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# THE USE OF TECHNOLOGY IN BIOLOGY TEACHING: AN INTEGRATIVE REVIEW

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## ABSTRACT

Technology is fundamental to education, as it facilitates access to knowledge, expands learning opportunities, and allows students and teachers to connect more dynamically and efficiently. Therefore, this scientific article addresses the use of technology in Biology teaching. Its objective is to demonstrate, through an integrative literature review, how technology has been incorporated into Biology teaching in everyday school life. The research methodology, an integrative review, aims to gather and synthesize the results of previously published research on the topic. To this end, the methodology employed was a bibliographic survey of specialized academic databases: Redalyc and Google Scholar. At the end of the research, 13 (thirteen) articles were selected for analysis, of which 10 (ten) were found on Google Scholar and 3 (three) found on Redalyc. Regarding the year of publication, it is noted that 3 (three) were published in 2021, 4 (four) were published in 2020, 5 (five) in 2019 and 1 (one) in 2018. The research identified a gap in the scientific knowledge worked, since regarding recent studies in the area of knowledge studied, no academic works published between 2022 and 2025 were found in the databases used.

**Keywords:** Technology; Biology; Technological tools; Teaching-learning.

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## INTRODUCTION

Over the past few years, technology has become fundamental in various areas, including education. Through technological advances, knowledge has been transmitted much more quickly and to an increasingly larger number of people.

As a result, schools and other educational institutions must prepare students to live in an "information society," incorporating the so-called Information and Communication Technologies (ICT) into their curriculum (Ghavifekr; Rosdy, 2015).

According to Silva (2024), technology plays a fundamental role in the school environment, as it allows for working with the particularities of each student, such as individualized teaching practices and the use of adaptive learning platforms, which enable students to progress at their own pace and level of understanding.

In this sense, the current technological context has enabled the establishment of new paths in online education, via the internet, especially in distance learning, as well as in face-to-face education, since the advent of the internet is generating new challenges for the classroom, both technological and pedagogical. Thus, technologies alone do not transform the school, but they offer countless possibilities for supporting teachers and fostering mutual influence among students (Moran; Masetto; Behrens, 2000).

Therefore, the use of technology, digital tools, mobile applications, and online learning platforms has also been transforming the way biological concepts are taught and understood (Rosa, 2025). The emergence of educational technology and the advancement of various digital media have made it increasingly possible to explore its use as a strong pedagogical resource for teaching biology.

Thus, biology teaching can be offered more efficiently, making classes more engaging and enabling students to understand the topics addressed more quickly, maintaining focus and developing critical thinking. In line with this view, Leite (2020) argues that methodological resources are indispensable for the effectiveness of the teaching-learning process, as the rapid pace at which technological innovations evolve brings changes in the way people learn and interact, strengthening and developing students so that they become socially critical and expressive individuals.

Therefore, this research is justified by the constant and evident incorporation of technology into people's daily lives, including students and teachers in the school environment, a fact that leads to reflection on the need to apply technological tools in biology teaching, as a pedagogical resource that will assist in students' learning in the classroom. The relevance of this work lies in gathering and disseminating data, studies, and knowledge about the importance of using technologies in teaching and how this use is occurring today. In doing so, it seeks to support future research conducted by students, teachers, professionals in the field, or those interested in the topic, creating a database of theoretical studies that will aid in the academic sphere.

From all that has been presented, it is clear that the current "technological society" demands a reinvention of the way classes are taught, with the organization and effective use of available technologies. In this context, this work has the general objective of demonstrating, through an integrative literature review, how technology has been incorporated into Biology teaching in everyday school life.

To this end, the research is guided by the following question: "How has technology been incorporated into Biology teaching in everyday school life?" To answer this question, the following specific objectives will be pursued: to identify the importance of technology for the educational process; to verify whether technology has been used in Biology teaching based on the results of the integrative review; and to highlight the main technological tools used in the classroom for Biology teaching.

## MATERIALS AND METHODS

This study consists of an exploratory bibliographic research, with a qualitative approach, based on data collection from secondary sources. Data analysis was carried out using the integrative review method, aiming to gather and synthesize research results on the use of technology in Biology teaching in a comprehensive and systematic manner, allowing for an understanding of the current state of scientific knowledge.

According to Mendes, Silveira, and Galvão (2008), this type of review enables the incorporation of evidence into professional practice, the identification of gaps in scientific knowledge, and the formulation of guidelines for future research. Whittemore and Knafl (2005) reinforce that the integrative review favors a comprehensive critical analysis by including both quantitative and qualitative studies, making it a useful tool for researchers and professionals in the field.

