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At School . . . with and Without a Computer: The Importance of ICT in the School of the Future

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Abstract

We live in a globalised, knowledge-hungry society in which the immediacy of information is increasingly a necessity that has become a reality even in the most remote places. This article aims to reflect on the importance of Information and Communication Technologies (ICT) in education, emphasising the need for skills and literacies in a globalised society. The school must provide tools that enable the acquisition of these competences, but the lack of continuous teacher training and adequate resources limits the effective use of these technologies in the classroom. The main research question concerns teachers' perceptions of ICT, the most widely adopted technologies, and their impact on their daily lives. To answer the research question, we defined the main objectives as understanding teachers' perceptions of ICT and identifying the technologies most used in teaching, highlighting how they can transform the learning process and improve the results of students, especially those with the most difficulties. The aim of this work is to find out how teachers perceive the use of ICT and, at the same time, to demonstrate that its use in the classroom enhances the teaching–learning process, making it more relevant, effective, and in line with the demands of the contemporary world.

Keywords: ICT; education; teachers; innovation; learning

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1. Introduction

With the advancement of technology, accessing databases, knowledge, and information in a few clicks is possible. The world of learners has changed dramatically. Likewise, as new forms of knowledge and ways of structuring it emerge, approaches to teaching and learning must change.

Classrooms are different from what they used to be. Although many retain traditional features, equipped with blackboards and controlled by authoritarian and strict teachers, the current generation of students, highly exposed to devices such as smartphones and tablets, has information and answers to all of their questions just a click away. The ease and speed of information and assessment of content translated by the teacher indicate that, today, with the support of digital and pedagogical resources, access to information is more agile, and learning assessment is more dynamic. The teacher acts as a mediator, translating complex content to make it understandable and accessible to students, accompanied by the desire for freedom to decide what and how they want to learn—showing that, alongside this agility, there is a growing desire for autonomy among students. They do not want to receive information passively, but to actively participate in decisions about content (what to learn) and methodology (how to learn) [1].

The contemporary classroom is constantly changing, marked by the growing presence of technology and the changing dynamics between teachers and students. Although many school environments still preserve traditional aspects, such as blackboards and a teaching practice centred on authority, a generation of deeply connected students has almost instant access to information through smartphones and tablets [2]. This new scenario significantly alters the role of the teacher, who moves from being the sole transmitter of knowledge to being the mediator of the learning process, responsible for interpreting and making complex content accessible, through the use of pedagogical and digital resources that enhance learning agility and dynamism [3].

Alongside this agility, there is an intense desire for autonomy among students, who are no longer satisfied with passively receiving content. They want to be actively involved in decisions about what to learn (content) and how to teach it (methodology), demanding more flexible approaches such as personalising teaching, using active methods, and incorporating interactive technologies. This movement aligns with critical and liberating pedagogical concepts, which recognise the student as the subject of their training process [4].

However, despite the advances and potential of this new teaching–learning model, it is necessary to reflect on significant challenges, such as unequal access to technologies, the need for ongoing teacher training in the appropriate use of digital resources, and the risk that rapid access to information will lead to superficial learning processes [5]. Thus, the reconfiguration of the classroom requires not only technological innovation but also a re-evaluation of pedagogical foundations, valuing the role of the student without compromising the teacher's qualified mediation.

This gives rise to the need for approaches that involve students in their learning in a collaborative and contextualised manner, using the new spaces and times provided by ICT (Information and Communication Technologies), which make students global citizens embedded in multiple networks. For ICT to truly contribute to teaching and learning, more than just superficial use is needed. These technologies are often applied without any connection to the educational context, functioning only as complementary tools that neither achieve nor transform how students think and learn [6]. This is because ICT is often just a decontextualised pedagogical accessory and, therefore, does not access students' mental and cognitive schemas. In these cases, it is a mere communication facilitator, not signifying new methods and pedagogical approaches. It replaces old tools with new ones, without considering the changes that these tools have brought to students and their context. To take better advantage of the new learning opportunities offered by technology, it is first necessary to deepen theoretical reflection on the context in which students currently find themselves.

