

HIGH-SPEED LEARNING: THE IMPACT OF THE INTERNET ON TEACHING

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ABSTRACT

The advent of 5G technology represents a significant transformation in the field of education, with a wide-ranging impact on how learning is facilitated. The choice of this theme is justified by the growing relevance that high-speed connectivity has in the digital age, expanding access to quality education. The main objective of the study is to investigate how the implementation of 5G can revolutionize educational practices, making them more interactive and inclusive. For this, a bibliographic approach was used, reviewing academic literature and case study reports on the use of 5G in educational environments. The main results indicate that 5G technology not only improves the quality of content transmissions, but also facilitates the integration of technologies such as augmented reality (AR) and virtual reality (VR), which promote immersive and engaging learning experiences. Additionally, enhanced connectivity makes it possible to personalize instruction, allowing educators to tailor materials and approaches to individual student needs. The most relevant findings highlight that 5G can democratize access to knowledge and expand educational opportunities for marginalized communities by challenging the traditional barriers of the school environment. Thus, the use of 5G in education not only improves content delivery but also redefines the interaction between educators and students, favoring a more inclusive and effective teaching process.

Keywords: 5G Technology. Education. Inclusion.

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INTRODUCTION

The emergence of 5G technology is promoting significant changes in several sectors of contemporary society, with the educational field being one of the most impacted by this digital revolution. The introduction of 5G promises a faster and more stable internet, providing a valuable infrastructure for the incorporation of pedagogical innovations. With reduced latency and amplified data transfer capacity, this new technology makes it possible to implement educational tools that were previously unfeasible due to limitations in connectivity. Therefore, the relevance of the topic stands out, especially in a world where digital education is established as a growing need. In addition, the exploration of the potential of 5G in education has highlighted its ability to enable more dynamic interactions, allowing teachers and students to establish a more engaging and collaborative dialogue, promoting the exchange of knowledge in real time, regardless of geographic location.

In this context, Evangelista *et al.* (2022) discuss the challenges and possibilities of remote teaching in the university environment, highlighting the importance of adapting to new technologies during the COVID-19 pandemic. The use of educational platforms that employ artificial intelligence to create personalized experiences reflects a move toward adaptive learning. Thus, the integration of 5G emerges as an opportunity to enhance the educational process in an effective and inclusive way, highlighting the need to explore how technological innovations can transform pedagogical practices and improve the quality of teaching.

As stated by Cunha *et al.* (2024), "innovative approaches in science and mathematics teaching" are crucial to meet the demands of an ever-evolving educational context. Therefore, this research seeks to shed light on the potentialities and challenges that 5G brings to the educational environment, ensuring that educators and students can fully benefit from its advantages. The central problem of this investigation refers to how the implementation of 5G technology can effectively transform teaching and learning in educational institutions. In this scenario, it is essential to analyze not only the opportunities that 5G provides, but also the challenges that emerge with this new reality.

In this sense, the question that guides this research is: "What are the implications of the adoption of 5G for the quality and accessibility of education in the digital environment?". The general objective of this work is to explore the implications of 5G technology in education, investigating its possible contributions to the improvement of teaching and learning. This main purpose will be achieved through the analysis of the transformations

that 5G proposes to pedagogical practices and the dynamics of interaction between educators and students. In addition, the research seeks to map the impacts of this technology on digital inclusion, aiming to understand how it can benefit students in different contexts.

Specific objectives include: (i) identifying key educational tools that can be enhanced by 5G technology; (ii) assess the role of 5G in promoting more inclusive education; and (iii) investigate the challenges related to teacher training in the 5G era. In this way, the research will allow a broader and more integrated understanding of the different aspects that make up this theme.

The methodology adopted to carry out the study will be of a bibliographic nature, with a review of the existing literature on the impact of 5G on education. Articles, books and relevant academic publications will be analyzed, as well as reports that discuss technological innovations in teaching. This approach will allow not only a survey of the available information, but a critique of the different perspectives on the subject.