The process of preparing this integrative review involved the following phases: I. Definition of the guiding question; II. Literature search strategy; III. Identification of studies and data collection; IV. Analysis of included studies; V. Discussion of results; VI. Presentation of the integrative review.

Thus, the guiding question of this work is: "How has technology been incorporated into Biology teaching in everyday school life?" Regarding the literature search strategy, the bibliographic survey was carried out using specialized academic databases: *Redalyc* and *Google Scholar*.

To locate relevant studies on the subject, the following search strings were used:

Table 1 – Search Strings

| | **Search Terms** |
|---|---|
| 1 | Biologia "*and*" Tecnologia; *(Biology **and** Technology)* |
| 2 | Biologia "*and*" Ensino "*and*" Tecnologia; *(Biology **and** Teaching **and** Technology)* |
| 3 | Biologia "*and*" estratégias de ensino e tecnologias "*and*" ensino de biologia. *(Biology **and** teaching strategies and technologies **and** biology teaching)* |

Source: Authors (2025).

From this point, information was collected from the databases through reading and examining scientific articles available in the archives, which were relevant to the topic under analysis and fit the time frame of 2018 to 2025. The publications resulting from the database search were selected using inclusion and exclusion criteria to identify what would actually be used as a data source

Thus, the criteria for the inclusion of works were:

- Publications available in Portuguese;
- Texts available in their original version;
- Publication period from 2018 to 2025;
- Thematic compatibility;
- Specific search for scientific articles (excluding theses, dissertations, books, and reviews).

On the other hand, the exclusion criteria used to define the data to be used were publications duplicated in different databases and those in which the object of study did not establish a relationship with the topic addressed.

After the criteria were defined, the search strings were used on the *Redalyc* and *Google Scholar* platforms, where 16 (sixteen) studies were found, which were separated into folders with the same name as the strings for duplication checking. Then, they were listed by the article name and by the databases in a table in Word and, subsequently, the classification tool was applied, which listed them in alphabetical order for manual counting.

After carefully reading the title of each work and the abstract of each one, 13 (thirteen) studies compatible with the theme addressed and located on the *Redalyc* and *Google Scholar* platforms were identified. After data collection and processing, separating what would be useful, the analysis and discussion of the data began, in which the first stage referred to reading the articles selected by theme; the second stage, observation of concepts, historical importance and contribution; and, in the third, the writing done by combining the notes.

## RESULTS AND DISCUSSION

The discussion stage of the results was carried out in an exploratory and comparative manner, based on the interpretation and synthesis of the authors addressed, relying on the scientific literature on the subject and aiming to meet the proposed objective of the study. Thus, 13 (thirteen) articles were selected for analysis, of which 10 (ten) were found on the *Google Scholar* platform and 3 (three) on the *Redalyc* platform.

Regarding the year of publication, it is noted that 3 (three) were published in 2021, 4 (four) were published in 2020, 5 (five) in 2019 and 1 (one) in 2018. At this point, it is important to draw attention to the absence of more recent publications, from the year 2022 onwards, which makes the field of study

even more relevant, because despite the growing technological expansion, studies on the theme combined with Biology teaching have not stood out in the academic research arena.

