, 2023).

Table 4 - Comparative table: Theme Research and Development in Information and Communication Technologies.

Policies	BR	EU
1. Encouraging scientific, technological and innovation research for accessible and inclusive ICTs.	x	x
2. Promotion of partnerships between different institutions, national and international, to boost the emergence of new technologies and applications aimed at digital (scientific) inclusion.	x	x
3. Encouraging the generation, organization and sharing of scientific knowledge in a free, collaborative, transparent and sustainable way (open science).	x	x
4. Sharing of digital resources between scientific, technological and innovation institutions and good practices with emerging technologies.	x	x
5. Creation of a strategy for training and requalification of teachers in ICTs and enabling technologies.	x	

Source: PNEB (BRAZIL, 2023), Digital Education Plan (EUROPEAN COMMISSION, 2018; EUROPEAN COMMISSION, 2023).

Case Study 1: Open schooling for community-school partnerships.

The program "*Inquiry Mapping with design thinking to develop a school community's agenda for the sustainable development of the Village of Tupé*" (CONNECT-SCIENCE, 2023b), launched by the collaborators of the CONNECT project, sought to support the co-creation of a diagnostic agenda for a community action plan with the Sustainable Development Reserve of Tupé. This reserve is composed of five communities: Livramento, Julião, Agrovila, Tatulândia, Central and São João do Tupé, which are served by a single municipal elementary school located in the riverside community of São João, where most of the research activities were carried out.

This is an open schooling practice, carried out between 01/10/2022 and 30/11/2022, by several representatives of the CONNECT project, including the Federal University of Amazonas (UFAM), University Center of Brasilia (CEUB), Institute of Higher Education of

Brasilia (IESB), APAN, NGO Anjos Digitais, IRAMA, REDA, Action Against Hunger and Fama Soluções. It had the direct involvement of 10 CONNECT members (experts from various fields, including computer science, community psychology, education policy, and enterprise, who together provided a multifaceted learning environment) and 15 more members of the local community, including adults and children, ages 2 to 15. The initiative followed a collaborative path aimed at sustainable, inclusive and educational development.

The results of open schooling allowed the community to map several challenges to include in the agenda: lack of teachers or high turnover, absence in the classroom in the face of difficulties in access to health, environmental and climatic problems that hinder access to school, student dropout, high teacher turnover, lack of secondary school in the community, difficulties related to infrastructure and technology that hinder school performance (needs inherent to adequate cooling and ventilation, quality internet signal, adequate lighting, resumption of river transport for students, among others). Amid the challenges, important opportunities were identified, such as the development of ecotourism, the production of sustainable local products, the use of alternative energy and the expansion of open schooling.

Throughout the initiative of practical application of open schooling, several activities were carried out, such as individual diagnostic interviews, individual and group conversational dynamics, as well as local visits. The conversations allowed a dynamic and authentic dialogue between the participants, allowing the expression of feelings, perceptions, and personal experiences.

The group conversational dynamics carried out in the social space of the school and during the local visits proved to be a powerful instrument in detecting the needs of the community and proposing viable solutions. Inspired by the active methodology of Design Thinking, the CONNECT group stimulated a collaborative dialogue between students, teachers, parents, community members, and researchers in the field of education. This dynamic aimed to generate solutions to school and community problems, anchored in collective reflection. The main challenge was to encourage the design of future solutions for schooling, especially regarding the classroom space.

Participants were motivated to question current educational models and to devise a prototype classroom of the future. The children alternated between digital and artistic activities, even with the unstable internet, creating drawings that represented solutions to the problems discussed. The practice of open schooling has generated a significant impact on the community, fostering discussions, with the identification of local problems and opportunities, as well as the

co-creation of solutions. According to Campolina (2012), in the innovative process, there are historical-subjective changes that configure the context, making it favorable to innovation.

Based on the theory of subjectivity of González Rey (MITJÁNS MARTÍNEZ; GONZÁLEZ REY, 2017), the theoretical model, which was built from qualitative epistemology and the interpretative constructive method, allowed the research team to identify the emergence of subjective meanings of belonging and union among the members of the group, in order to fight for common sustainable goals. The individual subjective configuration manifested by the participants demonstrated the personal motivation to learn, innovate, and transform, while the subjective social configuration highlighted the collective empowerment in the struggle for common interests for sustainable development.

The initiative has also had a significant impact on the approach to formal education in the region. The concept of open schooling, which is based on the idea that learning should not be restricted to the school environment and should involve the wider community, was well received. It is believed that the practice can be reused and adapted in other community programs and projects, potentially creating a positive impact, whether in Brazil or in other parts of the world.

Case Study 2: Open schooling for the protection of life and biodiversity.

