

MAKER CULTURE AND DIGITAL TOOLS IN REMOTE TEACHING: ACTIVE METHODOLOGIES FOR SCIENTIFIC LITERACY AND COMBATING DISINFORMATION



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ABSTRACT

During the COVID-19 pandemic, remote learning demanded rapid adaptation and continuous innovation in the educational environment. This paper examines how scientific-technological advances and digital tools have been incorporated into remote teaching through the active methodology of "maker culture". A literature review was conducted to evaluate this approach, highlighting Information and Communication Technologies (ICT) and their impact on basic education. While implementing these technologies offers innovative educational solutions, it still faces considerable challenges, such as a lack of infrastructure and resistance from some educators. The pandemic caused by the SARS-CoV virus has also intensified the spread of fake news and disinformation, highlighting the need for the population to actively play a role in building their own knowledge. In this context, the elective course "Learning Club" was aimed at combating misinformation and training elementary school students with tools to verify the veracity of information circulating on social networks. The project introduced academic methodologies in combating the dissemination of fake news, and students from the municipal network of Fortaleza participated in the creation of a banner presented at the X Municipal Science Fair, promoting the experience and understanding of scientific dissemination. Thus, the project has proven to be a vital tool in combating fake news, particularly among young people, in addition to encouraging new generations to go on to higher education, reinforcing the importance of student protagonism and the development of critical skills to confront misinformation.

Keywords: Active methodology. Maker culture. Literature review. Fake news. Student protagonism.

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INTRODUCTION

During the COVID-19 pandemic (caused by the SARS-CoV-2 virus), several challenges emerged in the economic, educational, and health spheres, highlighting the importance of scientific and technological advances to mitigate its impacts. In the Brazilian context, the educational model had to be profoundly reformulated in order to minimize the negative effects of the pandemic on children and young people. Measures such as social isolation, the use of masks, and the implementation of remote teaching were strategies adopted in the short and medium term to ensure the continuity of the educational process. Faced with this scenario, not only the education system, but also teachers and students had to adapt quickly to the new requirements imposed by the health crisis. (Schlemmer, 2021)

In this challenging scenario, the use of digital technologies and innovative methodologies have become essential to reduce harm in both the psychosocial and educational spheres. Such a scenario highlights the need for a multidisciplinary analysis of the impact of these technologies on education, as highlighted by . The advent of Information and Communication Technologies (ICT) has brought a new configuration to the educational environment, providing alternative teaching mechanisms that expand the methodological possibilities beyond the traditional model. These tools not only diversify pedagogical practices, but also foster the active construction of knowledge by students, giving them a more autonomous and protagonist role in the teaching-learning process (Moraes et al., 2021). Moraes and collaborators (2021)

Collaboration, sharing and democratization of access to digital technologies are principles of the *maker* culture in education and materialize in the development of projects and problem solving, constituting important elements for the construction of scientific literacy in Basic Education. The *maker* movement, which had its essays signaled in the 1970s, with the DIY movements, directly influenced education from the 2000s onwards (Carvalho, 2024).

However, it is important to note that, although Information and Communication Technologies (ICT) and movements related to *maker* culture offer significant solutions to the teaching and learning process, their global implementation still faces considerable challenges. Among the main difficulties, the lack of investment in technological infrastructure stands out, which prevents many schools from providing even basic devices

that enable the immersion of teachers and students in the various opportunities provided by ICT (Lima *et al.*, 2021).

In addition, a critical factor to be considered is the resistance of some education professionals to adhere to these technologies and new perspectives of knowledge construction in their teaching methodologies. Since, after a long time understanding education from a content-based perspective of accumulating knowledge quantified by evidence, many education professionals "are concerned with the ways in which creative activities relate (or not) to existing curricula and/or lead to the development of conceptual understandings". (Vossoughi; Bevan, 2014) This resistance can be attributed to various factors, such as the lack of continuing education, difficulties in handling digital tools, and even traditional pedagogical conceptions that do not consider technology as an essential resource for learning (Lima, 2021).