This context refers to a fundamental fact: the technologies of today's world are not just tools or instruments; they are the context of the student and an essential part of their world, their perceptions and social representations, and, consequently, their cognitive and learning processes. ICT has transformed the functioning of the human brain, especially in attention, memory, language, and the way we learn. Today, with young people's exposure to new technologies, they are increasingly adapted to them and, simultaneously, dependent on their use. As teachers (for the most part) did not have this same technological immersion from an early age, there is a generational gap in how they think and learn. This gap creates a barrier between the minds of students and teachers, hindering communication and the effectiveness of traditional teaching. To overcome this barrier, teachers need to understand how students think today, recognise the cognitive changes brought about by ICT, and adapt their lessons and teaching practices to this new reality.

Only then will teaching be more effective with methods compatible with how today's students learn through digital media [7]. The use of technology alone does not transform

education. It is transformative because it is integrated into the teaching–learning process, always aiming to improve students' experience and outcomes [8]. We have ample evidence of the potential added value of ICT in education and how the Internet, computers, and mobile phones have helped us live through the COVID-19 pandemic.

Furthermore, knowing that technology has been tested and has answered the doubts of even the most sceptical [9], we must also be aware of the need to constantly reflect on how best to control it intentionally.

Information and Communication Technologies (ICT) have significantly transformed contemporary society, influencing how knowledge is accessed, produced, and shared. In the educational context, the integration of ICT is not only desirable but also essential to promote more meaningful and motivating learning that meets the demands of the 21st century. The introduction of ICT in Portuguese aligns with national and international policy guidelines, such as the Digital Transition Plan, the Profile of Pupils Leaving Compulsory Schooling, and UNESCO guidelines.

These documents emphasise the importance of digital skills, critical thinking, and collaborative learning.

Information and Communication Technologies in education must go beyond their technical use and be anchored in a critical and reflective pedagogical approach. Technologies are not neutral: their impact depends on how they are integrated into teaching practices [10].

In this sense, models such as TPACK (Technological Pedagogical Content Knowledge) and Bloom's Digital Taxonomy offer fundamental theoretical references for thinking about the meaningful integration of ICT. The TPACK model [11], posits that the effective use of technology in teaching relies on the interconnection among content knowledge, pedagogical knowledge, and technological knowledge.

Evaluating these and other existing models will form part of my subsequent study, which will be incorporated into my doctoral thesis.

In Portugal, under the government slogan, "We do not stop. We are ON", several measures have been taken, including in the education sector, for which "a set of resources has been made available to support schools in the use of distance learning methodologies that would enable them to continue the teaching and learning processes" [12]. The University of Minho, which houses a Centre of Competence in ICT (CCTIC) at its Institute of Education, is a structure that, "in close collaboration with ERTE (Educational Resources and Technologies Team), has the mission of supporting schools in integrating ICT into the curriculum, thus contributing to the development of digital skills in education" [1], which immediately made available a service to "help teachers solve some of the most immediate problems related to distance teaching and learning"; Two new projects were also created from scratch at this Institute: the "Trancadas em Casa" (Locked at Home) project, with the "aim of welcoming children's voices and disseminating their experiences and needs" [6]; and the Approximar Network, a "socio-educational and community intervention project with technological mediation aimed at the elderly population in situations of social isolation in Portugal, aggravated as a result of the COVID-19 pandemic" [7]. It was not only in Portugal that ICT made a decisive contribution during the pandemic. We can mention "CovEducation", which enabled university students to be paired with younger students to facilitate online learning [8].

With the global pandemic, anyone interested in learning about experiences in other areas can consult the database of emerging approaches that the World Bank is cataloguing [9]. Digital technology alone is not the ultimate goal of any educational process. One does not learn how to use technology in the classroom, nor can one measure the quality of a lesson by the amount of technological resources used. The use of ICT in the classroom must be

planned and, above all, have a pedagogical purpose, because "digital is not the end, it is the means" [12]. When integrated with a pedagogical intention, ICT offers fundamental conditions for transforming the ways in which people learn. Not only does it facilitate access to information, it also creates opportunities for the focus of learning to go beyond memorising content and concentrate on developing creativity, curiosity, and critical thinking. By freeing students from mechanical and repetitive tasks, technology allows them to explore the "why" of things, deepen their understanding, and connect knowledge to real-life situations. Furthermore, by enabling more personalised and meaningful learning experiences, ICT helps students understand the significance of their efforts, sparking genuine motivation and commitment. In this way, technology ceases to be an end in itself and becomes a powerful means of humanising the educational process.