Table 2 – Base studies of the research

| Article Title | Year | Authors | Databases |
|---|---|---|---|
| Tecnologia e inovação aliadas à educação: o uso de softwares educacionais para o ensino de ciências e biologia *(Technology and innovation allied to education: the use of educational software for teaching science and biology)* | 2021 | Ailton Donizetti dos Santos e Derli Barbosa Dos Santos | *Google Scholar* |
| O uso da tecnologia digital da informação e comunicação como ferramenta didática para o ensino de biologia celular no ensino médio *(The use of digital information and communication technology as a didactic tool for teaching cell biology in high school)* | 2021 | Amanda do Amaral Luna | *Google Scholar* |
| As tecnologias da informação e comunicação no ensino de Biologia: Aproximações teóricas *(Information and communication technologies in Biology teaching: Theoretical approaches)* | 2021 | Ítalo Câmara de Almeida, Luciana Canário Mendes e Ricael Spirandeli Rocha | *Google Scholar* |
| Potencial pedagógico do aplicativo *whatsapp* no ensino de biologia: percepções dos professores *(Pedagogical potential of the WhatsApp application in biology teaching: teachers' perceptions)* | 2020 | Douglas Carvalho Amorim | *Google Scholar* |
| Ensino de ciências e o uso de tecnologias digitais: uma proposta de sequência de ensino investigativa sobre o sistema reprodutor humano *(Science teaching and the use of digital technologies: a proposal for an investigative teaching sequence on the human reproductive system)* | 2020 | Caroline Oenning de Oliveira e André Luís de Oliveira | *Google Scholar* |
| A tecnologia digital potencializando o ensino de biologia celular: a utilização do blog aliado ao canva *(Digital technology enhancing cell biology teaching: the use of blogs combined with Canva)* | 2020 | Mariana Teixeira Santos Figueiredo Salgado e Vanda Leci Bueno Gautério | *Google Scholar* |
| Ações educacionais em tempos de pandemia: reflexões sobre a biologia no ensino médio *(Educational actions in times of pandemic: reflections on biology in high school)* | 2020 | Walkíria dos Reis Lima, Joana Peixoto e Adda Daniela Lima Figueiredo Echalar | *Redalyc* |
| A importância do uso da tecnologia digital no ensino de ciências e biologia *(The importance of using digital technology in science and biology teaching)* | 2019 | Emillayne Paloma Santos Sedícias; Karoline Barbosa da Silva; Ellen da Silva Santiago; Kátia Fernanda Alves de Andrade; Ubirany Ferreira Lopes | *Google Scholar* |
| Utilização de mídias sociais no ensino de biologia vegetal: buscando novas estratégias de ensino *(Use of social media in plant biology teaching: seeking new teaching strategies)* | 2019 | Karina Moreira Freitas e Reinaldo Ríchardi Oliveira Galvão | *Google Scholar* |
| Utilização de jogos digitais como estratégia didático-pedagógica: uma experiência com alunos de ensino médio na disciplina de biologia *(Use of digital games as a didactic-* | 2019 | Marcelo Alexandre Bruno, Regina Barwaldt e Sueli Aparecida Thomazine | *Google Scholar* |

| | | | |
|---|---|---|---|
| *pedagogical strategy: an experience with high school students in the biology discipline)* | | | |
| A Utilização das Tecnologias da Informação e Comunicação no Ensino de Biologia: Uma Revisão Bibliográfica *(The Use of Information and Communication Technologies in Biology Teaching: A Literature Review)* | 2019 | José Rufino Silva dos Santos e Brenda Thaise Cerqueira de Souza | *Google Scholar* |
| Uma análise do conteúdo de Botânica sob o enfoque Ciência-Tecnologia-Sociedade (CTS) em livros didáticos de Biologia do Ensino Médio *(An analysis of Botany content under the Science-Technology-Society (STS) approach in high school biology textbooks)* | 2019 | Cássia Luã Pires de Souza e Rosane Nunes Garcia | *Redalyc* |
| Tecnologias digitais, biologia do conhecer e pesquisa-ação no ensino de línguas *(Digital technologies, biology of knowing and action research in language teaching)* | 2018 | Rodrigo Camargo Aragão e Iky Anne Fonseca Dias | *Redalyc* |

Source: Authors (2025).

Science and Biology teachers have constantly sought methodological approaches that go beyond the limits of the traditional curriculum, aiming to incorporate the use of technology as a strategy to encourage students to explore and expand their scientific knowledge, in response to the demands of the modern world (Sedícias et al., 2019).

Alexandre Bruno, Barwaldt and Thomazine (2019) clarify that the traditional teaching model, in which there is a hierarchy where the teacher is the protagonist, the only "owner of knowledge" in the classroom, is being questioned, as it does not meet the profile of "digital native" students. For this reason, Information and Communication Technologies (ICTs) bring to reflection and discussion the urgent need to rethink traditional teaching models.

Information and Communication Technologies (ICTs) are part of people's daily lives, being responsible for transmitting and receiving information through different devices, such as computers, the internet, tablets and smartphones. In addition to these, ICTs also include older technologies, such as television, newspapers and even the mimeograph. According to the literature, some researchers began to use the term *New Technologies* to refer specifically to digital technologies, also called Digital Information and Communication Technologies (TDICs), which represent a technological advance by incorporating the use of the internet through software and applications.

In Biology teaching, it is common for teachers to resort to analogies to facilitate content understanding. However, they often encounter students who, despite growing up in an environment permeated by technologies, do not recognize these resources as allies in the learning and professional training process. In many cases, Information and Communication Technologies (ICTs) are still seen by students themselves and by the community — including parents, schools, pedagogical coordination, education professionals and even legislators — only as means of entertainment. Thus, there is an urgent need to socialize and insist on the insertion of ICTs in the teaching-learning process, that is, to reduce the

gap between theory, concepts and practical applications, including ICTs (Alexandre Bruno; Barwaldt; Thomazine, 2019).