In order to promote the active participation of students who have gone through a long period of social isolation and passive learning, pedagogical practices that promote student protagonism become increasingly necessary, considering that the student is the central subject of the educational process. Promoting student protagonism and stimulating self-knowledge are fundamental strategies for the formation of critical and independent citizens. Unfortunately, studies point to the possibility of the emergence of new pandemics in the future, including variants of the SARS-CoV-2 virus (coronavirus) itself, which reinforces the importance of student autonomy in the construction of their knowledge. Given this scenario, the development of digital skills is essential for students to know how to filter, interpret, and validate information, especially in times of health and social crisis (Ferreti *et al.*, 2004) SDGS, 2023)

Another crucial point that underlies and justifies the development of this project is the significant increase in the spread of disinformation during the COVID-19 pandemic. The term *fake news*, originating in the English language, refers to false or distorted news, often disseminated with the intention of manipulating public opinion. During the pandemic, thousands of *fake news* were disseminated, many of them related to ineffective treatments against COVID-19, and one of the most emblematic examples was the spread of the idea that chloroquine, a drug used to treat malaria, would be effective against SARS-CoV-2. This information was widely disseminated in various media, including by figures of high public representation, who used official government vehicles for dissemination. However, subsequent scientific studies proved that chloroquine was not effective against the virus, in

addition to presenting health risks when used without medical indication (WHO, 2020). (SILVA; PENA, 2021) Therefore, the promotion of a pedagogical practice that provides the student with digital knowledge to search for official information from scientific articles (peer-reviewed and published in specialized journals) in reliable databases is the main justification that directly impacts the relevance of this project: the autonomy and knowledge to obtain information from the correct sources.

In order to implement official research strategies widely used in higher education, as well as to foster the *maker culture*, the following pedagogical practices were carried out: investigation and obtaining of scientific articles in official databases (CAPES Journal Portal) and elaboration of works with graphic design on digital platforms (*Canva* and *Microsoft Powerpoint*). The method basically consists of a practical methodology of scientific work known as literature review (Vossoughi; Bevan, 2014)

The teachers of the Municipal Department of Education (Fortaleza City Hall) applied an essential teaching methodology for the formation of critical and scientific thinking, and this approach aims not only to develop the investigative competence of students, but also to enable them to critically analyze reliable scientific sources, for this purpose digital platforms were presented to obtain scientific articles and reliable publications (official databases for search for articles published in specialized journals), and digital resources for the construction of graphic elements such as banners, folders, and posts for social networks (**Figure 1**).

Figure 1: Databases and digital platforms: Scielo, CAPES Journal Portal, Virtual Health Library, ScienceDirect, PubMed, Google Scholar, Microsoft PowerPoint, and Canva.



The databases for researching scientific articles and the tools for producing graphic resources were presented to students in the teaching practices of the "Learning Club" to investigate the scientific bases that underlie the technological resources used for remote teaching during the pandemic. **Source:** Prepared by the authors.

In order to provide a new teaching-learning modality, the work was implemented based on the *maker* culture, one of the most up-to-date and revolutionary active methodologies, in which the student is challenged to produce informative material, be it a song, a video, a post on social networks, among others. In summary, active methodologies are characterized by offering the teacher theoretical support so that he can make teaching proposals, providing opportunities for situations that lead the student to be able to be the protagonist of his own learning. It is also worth mentioning other modalities, such as: problem-based learning (PBL), peer learning, case study, hybrid teaching, flipped classroom, mock jury, debates, verbalization and observation groups, games, integrated panel, and thematic projects (Jesus, 2021).

DESCRIPTION OF THE EXPERIENCE

The students of the "Learning Club" discipline participated in weekly meetings aimed at familiarizing themselves with databases widely used in academic research and higher education, such as *SciELO*, *ScienceDirect*, *PubMed*, CAPES Journal Portal and Google

Scholar. In this way, the initiative provided students with the opportunity to explore essential tools for the search and validation of scientific information. The principles of *maker* culture, such as collaboration in the classroom, sharing and democratization of access to digital technologies, were developed in this work.