In 2023, six female students, four of British nationality and two of Brazilian nationality, all residing in the United Kingdom and aged between 12 and 15 years, along with two mothers, an educator, and a researcher, came together to explore biodiversity, environmental protection, and indigenous peoples. The study, conducted outside the school curriculum, challenged students to research knowledge related to the protection of the Amazon, particularly focusing on forest preservation and the Yanomami indigenous community, which is threatened by illegal exploitation of precious metals in environmental reserves, such as gold mining.

The methodology followed the DigComp Framework (EUROPEAN COMMISSION, 2023), covering areas such as information literacy, communication and collaboration, digital content creation, security, and problem-solving.

The pedagogical techniques adopted, based on the CARE-KNOW-DO pedagogical model, included Inquiry-Based Learning (IBL), Web Learning (WBL), Artificial Intelligence (IABL), Projects (PBL), and the construction of investigative concept maps. These techniques emphasized learner autonomy, in-depth understanding, and the practical application of knowledge (OKADA; SHERBORNE, 2018), (OKADA; GRAY, 2023), (OKADA et al., 2023).

Students were central to the process, exploring topics, cooperating on projects, and personalizing learning through technology. Learning linked to real-life challenges and valued

critical thinking and collaboration, increasing student engagement. The findings were compiled into a digital repository, with each new piece of information leading to a partial answer to the proposed questions, fostering a collaborative environment.

At the end of the project, they created an investigative concept map titled "Protecting Life in the Amazon," which included drawings made by the students, photographs taken with cell phones featuring texts and elucidative images, and questions formulated by the participants. These questions included: "Can we protect the forest and its animals?", "Which beings are in danger?", "What happened to the Yanomamis?", "What could be the consequences for Earth without the Amazon rainforest and its peoples?", "Where can I find reports on indigenous lands?", "How can the wisdom of the natives be valued?", "As students and scientists, both in Brazil and the UK, could we protect the Amazon?", "What are the climate issues present in the Amazon?", and "How can science and technology help us?" This approach not only facilitated effective knowledge absorption but also contributed to the creation of a collaborative and questioning educational space.

Acquiring knowledge about the Amazon, its biodiversity, indigenous culture, and climate impact is of great relevance in the open schooling of European children and adolescents. This knowledge strengthens global citizenship, promotes the appreciation of cultural diversity, encourages critical thinking, and raises awareness about the influence of countries themselves on global environmental policies. Additionally, it enables an interdisciplinary learning approach, developing crucial skills to address the complex challenges of our globalized world. Therefore, purposeful study (focused on the Amazon and its peoples) is a powerful pedagogical tool to prepare young people for a sustainable and interconnected future.

The group of participants in the practice was invited to present their work at the Green Forum on March 28, 2023, at the Open University (UK) for the European Community and member countries.

DISCUSSION

Upon comparing the policies, some relevant points for discussion emerge. A strength of European policies is the cooperation among the nations that make up the European Union (EU). Cooperation is a crucial element for the successful implementation of these policies. Sharing best practices and collaborating to address challenges that transcend national boundaries will be encouraged. This joint effort will allow countries to learn from each other and develop effective strategies to overcome obstacles related to the digitization of education, thereby fostering more robust projects, technical cooperation agreements, and investments.

The EU strategy places a greater emphasis on security by highlighting the importance of addressing the challenges of digital transformation through awareness campaigns and educational initiatives on online security, cyber hygiene, media literacy, and critical training for the use of artificial intelligence. These actions aim to ensure that individuals are equipped with the skills and knowledge needed to navigate the digital world safely, responsibly, and in a scientifically innovative way.

Another point that the EU strategy seeks to emphasize is diversity more broadly. It highlights the goal of closing the gender gap in the technology and entrepreneurship sector by promoting digital and entrepreneurial skills among females. These measures aim to create a more inclusive and egalitarian environment by encouraging female audiences to actively engage in the field of technology and take advantage of the opportunities offered by the expanding digital economy.

In parallel, Brazil has made efforts to make Information and Communication Technologies (ICTs) accessible and inclusive for all. These efforts are supported by Brazil's extensive experience and knowledge in ICT infrastructure. VSAT technologies powered by solar energy, fiber optic networks, and the reinforcement of internet connectivity with investments in 5G technology for urban centers, human capital, and the promotion of digital integration are important aspects of this process that Brazil has been working on but needs to accelerate. The PNED – National Policy for Digital Education (BRASIL, 2023) is a vital component, focusing on ensuring the necessary resources for high-speed internet access for all public education institutions, which is crucial for the effective implementation of education and digital inclusion. Understanding the characteristics and specificities of each location and the needs of school users is fundamental for resource allocation strategies. To this end, Brazil needs to invest in Big Data and Analytics solutions, as well as make robust investments in cybersecurity.

The PNED faces significant challenges due to Brazil's vast territorial extension and associated infrastructure difficulties, which demand greater investments to provide quality internet signals. In addition, inefficient and insufficient allocation of resources across the country in the budget by the National Congress and delays in the process between specification and installation of ICT resources in schools, coupled with rapid technological obsolescence, are pressing issues that require solutions.