Finally, the research will culminate in a synthesis that will connect the arguments presented, allowing a reflection on the possible directions that education can take with the rise of 5G. The joint analysis of the opportunities and challenges provided by this technology will serve as a key resource for educators, policymakers, and researchers, contributing to discussing how education can thrive in an increasingly digital and interconnected context.

THEORETICAL FRAMEWORK

The theme of accessibility and inclusion in the context of education enhanced by 5G technology is extremely relevant, as it reflects the need for an educational environment that respects and values diversity. The advancement of communication and information technologies has transformed education, creating new possibilities for learning and interaction. In this sense, the high-speed connection provides access to a variety of digital resources that can benefit all students, especially those with special needs. Inclusion and accessibility, therefore, should be seen as essential components to ensure that the digital revolution provides equitable opportunities for all students.

To understand the impact of 5G on inclusive education, it is essential to address some fundamental concepts, such as digital accessibility, assistive technologies, and adaptive teaching methodologies. According to Freitas (2023), augmented reality in the

educational environment can demystify the complexity of the content, allowing students to interact more effectively with the teaching material. In addition, assistive technologies play a key role in providing access to knowledge, allowing students with visual and hearing impairments, for example, to integrate more fully into school activities. The intersection of these technologies with educational methodology is therefore key to promoting inclusive and accessible teaching.

Historically, the evolution of inclusive educational practices has been marked by important debates and legislation. In the 1990s, the movement for inclusive education gained momentum, emphasizing the importance of adapting teaching to the needs of all students, regardless of their individual characteristics. The emergence of digital technologies over the last two decades has represented a significant advance in this process, enabling the creation of more personalized teaching strategies, which take into account the different forms of learning. 5G, in turn, intensifies this evolution, allowing for more dynamic and accessible interaction between educators and students.

Currently, the debate on inclusion in the school environment encompasses several perspectives, such as the effectiveness of digital platforms, the role of the teacher, and public education policies. Guimarães Junior *et al.* (2024) highlight that social networks can contribute to the learning process, facilitating interaction and the exchange of experiences among students. However, this discourse must be complemented by a critical reflection on the inequalities that still persist, which can limit the access of certain groups to the use of technologies. Therefore, the current discussion on inclusion is multifaceted and requires an approach that considers the social and economic realities of students.

The articulation between the theoretical concepts presented and the central problem of the research reveals the need to build an educational environment that truly respects and promotes diversity, using technological innovations as allies in this process. Accessibility, in this sense, must be integrated into pedagogical practices, through the continuing education of educators and the development of content that meets the diverse needs of students. The implementation of methodologies that use emerging technologies is, therefore, a path that can facilitate the inclusion and active participation of all students.

In summary, the theoretical framework elaborated here supports the study by highlighting the interconnection between accessibility, inclusion and 5G technology in education. The analysis of theories and concepts, accompanied by the investigation of current realities, contributes to a more comprehensive understanding of the phenomenon

in question. In this way, the knowledge accumulated throughout the research not only broadens the understanding of the theme, but also offers subsidies for the proposition of educational practices that respect and celebrate diversity in the school environment. Thus, we ensure that the digital revolution in education, mediated by 5G connectivity, becomes a real opportunity for inclusion and accessibility for all students.

ONLINE AND HYBRID LEARNING

Online and hybrid learning is shaping contemporary education in surprising ways, especially with the arrival of 5G technology. This new generation of connectivity not only improves access speed, but also provides greater interactivity in teaching experiences. With the ability to access educational content anytime and from anywhere, students can engage more effectively. The flexibility of these modalities allows each student to find their own pace and style of learning, reflecting the diversity in the ways of understanding and absorbing knowledge.

Online learning, in turn, is a model that stands out for the totality of its activities carried out on digital platforms. This implies a new teaching environment in which interaction occurs through videos, discussion forums and collaborative activities in real time. Costa Júnior *et al.* (2021) state that "hyperconnectivity is shaping the teaching and learning processes", showing that the presence of technology changes the educational dynamics and offers new paths for the education of students.