The research was guided by the following problem: "To combat false sources and *fake news*, in which databases is it possible to safely obtain scientific information about the sciences responsible for the digital tools of remote teaching?" This questioning reflects the need to develop students' information literacy, promoting their autonomy in identifying verified scientific content and reducing their vulnerability to misinformation. In a scenario where the dissemination of *fake news* represents a global challenge, especially in the educational and scientific context, this initiative is a fundamental instrument for the formation of critical and well-informed citizens.

In this scenario, inquiry-based education is based on inspiring participants' interest, fostering engagement, developing understanding of the processes and concepts at the heart of creative activities, and supporting students' identities as thinkers, creators, and producers of knowledge. (Vossoughi; Bevan, 2014)

Tools that strengthen the context of education were investigated, especially in the midst of situations of social isolation, helping teaching practice in basic education (Santos, 2018). Specifically, the scientific bases that underlie the following technologies were investigated:

- Instant messaging system (*Whatsapp*);
- Collective video call system (*Google Meet*);
- Content and activity management system (*Google Classroom*);
- Digital video platform (*Youtube*);
- Data search and research system (*Google* and *Wikipedia*);
- Form-driven assessment platform (*Google Forms*);
- Digital Internet Connection Signals: Wireless Networks and 3G/4G Signals

Based on the challenge established to respond to the initial problem, the research group of the "Learning Club", coordinated at the Frei Lauro Schwarte Municipal School by teachers Antonio Neto and Natália Chaves, and composed of 10 students from the 9th grade of elementary school, developed a literature review work, compiling the main

technologies and scientific advances that promoted practical solutions to the limitations imposed by social isolation.

For this project, 10 students from the 9th grade of elementary school were selected, who created a list of the most relevant technologies and made a bibliographic survey of the scientific bases that support these technologies. Knowing this, the scientific concepts that underlie each of these technologies were discussed in the weekly class of the "Learning Club" and gave rise to research on the scientific bases of each one.

Articles and scientific publications were consulted on the CAPES Journal Portal, based on the descriptors: digital platforms; remote teaching and information technology. Filters were used to select articles, theses, and dissertations in Portuguese, published between 2010 and 2021. In these articles, the students specifically sought to find out which science provides the theoretical and practical basis for each technology. Then, the digital tool *Canva* (<https://www.canva.com/>) and the software of the *Microsoft Office* package for the elaboration of banners and graphic materials, widely used in online presentations, were presented: *Microsoft Powerpoint*. With them, the students produced a banner with all the aspects and items established by the practical methodology of the scientific work: Introduction, objectives, methodology, results, discussion, final considerations and references.