Prensky (2001) warns that educators, devalued and demotivated by various economic and social aspects, are not always available and/or open to new proposals that require changes. Thus, the changes that should happen within each professional and then extend to the school environment and, consequently, to the classroom, float in a sea of uncertainties between the "must do" (because ICTs must be part of the process) and other issues of "how to do it."

For the author, this phenomenon is explained by the fact that individuals fear the "new," changes and even confrontation with these "digital native" students who seem to know everything about digital tools. Natives grew up under this digital technology, while previous generations, especially teachers, are migrating to these technologies (digital immigrants).

Salgado and Gautério (2020) point out that Information and Communication Technologies (ICTs) can be applied in Science teaching through active learning methodologies, such as Inquiry-Based Learning, blended learning and the use of educational technologies, such as virtual laboratories and activities carried out in Virtual Learning Environments (VLE). The author highlights that these elements are integrable and viable within the classroom context, contributing to overcoming challenges faced by Brazilian schools and enabling teachers to adopt new pedagogical approaches, while offering students different ways of learning.

According to Santos and Santos (2021), the problem of optimizing Science and Biology teaching, due to the lack of didactic/pedagogical resources in public schools, can be solved through educational software. Educational software is one that enables teachers to efficiently exercise their pedagogical practice. Thus, these are tools that, through various resources such as images, texts, animations and others, address curricular content.

Regarding educational software, Luna (2021) mentions the *Phet Colorado* simulator, a computational tool that promotes the learning process, motivating students and teachers and fostering interactivity. He also highlights the educational website "www.celuladidatica.ufpr.br," classified as a thematic repository in the area of Cell Biology, that is, a collection of selected educational objects on cell structure and function, which provides motivating digital resources of scientific relevance and facilitates the teaching-learning process, grouped by content related to cell structure and function. Finally, attention is also drawn to the use of the *Pixton* software, developed by the company *Pixton Comics Inc.*, a tool aimed at creating comic strips, intended for teachers and students, companies and individuals who seek to create comics.

Although the use of educational software in Science and Biology classes is efficient, it is conditioned by some factors that cannot be disregarded. The use of this software must result from

coherent planning by the teacher and from directed and conscious mediation. More than simply making the software available in class for students to explore arbitrarily, it is necessary to select the best software considering the lesson objectives, alignment with the curriculum and the availability of basic resources, such as operating system, internet and others (Santos and Santos, 2021).

Another technology identified as a tool for Biology teaching, according to Salgado and Gautério (2020), is the Blog and Canva.

> The learning construction category highlighted how the Blog and Canva can assist in the learning process. Among the aspects listed, it was highlighted that the use of digital tools made learning more dynamic and fun, in addition to the development of the platforms being an interesting way to review the theoretical concepts seen in class. Considering the difficulty students have in learning content related to Biology, we found in the use of the Blog and Canva an efficient way to build this learning. The possibility of visualizing the abstract during the creation of the platforms was another highlighted aspect, associated with the ability to escape traditional teaching, forming the third category. We demonstrated that the Blog and Canva helped in teaching Cell Biology by enabling the visualization of complex structures and processes, which cannot be done when using only the blackboard and chalk. Students highlighted that the use of digital tools allowed them to "break the routine," which, in our interpretation, is the distancing from traditional teaching that is so commonly used (Salgado and Gautério, 2020, p. 125).

The use of technology in Biology teaching has proven to be a diversified tool, given the vast number of educational technologies that support the students' teaching-learning process.

Santos and Souza (2019) listed some of the main educational technologies that have been used in Biology teaching: YouTube, Khan Academy, Google Classroom, blog creation, websites such as Portal do Professor, Escola Digital, Biblioteca Digital de Ciências, applications, programs and simulators aimed at Biology teaching that can be used both on computers and smartphones.

> •YouTube, which allows both posting and viewing video lessons and also offers numerous other management tools such as channel creation and integration with other social networks (...).
> • Khan Academy aims to provide high-quality education accessible to all; its platform offers a wide variety of articles, exercises and educational videos, including Biology, also allowing the creation of classes for management (...).
> • Google Classroom, which helps students and teachers organize tasks, increase collaboration and improve communication, also allowing the creation of classes, distribution of tasks, grading, sending feedback and viewing everything in one place.
> • The creation of blogs, which allow editing messages, as well as making texts, images and sounds available at any time and place. A tool similar to the blog and easy to handle is scoop.it, which is an online platform where it is possible to define, monitor and share information and data;
> • Websites such as Portal do Professor, Escola Digital and Biblioteca Digital de Ciências are spaces for teachers to access lesson plan suggestions, download support media, get news about education or even share a lesson plan, participate in a discussion or take a course.
> • Use of applications, programs and simulators aimed at Biology teaching that can be used both on computers and smartphones (Santos and Souza, 2019, p. 13-14).