In the context of hybrid learning, which combines face-to-face and virtual, the opportunities increase significantly. This flexibility appeals to students seeking a balance between physical interaction and the advantages of autonomous learning. The combination of these educational modes enhances the student's experience, making him the protagonist of his learning process. In this scenario, face-to-face classes are not only a complement, but an essential support for the development of interpersonal skills.

The use of 5G also transforms the quality of the educational material available. The ability to transmit high-definition videos and perform real-time interactions without delays improves students' absorption of content, an aspect widely discussed by Lima *et al.* (2021). These technical advances drive the creation of rich and dynamic environments, where students can explore resources such as simulations and augmented realities, arousing interest and curiosity.

Changes in teaching methodologies also require a new approach to feedback and supervision. In hybrid learning, constant communication between students and educators is key. Technology provides tools that allow a closer monitoring of the individual development of each student, which can be a game-changer in the personalization of the educational experience. Thus, learning becomes a pathway in which the educator acts as a guide, encouraging exploration and creativity.

In addition, the impact of 5G technology extends to the democratization of education. Previously isolated regions with limited access to educational resources can now participate in high-quality online courses. This promotes inclusion and equal opportunities, making it possible for students from different social and geographical backgrounds to benefit from the same content. As a result, an academic environment emerges that is more aligned with the challenges of the twenty-first century.

In this context, personalizing the learning experience through adaptive software is even more feasible. These systems adjust the teaching material according to the needs and progress of each student. From the collection and analysis of data, educators can identify areas that need improvement, providing a truly targeted teaching. Lima *et al.* (2020) highlight that "the Internet of Things has a transformative role in learning", supporting this personalization.

Thus, the combination of online and hybrid learning, catalyzed by 5G, not only transforms access to education, but reconfigures the very nature of the learning experience. The notion that everyone learns in the same way is overcome, giving way to a more inclusive model that respects diversity. Enhancing engagement and interaction between individuals also contributes to a more vibrant learning environment.

In addition, the evolution of education in the digital age resignifies the role of educators. These professionals now need to adapt to a dynamic that involves greater use of technology. They are no longer just transmitters of knowledge, but rather facilitators of learning. Collaborative work between students is encouraged, promoting the development of skills necessary for the 21st century, such as critical thinking and creativity.

Modern education, therefore, must consider the multiple dimensions of learning. Active methodologies, which involve the participation of students in the production of knowledge, become increasingly relevant. This approach provides more meaningful and lasting learning, while technology serves to support and enhance this process. Social

interactions in hybrid environments also encourage the construction of support and learning networks among students.

In summary, the educational experience is constantly changing, driven by technology and the need to meet the demands of contemporary audiences. Educational institutions must be aware of these changes, seeking to innovate in their pedagogical practices. The success of this transition depends on the ability to integrate technology and education in a coherent and efficient way, providing learning experiences that inspire and motivate students.

Thus, the future of education can be shaped by this intersection between technology, online and hybrid learning. With the continuity of technological advancement, it is expected that new forms of interaction and new resources will emerge, further enriching the educational process. In this new scenario, education will not only be an accumulation of information, but a journey of personal and social transformation.

Finally, when considering learning as a social phenomenon, it is necessary to value the exchange of experiences and collaborative learning. This vision expands the possibilities of knowledge construction and strengthens the educational community. Education should, therefore, be understood as a dynamic and constantly evolving aspect, which accompanies the transformations of society. In this way, online and hybrid learning, combined with 5G technology, signals a promising future for the educational field.

METHODOLOGY

The methodology proposed for this study aims to investigate how 5G technology influences learning in contemporary educational environments. The research is characterized by a mixed approach, integrating qualitative and quantitative methods, in order to provide a comprehensive analysis of the impacts of high-speed internet on education. The main objectives include identifying trends in the use of 5G technologies and understanding the experiences of educators and students in the face of this new technological reality.