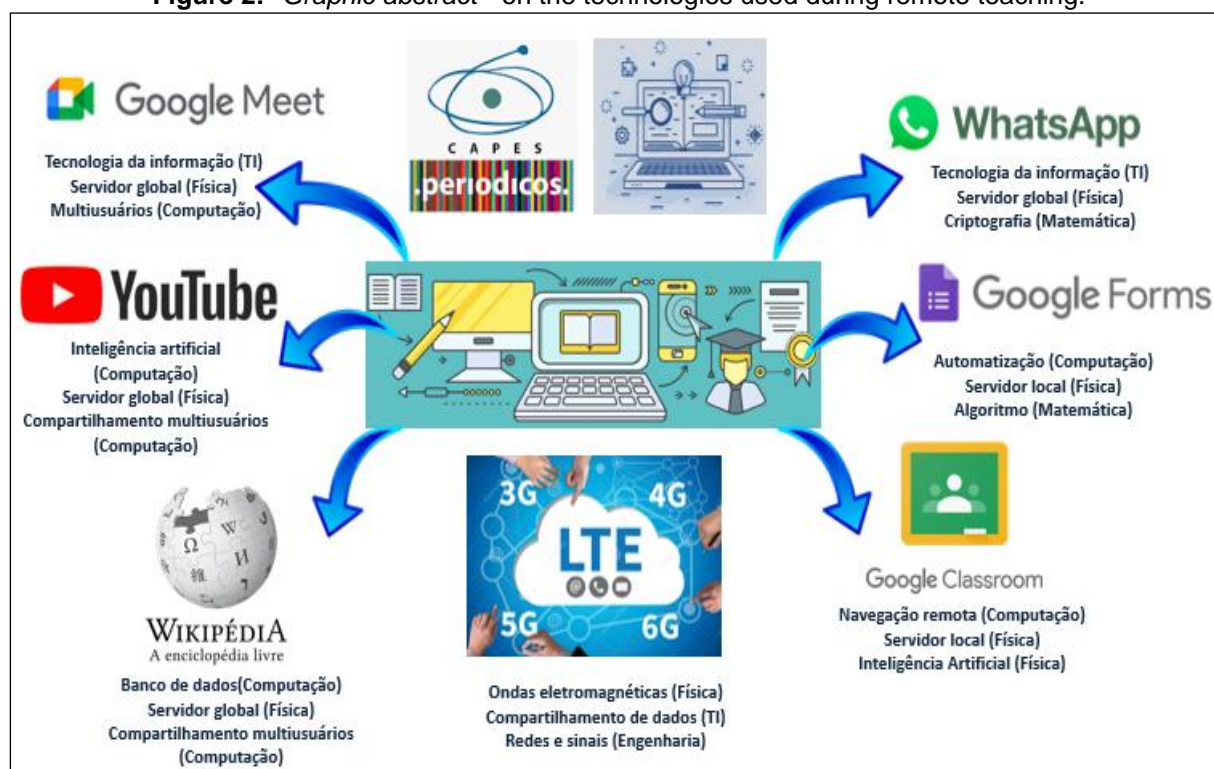
RESULTS AND DISCUSSION

The immersive pedagogical practice to which the basic education students were subjected was successful and capable of elucidating the scientific concepts and the specific sciences that underlie each of these technologies, and these topics were discussed in the weekly class of the "Learning Club", with emphasis on the following sciences (Santos, 2020):

- Information Technology (IT)
- Computer Science;
- Programming;
- Automation and Robotics;
- Artificial intelligence (AI);
- Electromagnetic waves;
- LTE networks (also known as "long term Evolution): (3G/4G/5G).

The technologies were illustrated by the students through the production of a "graphic abstract" (**Figure 2**), an element observed by them in several publications, and which provided the basis for the summary of the research findings, which correlates each technology used in remote teaching during the pandemic with the sciences that provide the scientific-technological basis for each one.

Figure 2: "Graphic abstract" on the technologies used during remote teaching.