The PNED includes the execution of projects for the development of digital skills and the incorporation of innovative teaching methods. It is also crucial to refine digital skills among youth and adults. These skills are vital for an increasingly technological work environment and

to open up new job and career opportunities. However, the lack of basic digital skills among a significant portion of the population may slow the implementation of this policy and widen the digital divide. Developing these skills among young people can open up new career opportunities and enable full participation in the green digital economy (for sustainability). However, the rapid evolution of technology can quickly render these digital skills obsolete, necessitating ongoing updating and training.

The PNED emphasizes the development of competencies for professionals in educational institutions, offering training programs aimed at managers and teachers to effectively integrate ICTs into education. Alongside the need for continuous updates due to technological advancements, challenges include a shortage of teachers in schools and limited time within their schedules to participate in training programs.

The PNED aims to stimulate the generation, organization, and sharing of scientific knowledge in a free, collaborative, transparent, and sustainable manner. It also promotes research and innovation in ICTs, encouraging the sharing of digital resources and open science, including collaboration with Scientific, Technological, and Innovation Institutions (ICTs). However, progress can be hindered by limited funding and bureaucratic barriers. The law also contemplates international partnerships, which can accelerate ICT advancements and enhance Brazil's global position in terms of innovation.

It is imperative to ensure effective evaluation and establish clear targets for policies. The absence of clear parameters and indicators for evaluating digital education can lead to inconsistencies and impede the effective implementation of digital education policy and the efficient allocation of resources. Overcoming these challenges is fundamental to the success of the National Policy for Digital Education. Sustainable financing models, driven by shared interests, can lead to significant investments in education quality.

To finance these actions, the law provides for the use of various sources of funds, including budget allocations, donations, international agreements, and public-private partnerships. However, reliance on external funding and the absence of a sustainable budget can limit resource availability.

Therefore, overcoming these challenges will be decisive in ensuring the success of the PNED. By surmounting these obstacles, Brazil will be better positioned to leverage the opportunities that ICTs offer, enabling significant advancements in digital inclusion and education quality.

The open schooling project, Case Study 1, which focuses on open schooling in the Tupé Sustainable Development Reserve, serves as a compelling example to grasp the influence of

digital education policies in Brazil. It involves the community in the educational process and addresses infrastructure and access barriers that the policy aims to overcome. The initiative promotes digital inclusion as a means of strengthening the community and fostering sustainable development. The participation of students and the community in identifying problems and co-creating solutions exemplify the active and engaging education vision that the digital education policy seeks to promote. The impact of the initiative, the acceptance of open schooling, and its potential applicability in other community projects demonstrate the effectiveness and relevance of the PNED – National Digital Education Plan, suggesting its contribution to sustainable development and digital inclusion in diverse communities.

The practice of open schooling, Case Study 2, which focuses on open schooling through research on the protection of the forest and indigenous peoples (their guardians), serves as an excellent example to comprehend the influence of the digital education action plan in the European Union. It is evident that students have developed digital skills, promoted digital inclusion among adults, improved information and data search literacy, enhanced communication, and collaboration abilities, created digital content, exercised caution regarding safety, and demonstrated problem-solving skills.

The pedagogical approaches employed, including inquiry-based learning, web utilization, artificial intelligence, design principles, and concept map construction, have stimulated critical thinking, collaboration, and student autonomy. Raising students' awareness of social and environmental issues, such as the protection of indigenous peoples (Yanomami) and environmental preservation (Amazon), aligns with the European Union's vision of promoting global citizenship. The practice also fostered collaboration and the exchange of findings, questions, and reflections among students, promoting interdisciplinary learning and the development of digital skills necessary to address global challenges.

The presentation of the students' work in a forum at the Open University (UK) underscores the importance of sharing the results of educational projects and promoting the exchange of knowledge among different regions and countries. In summary, this practice exemplifies the connections between open schooling and the European Union's Digital Education plan by fostering digital skills, student engagement, environmental awareness, and global citizenship.

FINAL CONSIDERATIONS

This study underscores the importance of three key elements in promoting digital and scientific skills for global sustainability.

Firstly, educational opportunities that integrate socio-scientific approaches are crucial as they facilitate a contextualized understanding of digital and scientific phenomena. Participatory science and technology methods, such as design-thinking and inquiry mapping, coupled with hybrid environments incorporating cloud technologies and artificial intelligence, constitute the second fundamental dimension. These provide an innovative foundation for problem-solving and decision-making. Lastly, local and global partnerships are indispensable, forming the third element, catalysing the exchange of knowledge and advanced practices, and uniting global perspectives to address local challenges.

Collectively, these three elements serve as a potent vector for a sustainable future through digital and science education. Further studies should be conducted to align digital educational policies with practice and evaluate implementation strategies at both macro and micro levels. The involvement of all stakeholders is crucial to ensure that policies effectively translate into action, shaping a sustainable digital educational reality.

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