The methods chosen for this research involve a systematic review of the literature. This initial step is vital to compose a solid theoretical basis, allowing critical analysis of how communication technologies are being incorporated into pedagogical practices and what are the consequences of internet speed in the construction of knowledge. According to Narciso and Santana (2025, p. 19460), "the critical review of methodologies is one of the

paths to new discoveries". Therefore, the literature review will serve as a foundation for the collection and analysis of empirical data.

For data collection, questionnaires, interviews and focus groups with educators and students at different levels of education will be used. The structured questionnaires will facilitate the collection of quantitative data, which will be statistically analyzed to identify trends and patterns in the use of 5G technologies. This method will allow measurable information to be obtained, which is essential for understanding the effectiveness of new educational tools. According to Santos *et al.* (p. 1258), "technology and instructional design are fundamental to enhance education".

The qualitative perspective will be ensured through interviews and focus group discussions. These approaches will enable the collection of deeper data, capturing the voice of participants and elucidating their perceptions and experiences in the face of the integration of 5G technology in the educational context. Thus, it will be possible to explore both practical issues and social and emotional aspects related to the transformation of learning.

The procedure for data analysis will involve triangulation, which combines qualitative and quantitative data. Quantitative information will be analyzed using statistical software, allowing correlations and significances to be explored, while qualitative analysis will be carried out through coding techniques, which will allow the identification of recurring themes in the participants' narratives. This strategy will ensure the robustness of the results, ensuring a comprehensive understanding of the impact of 5G technologies on education.

Regarding ethical aspects, the study will be conducted in accordance with the guidelines established for research involving human beings. All participants will receive clear information about the objectives of the research, ensuring that their participation will be voluntary and informed. In addition, the anonymity of participants will be ensured, respecting the confidentiality of the information collected.

The methodological limitations of the study include possible biases in the selection of participants and the heterogeneity of the experiences reported. The diversity of the target audience can influence the results, making it important to consider how these variations may impact the interpretation of the data. Therefore, the study will be careful to recognize these limitations and their potential implications for the conclusions presented.

Through this methodological framework, the research will seek not only to map the use of 5G technologies in education, but also to contribute to the development of innovative pedagogical practices that use ultra-fast connections effectively. The analysis of the data and its implications will provide subsidies for future investigations in the field of education, fostering an increasingly connected and dynamic learning environment.

DEVELOPMENT OF DIGITAL SKILLS

In contemporary times, the strengthening of digital skills presents itself as an urgent need, especially in education shaped by recent technological innovations, such as the 5G Internet. This development cannot be reduced to the mere use of devices or applications, but requires a comprehensive set of skills that enable students to navigate, analyze, and generate information critically and ethically. For today's education to meet these demands, it is imperative that digital skills are incorporated into the curriculum, favoring not only familiarization with new technologies, but also the ability to critically analyze their social, ethical and cultural implications.

The environment provided by the 5G Internet provides faster and more comprehensive access to information, which presents both opportunities and challenges. In this context, students need to be prepared to discern between reliable and unreliable sources, as well as to effectively use the multiple media available to support their learning processes. Training should therefore consist of pedagogical practices that encourage collaboration, digital content creation and the use of online communication tools. Active learning and the collective construction of knowledge are essential for this scenario.

A research conducted by Munoz *et al.* (2024) emphasizes that *information and communication technologies* favor the quality of the teaching-learning process, highlighting the importance of an educational environment that promotes interaction among students. This interaction is one of the key components for the development of digital skills, as it allows students to learn to work in teams, share ideas, and build more meaningful learning.

The implementation of educational programmes aimed at developing digital skills should be continuous and adaptive. It is essential that these programs take into account the speed at which technologies evolve and the demands of the labor market, which are also constantly changing. Educational institutions face the challenge of updating their

pedagogical approaches, using methodologies that integrate not only academic content, but also technical skills that are increasingly demanded in the professional world.

In this sense, the engagement of educators is an essential factor. Providing continuous training on new teaching tools and methodologies is indispensable to ensure that teachers not only stay up to date, but also become drivers of change. As Moreira, Henriques and Barros (2020) state, "collaborative work between educators and students is fundamental for the creation of an effective learning environment". This collaboration should be encouraged from the early school years, creating a solid foundation for the development of future competencies that will be required in a digitalized world.