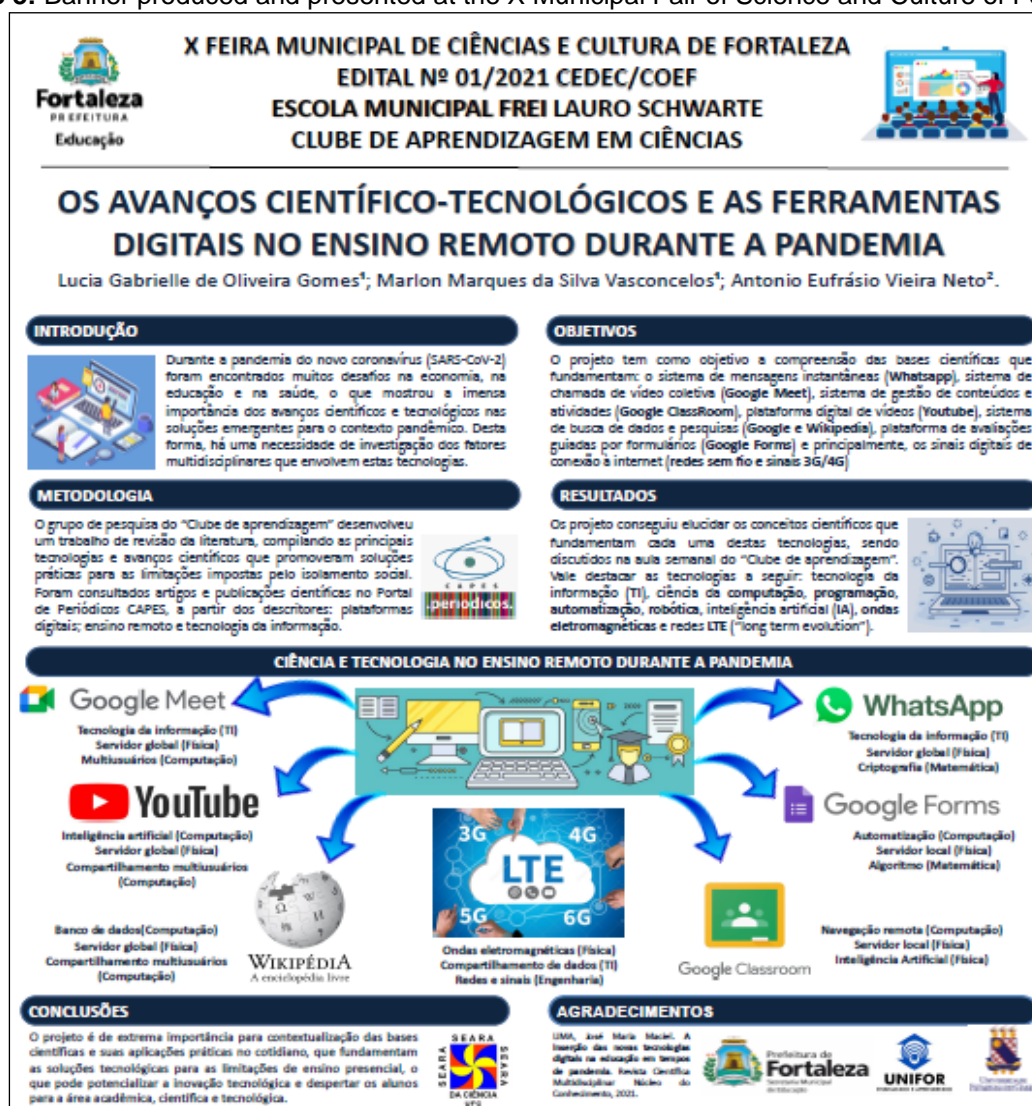


The "graphic abstract" was produced in the project, containing all the technologies listed as allies in remote teaching during the pandemic, and their respective associated sciences. **Source:** prepared by the author.

After the elaboration of a scientific work and the elaboration of the "graphic abstract" element, the students were stimulated to a stage of the research, also inherent to the academic context: scientific dissemination. At this stage, the teacher responsible for the teaching practice guided the students to prepare a summary and a banner for participation in the "X Notice of the Municipal Science Fair of the City of Fortaleza".

At this stage, students were able to see all the elements of a scientific event notice, and learned about the requirements for the dissemination of a scientific work. Finally, the research group produced, as a final step of the project, an illustrated banner (**Figure 3**), containing all the elements common to a scientific event.

Figure 3: Banner produced and presented at the X Municipal Fair of Science and Culture of Fortaleza.



The banner is the product of the student protagonism of the students of the Learning Club of the Frei Lauro Schwarte Municipal School, illustrated and built in the final stage of the student immersion project for literature review, seeking to elucidate the scientific bases of the technologies present in remote teaching.

Source: prepared by the author

The banner was submitted to the "X Municipal Science Fair of the City of Fortaleza", in partnership with Seara da Ciências, an institution linked to the Federal University of Ceará, where several projects are carried out aiming at the association of the University with schools and students of basic education. In this event, students were approved in the District Stage and in the Municipal Stage, being considered "semifinalists".