Through the work of Amorim (2020), another important, if not the main, technological tool is highlighted, which is widely used in the school environment by teachers, students and all those who make

up the school community. According to the information compiled by the author, WhatsApp can be used for clarifying doubts through the formation of discussion groups, but with care regarding the information posted and how students help each other in answering questions, demonstrating that the teacher's mediating role is essential to validate the scientific information presented. In addition, it showed that it creates an emotional bond, is a space for clarifying doubts and conducting research, as well as sharing materials, assisting in the teaching process.

It is noted that the use of these technological tools can be an alternative to the methodologies employed in teaching, positively influencing the dynamics of classes and facilitating the understanding of more difficult concepts, considering that they can illustrate phenomena in a simpler and more dynamic way, helping students understand complex processes.

Castro et al. (2015) state that technology linked to teaching is interactive, where teachers and students are responsible for teaching and learning. It is worth noting that the mere use of technologies is not enough, even if these tools collaborate with the teaching and learning processes. There must be a combination of technology use with face-to-face interactions.

Thus, given technological advances, it is clear that the development of technologies has significantly impacted different sectors of society, including education. In this scenario, technological tools can act as pedagogical resources, but it is important to emphasize that their isolated use, only as a visual or illustrative support in classes, does not imply, by itself, a pedagogical transformation. For there to be a real improvement in the teaching and learning process, it is essential that these technologies be used as mediators of knowledge construction. This requires the creation of strategies that go beyond the limits of the textbook, providing students with new ways of accessing knowledge. Therefore, discussing the difficulties and limitations faced by teachers in using technologies becomes an important step to promote their insertion and dissemination in the school environment.

## FINAL CONSIDERATIONS

The purpose of this work was to demonstrate, through an integrative literature review, how technology has been incorporated into Biology teaching in everyday school life in recent years.

In this context, the importance of using technological means in the classroom does not diverge from the use of traditional supports, such as the blackboard, markers, and textbooks, but rather emerges as a complement, a resource that facilitates teaching practice and instruction, contributing to meaningful and dynamic learning. Thus, it is up to school managers and teachers to keep up with the main trends, increasingly investing in teaching methods that bring technology into the classroom.

It is evident that Biology teaching is undergoing valuable methodological transformations for the teaching-learning process, as this area faces challenges related to the complexity of its content, which is

often abstract and difficult for students to assimilate. This difficulty is aggravated by the predominance of traditional methods based on memorization, often disconnected from students' reality and lacking practical activities that promote the understanding of biological concepts. The absence of these practices limits the development of critical thinking and hinders a more meaningful relationship with the topics addressed. Therefore, the use of technology emerges as a viable alternative for improving teaching.

It is necessary to highlight the relevance of continuous teacher training as an essential element for achieving the main purpose of education, which is to form critical citizens capable of actively participating in social, political, scientific, and technological decisions, thus contributing to the improvement of society as a whole.

Finally, it is noted that all the objectives of this research were achieved, both the general one—namely, to demonstrate, through an integrative literature review, how technology has been incorporated into Biology teaching in everyday school life—and the specific objectives, which were achieved by identifying the importance of technology for the educational process, verifying how technology has been used in Biology teaching based on the results of the integrative review, and highlighting the main technological tools used in the classroom for Biology teaching.

As for the limitations of this research, it can be mentioned that it was carried out using only two databases (*Google Scholar and Redalyc*) and with a short time frame, from 2018 to 2025. Therefore, it is possible that if a larger number of databases had been used, as well as a longer time frame, more results would have been obtained. However, the limitation was intentional, since when dealing with technology, it is prudent to work with the most recent scientific knowledge.

Finally, it is important to mention that a gap in the scientific knowledge addressed was identified, since regarding recent studies in the area of knowledge studied—namely, the use of technology in Biology teaching—no academic works published between the years 2022 and 2025 were found in the databases used. Therefore, this scientific article enabled the formulation of guidelines for future research, as by identifying the knowledge gap, it can be suggested that more current field research be carried out, aiming at the production of more recent scientific knowledge on the subject.

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