Technologies provide some of the conditions necessary for the focus of learning to be "centred on creativity, on the 'why' of things and on the 'why' of the effort to learn" [13]. Since school is the place for education, the environment for student–teacher relationships, and the environment for student–educator interaction, we realise that schools that provide meeting points and physical presence must be complemented with computing and communication infrastructure that offers online company [14], since we live in a hyperconnected era, in which "our actions, perceptions, intentions, morality and even our physicality are interconnected with technologies" [14]. At a time when it may be unwise to ignore that 25% of young Portuguese people who participated in National Defence Day in 2019 said that they spend six hours a day on the Internet [15], it is understandable to admit and predict that learning experiences include experiences with the regular, intentional, and conscious use of technologies. It is important to note that some argue that guaranteed (free) access to the Internet should be considered and included in the set of human rights [16].

In an age when most social, professional, educational, and even political interactions take place in the digital environment, excluding individuals from access to the Internet means, in practice, preventing them from fully exercising other fundamental rights, such as the right to information, education, freedom of expression, and citizen participation.

According to the United Nations (UN), the Internet has become essential to exercising civil, political, economic, social, and cultural rights. In 2016, the UN Human Rights Council stated that countries should not adopt measures that impede access to the Internet, recognising it as an essential tool for ensuring freedom of expression and association.

In addition, authors argue that, in the information society, digital exclusion deepens social inequalities and limits the development of human capacities. Access to the Internet must therefore be understood not only as a technological issue but also as a condition for the whole exercise of citizenship [10,17].

This exploratory study is part of a broader research project focused on ICT. The study focuses on understanding teachers' perceptions of the use of emerging technologies in education.

To this end, we adopted the focus group methodology, a qualitative technique that allows us to interactively explore the opinions and attitudes of a group of participants. The objective of the focus groups was to answer our research question: "To what extent are new ICTs important in the teaching and learning process from the teachers' perspective?" This led us to other questions: What are teachers' perceptions of Information and Communication Technologies? What are the new technologies most used by teachers in the classroom? What is the impact of new technologies, from the teachers' perspective, on the teaching–learning process? To answer these questions, we set two main objectives: to determine teachers' perceptions of ICT and, in particular, the ICT recommended for teaching in a given cycle of education; and to determine the ICT most used by teachers in the classroom.

2. Background

2.1. The Role and Function of ICT at School

ICT has been assuming an increasingly influential and even indispensable role in various disciplinary areas, with a permanent evolution of the paradigms related to their use. Due to the potential of ICT, there has been a strong focus on exploring these technologies in education in recent years. The reasons that led to the inclusion of ICT in the curriculum are present in a society that has evolved and has changed profoundly—that is, that has moved from an industrial society to an information or knowledge society, where new challenges have emerged, with ICT as a driving force of these changes.

Initiatives such as the technological modernisation programme of the Portuguese school of the XVII Constitutional Government were important in achieving a decisive turn towards what really matters in the school: teaching and learning, using technology and digital resources (Plano Tecnológico da Educação (PTE)—Resolution of the Council of Ministers No. 137/2007, of 18 September 2007).

Along the same lines, the Ministry of Education, when introducing the subject of ICT in the 9th grade curriculum in the 2004/2005 school year and, in 2007, in the non-disciplinary curricular areas of the 8th grade, outlined how "strategic objective the need to ensure that all young people have access to Information and Communication Technologies, as an indispensable condition for improving the quality and effectiveness of education and training, in light of the demands of the knowledge society" [13]. The importance of some dynamics that induce this progress strategy—namely, the selection of pedagogical activities and forms of organisation—focused on the goals to be achieved, with special emphasis on curricular activities in the classroom and the role of ICT in the development of transversal skills of students, but also, for the work carried out in other contexts, it was widely mentioned in the 2015 Education Program.