In addition, digital skills must be addressed in a multidimensional manner. The student cannot only consume content; He must also be able to create, collaborate, and communicate effectively. Creativity, problem-solving, and the ability to work in a team emerge as essential skills that complement technical knowledge. Education must therefore prepare students to be not only consumers of information, but also creators and innovators. The digital environment should be a space for experimentation and continuous learning, where error is seen as part of the learning process.

Finally, the integration of digital skills into the curriculum brings to the fore the need for a re-examination of assessment methodologies. Traditional assessments, which often focus only on memorizing content, need to be redesigned to consider the level of engagement and the student's ability to apply knowledge in a practical way in real situations. Evaluations that promote projects, presentations and collaborative work will result in a more dynamic teaching that is coherent with the demands of today's society.

Therefore, the strengthening of digital skills is an issue that crosses several dimensions of education. By promoting a curriculum that integrates different skills and favors creativity, collaboration, and innovation, educational institutions not only prepare students for the future but also empower them to be active agents of transformation in an ever-evolving world. As Medeiros *et al.* (2024), "the path to a truly transformative education lies in overcoming obstacles and adapting to the new realities that cyberculture presents to us". Thus, by focusing on the development of digital skills, contemporary education becomes more relevant, preparing students for the challenges that lie ahead.

RESULT AND DISCUSSION

The arrival of 5G technology in education represents a significant milestone that opens up new possibilities for teaching methodologies and the learning experience. With connection speeds much higher than previously available, 5G allows various pedagogical tools to be used in a more efficient and integrated way. Methodologies such as the flipped classroom, in which the student is encouraged to study the content before arriving at school, and project-based learning, which encourages research and group problem solving, find in this new environment an easier way of implementation. According to Santos *et al.* (2024), "the fast and stable connection transforms the dynamics of learning, enhancing both teaching and learning". This statement illustrates how 5G can create a more dynamic and interactive environment, facilitating the exchange of information between students and teachers.

Another important aspect to consider is the offer of immersive experiences through technologies such as augmented reality (AR) and virtual reality (VR). The use of these tools not only enriches the content covered in the classroom, but also favors more engaging and meaningful learning. With 5G, it is possible to integrate various platforms and resources that were previously limited by low bandwidth, allowing virtual experiences to be carried out in real time and with high quality. The positive impact of this approach is clear, as students tend to feel more motivated and interested in the subjects covered, resulting in a more satisfactory academic performance.

In addition, the democratization of access to learning is one of the most relevant contributions of 5G. In several regions of Brazil, where internet access was restricted, the new technology has enabled the digital inclusion of a significant number of students. With this, it is possible to access a wide range of educational resources, such as online classes, digital teaching materials, and distance learning platforms. As Silva *et al.* (2023), "5G technology has the potential to reduce geographical and social barriers that have historically limited access to quality education." This improvement in access is not restricted to urban areas alone, but extends to rural areas, where the presence of schools and qualified teachers is often insufficient.

In addition to inclusion and access, 5G also facilitates collaboration between students and educators from different locations. This interconnection allows different groups to come together to carry out interdisciplinary projects, promoting an exchange of experiences that enriches the learning of all involved. The ability to connect devices on a

high-speed network paves the way for students from different social and economic realities to benefit from collectively enriched learning. By generating this interaction, 5G not only broadens students' cultural perception, but also prepares them for the increasingly globalized and interconnected job market.

However, the implementation of 5G in education does not come without challenges. The introduction of this technology raises important questions about the privacy and security of student information. The collection and storage of sensitive data in virtual environments requires the adoption of appropriate protection policies, in order to ensure that students' rights are not compromised. Therefore, it is essential that educational institutions develop and adopt a robust regulatory framework, promoting ethical practices that ensure data protection. Rapid technological advancement requires critical reflection and careful preparation so that the benefits are widely realized without sacrificing the safety and integrity of users.