The execution of this work provided the students of the Frei Lauro Schwarte Municipal School with the opportunity to experience academic practices, promoting a significant approximation between basic education and the university, digital and scientific environment. It is relevant to highlight that the immersion of basic education students in the

academic environment is already a widespread practice in public and private schools in Fortaleza. Projects such as "Professions Fair", for example, allow students to get to know the daily life of different areas of knowledge and the careers offered by higher education. These initiatives are essential to broaden students' vision of their future possibilities, encouraging the continuity of studies and admission to higher education institutions. (Oliveira *et al.*, 2019)

The social impact of this project goes beyond the teaching-learning of elementary school students, because with the growing advance of the dissemination of *fake news* and disinformation, it becomes increasingly necessary to introduce, from an early age, mechanisms that enable children and young people to verify and critically analyze the information they receive, and in this regard, familiarization with reliable databases and contact with scientific articles from an early age can be great allies.

With the increase in the flow of unverified content, especially on social networks and instant messaging apps, the formation of a culture of fact-checking and critical thinking in basic education is a determining factor for building a more informed society that is less vulnerable to misinformation. (Dantas *et al.*, 2020)

In this context, this project enabled elementary school students (final years) from the public school system of Fortaleza to experience the daily life of academics and journalists, encouraging them to seek correct and well-founded information. The project not only promoted the development of investigative skills, but also strengthened the autonomy of students, making them protagonists in the construction of their own knowledge. This process is fundamental, especially in a scenario in which Brazil, despite legislative advances in combating the spread of Fake News, still faces structural challenges in monitoring and controlling the spread of false content.

The proliferation of "*bots*" and automated networks that disseminate disinformation on a large scale, mainly through platforms such as WhatsApp and Instagram, highlights the need for educational strategies aimed at training individuals for a more critical and responsible navigation in the digital environment (Michalski *et al.*, 2019)

In view of this, the search for correct and verifiable information becomes not only a collective need, but also an individual choice, which requires preparation and access to appropriate tools. In this sense, the project played a key role in introducing students to the main scientific platforms, enabling them to identify reliable sources and distinguish scientifically based information from content without academic support. In addition, the

creation of a "graphic abstract" and presentation of a scientific banner at the "X Municipal Science Fair" provided students with an essential experience in the dissemination of knowledge, one of the most important stages of the scientific method. With this, it is valid to say that the active methodology used is an educational process that encourages critical-reflective learning, where the participants have a greater approximation with reality, thus enabling a series of stimuli that can occur greater curiosity about the subject addressed, it can even propose challenges where the participant seeks solutions, thus obtaining a greater understanding (Souza *et al*, 2021).

This experience reinforced the importance of scientific communication as an instrument to combat misinformation, allowing students to understand the relevance of science in contemporary society. In this way, the project not only contributed to the strengthening of scientific literacy and critical thinking among students, but also enabled them to act actively and consciously in the information age.

By making them protagonists in the construction of their own knowledge, the importance of an education committed to truth, science and the development of citizens prepared to face the challenges of disinformation in the 21st century was reinforced.

FINAL CONSIDERATIONS

Based on the self-assessment of the students involved, the active methodology used in the elaboration of this project proved to be highly beneficial and presented several advantages in relation to traditional approaches. One of the main advantages of the active methodology, especially with the integration of technologies, is the flexibility of activities and the increase in student interaction in the learning process.

The advances associated with *maker culture* and critical education have strengthened the scientific literacy of students, promoting their active participation in projects and research and making them protagonists of the educational process. In addition, this integration demonstrates effectiveness in the social commitment of basic education students, who often need to assume the responsibility of educating their own family members about the care with the consumption of information widely disseminated on the internet.

Pedagogical practices based on student protagonism provide young people with the opportunity to experience and reinterpret aspects of their family environment, thus emphasizing their importance in the educational process. In this study, the application of

methods and knowledge typical of academic research transcended the laboratory and equipment, demonstrating that the introduction of this scientific thinking in basic education can be a powerful force in the transformation of teaching practices.

The project, developed by elementary school teachers with direct involvement in scientific research, is of vital importance to contextualize the scientific bases and their practical applications in everyday life, which support technological solutions to the limitations of face-to-face teaching. In addition, it can also enhance technological innovation and arouse students' interest in academic, scientific and technological areas.

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