2.2. Perspectives on Teaching and Learning with ICT

We live in an information society supported by ICT, but that does not translate into a knowledge society. To achieve this, we must work together to "generate" knowledge with the available information. The teacher will play a very important role in this process. Currently, the excess of information implies difficulties in its organisation. Therefore, it will be up to the school to play a leading role in learning the mechanisms for transforming information into valid knowledge. For this, it is necessary, if not essential, that changes and adaptations occur in the school itself according to the current conditions. This is the only way to prepare students for a world in constant change and rapid evolution. According to [14], in the knowledge society, "it becomes imperative that each subject learns to learn", which implies that each person is understood as a central purpose of education, in the sense of taking charge of the construction of knowledge itself and developing mechanisms for self-learning or collaborative learning. To achieve this purpose, the teacher must see the computer as a facilitating and fundamental tool in student learning.

The redefinition of the teacher's role in the digital age requires a paradigm shift in their pedagogical performance. Teachers must stop being mere transmitters of knowledge and become mediators of knowledge, continuous learners, constructors of meaning, and intentional organisers of learning. This transformation demands much more than mastery of basic tools such as Word or PowerPoint; above all, it requires a critical and creative understanding of the possibilities offered by digital technologies. To achieve this new professional profile, it is necessary to overcome fears and resistance, actively exploiting the resources made available by Web 2.0 and Web 3.0, which favour the creation of interactive learning, entertainment, and collaboration spaces on the web. These tools broaden the horizons of educational practice, allowing for the development of methodologies that are

more dynamic, personalised, and connected to students' contemporary realities. Thus, pedagogical innovation mediated by ICT is not just a technical requirement but an ethical commitment to a more meaningful and transformative education [15].

The teacher acquires a technological culture—ceasing to be a mere transmitter of knowledge, the main holder of knowledge—and, in turn, the student is no longer the passive consumer of information, restricted to the simple oral explanation of a classroom, which resulted in limited information. In this way, the student has an assistant who helps build their knowledge. The best way of teaching is one that values the student's ability to seek new understandings through active and investigative processes. This concept is in line with constructivist learning theories, in which the student takes a leading role and builds knowledge from their own experiences and reflections. From this perspective, the teacher needs to be attentive to the elements that make up the learning process, to encourage the development of both cognitive and artistic thinking, recognising that these dimensions complement each other and enrich the educational process. In addition, the teacher is seen as a facilitator whose role is to create environments conducive to learning, acting with sensitivity and openness to the new. This attitude requires teachers to be willing to learn throughout the process, assuming an attitude of listening, curiosity, and constant updating. In this way, teaching becomes a space for collaboration, creativity, and mutual growth, in line with the demands of a more critical, inclusive, and transformative education [16].

Today, learning is not limited to the school environment: it is continuous, collaborative, and takes place in different contexts (the classroom, social networks, groups of friends, or everyday experiences). The student is seen as someone who not only consumes knowledge but also shares and builds it collectively, creating environments of exchange, dialogue, and mutual growth [13]. An innovative attitude on the part of school staff is essential, as they must prioritise the search for new teaching methods capable of responding to the challenges of contemporary education. In this sense, the integration of Information and Communication Technologies (ICT) into the learning process must go beyond their restricted use as a mere technical support or support tool. Instead, ICT needs to be incorporated in a strategic and meaningful way, as a central element in the development of students' cognitive, creative, and collaborative competences. This effective integration requires a review of traditional teaching practices and promotes the construction of new pedagogical strategies for approaching school programmes and curricula. It is, therefore, a methodological transformation that brings teaching closer to the digital reality experienced by students, making learning more dynamic, contextualised, and relevant to citizen education in the 21st century.

The presence of ICT in pedagogical practice should "awaken curiosity, develop autonomy, stimulate intellectual rigour, and create the necessary conditions for the success of formal and permanent education" [18]. Today, we are in the era of the E (electronic)—that is, in the era of the e-teacher, e-moderator, e-learner, e-school, e-learning, e-learning, etc., but this does us little good if we do not understand that our students are different, have different interests, and arrive at school with an enviable technological background for many of us. Our students need to be guided to develop skills that allow them to mobilise knowledge, manage the large amount of information that they are bombarded with daily, and develop meaningful learning adapted to the current demands of society. Throughout these two decades of the use of ICT, teachers have been challenged to find the most appropriate methodologies for their students in each context.