Additionally, it is essential to address the issue of digital inclusion. Despite the promises of democratization of access, there is a risk that technological advancement will widen inequality between different social groups. The lack of adequate infrastructure in some regions of the country, coupled with the difficulty of accessing electronic devices, can result in an even greater exclusion for those who are already disadvantaged. Therefore, the debate on how to implement 5G in education must be guided by a critical analysis of the social and economic realities of students and the regions in which they are inserted.

The discussion around the implementation of 5G in education must therefore be accompanied by a careful assessment of the social, ethical, and pedagogical impacts that this technology can bring. The balance between innovation and social responsibility is key to ensuring that technological advances not only offer new opportunities, but also contribute to a more inclusive and safe mode of education.

Finally, it is evident that 5G has the potential to transform the educational landscape as a whole. The possibilities of integrating new methodologies, increasing access to resources, and creating more collaborative learning environments are initiatives that, if well implemented, can generate a perennial positive impact on education. However, it is essential that this transformation occurs in an ethical, inclusive, and responsible manner. Thus, we will not only be preparing our students for the challenges of the future, but also promoting a fairer and more equitable education for all.

FINAL CONSIDERATIONS

The objective of this research is to analyze the impact of 5G technology on education, exploring how its characteristics can transform teaching and learning practices. The survey investigates the opportunities offered by high connection speeds, as well as the challenges that arise in this new scenario. The main results reveal that 5G not only expands the technological capabilities available in classrooms, but also promotes a more inclusive learning environment. With the possibility of access to rich content, such as high-definition videos and augmented and virtual reality applications, there is an increase in student engagement. According to the findings, "the fast connection allows for more efficient and productive interactions between students and teachers" (Teixeira; Rech; Anacleto, 2023). In addition, the research highlights that technology facilitates real-time collaboration, which enriches knowledge sharing and stimulates creativity. The interpretation of the findings suggests that the implementation of 5G can contribute significantly to the reduction of educational disparities. Access to digital resources, previously limited in areas with low-quality connections, expands, providing equal opportunities for all students. In this sense, digital inclusion imposes itself as an essential factor for education to become truly equitable. The survey confirms that "the democratization of access to information and knowledge is one of the most relevant consequences of the adoption of 5G" (Sobrinho Junior; Moraes, 2022).

When considering the relationship between the results and the hypotheses raised, it is observed that the expectations regarding the impact of 5G on education are fulfilled in many aspects. On the one hand, the initial hypothesis, which maintains that the speed of connection could improve pedagogical practices, is validated by the data obtained. On the other hand, the challenges identified, such as the need for teacher training and investments in infrastructure, reinforce the urgency of strategic planning for the adoption of this technology in the educational environment. The contributions of this study to the area are significant. By offering an in-depth understanding of how 5G can be a vector of innovation in education, the research provides valuable insights for managers and educators seeking to implement effective solutions in their contexts. In addition, the results stimulate debates on the importance of continuous teacher training and on the urgency of developing curricula that integrate new technologies, ensuring that they are used in a pedagogical and effective way.

However, it is relevant to recognize the limitations of the research. The scope of the analysis focused on urban environments, where 5G infrastructure is already in advanced deployment. Thus, the impact in more remote regions or with deficient infrastructure requires further investigations. In addition, sociocultural aspects that can influence the adoption of 5G in education require a deeper analysis for a comprehensive understanding of the phenomenon.

Finally, the reflection on the impact of this work signals the relevance of 5G in the future of education. Technology not only changes the way content is presented, but also redefines the role of the educator and the student. It is a transformation that goes beyond simple connectivity; It is a restructuring of the very understanding of teaching and learning. Thus, the research is inserted in a broader context, emphasizing the importance of an education that adapts to the demands of a world in constant technological evolution. The relevance of the theme reaffirms that the integration of technology is a necessary step towards building a more inclusive and dynamic educational system, capable of better preparing students for the challenges of the future.

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