In this short space of time, technological evolution has been enormous, but we must be aware that the next technological leaps will be even faster, and it is up to us—teachers—to find the best way to enhance the use of ICT in the development of students' transversal skills at the service of learning or, to quote, for "their professional development, but, above

all, for them to be able to use them with their students, providing them with innovative learning situations, more interesting and closer to the surrounding reality" [19].

ICT is essential for teachers who want to develop meaningful learning with their students, translating into an attitude that facilitates the knowledge construction process [20]. It is indeed of paramount importance for the educational community that ICT be a tool as current as paper, pen, and chalkboard, and simultaneously, that it be a dynamic, interactive, and appealing learning enhancer, which facilitates collaboration and sharing of knowledge and experiences. The growing investigations carried out on this topic demonstrate that there are many benefits from this integration of ICT, given that (i) ICT is a resource and means of facilitating learning, and (ii) its integration causes effects in the development of research skills and the collection, selection, ordering, management, and use of information [20].

We believe that teachers can play a fundamental role in the development of transversal skills in students by encouraging the use of ICT, and by promoting among them the construction of interpersonal relationships, collaboration, and interaction. Likewise, at an individual level, each student should be encouraged to foster skills such as negotiation and autonomous learning. "Effectively, it is not a question of teaching children to use ICT, but rather of putting them at the service of their educational development" [21].

2.3. The Role of the School

Increasingly, the role of school is being changed due to social transformations. It is currently the starting point of a continuous lifelong training process, having a "systemic function of preparing citizens both to develop their qualities and to live in society", as advocated [22]. In this way, it works as a regulator of student learning in the information and knowledge society. As a result of this reflection, we dare to say that, more than providing a set of knowledge, its objectives should focus on the development of skills and knowledge—that is, on the formation of citizens who assume knowledge and learning as inherent values, to the model of the Society of the 21st Century. The Green Book for the Information Society in Portugal (1997), a reference text for schools of the 21st century, states in Chapter 4 that "[The school] has to be seen as a place of learning instead of a space where the teacher is limited to transmitting knowledge to the student; it must become a space where the means to build knowledge, attitudes and values and acquire skills are provided. Only then will the school be one of the pillars of the knowledge society." The school has a leading role to play in the evolution of the information society to a knowledge society, by being concerned with providing teachers and, consequently, students with new skills, allowing them to respond effectively to the new demands of this emerging society.

In the face of social, technological, and cultural transformations, the school must reassess its role in society. The society of the twenty-first century highlights the need for a more comprehensive educational approach, which goes beyond the simple transmission of theoretical content and promotes the integral formation of students. In the current context, marked by rapid social, technological, and cultural transformations, the school must prepare students not only to master information but to apply knowledge in a critical, creative, and collaborative way.

Developing skills—such as problem-solving, critical thinking, effective communication, and social responsibility—becomes as important as acquiring formal knowledge. Thus, the school should be conceived as a dynamic space for the construction of meanings, in which knowledge is articulated with practice, ethics, and citizenship, responding to the demands of a society in constant change [18].

Reinforcing qualifications and skills is essential for building a knowledge society and is one of the main objectives of education (Resolution of the Council of Ministers n.º 137/2007): "It is up to the school to teach reading, writing, understanding basic notions of

the physical and social world, solving problems and so on (. . .), but how does the school do this?" [19]. The school must respond to the demands of contemporary society, advocating an effective integration of digital technologies in everyday educational life. By suggesting that computers should be present as notebooks and books, and that blackboards should be replaced by interactive whiteboards, it is essential to reconfigure resources and learning environments, making them more dynamic, accessible, and compatible with the technological reality experienced by students. However, the most profound transformation lies in the change in the focus of pedagogical practices: the teacher is no longer just a transmitter of content to become an organiser of the students' learning paths. This implies a more demanding, intentional, and student-centred planning, aimed not only at defining teaching strategies but at building meaningful experiences that respect individual rhythms and needs. Thus, the contemporary school must take on the challenge of articulating technological innovation and pedagogical innovation, promoting a more interactive, reflective teaching aimed at the integral formation of the subject [20].

Since the Internet is the most immediate source of information today, and facing a society that demands constantly updated knowledge, the school will undoubtedly have a very important role to play in developing competences for the selection, treatment, and analysis of the enormous flow of information that comes to us daily.

In today's world, with Internet access available on the digital devices (smartwatches, smartphones, laptops) that we all use every day, information circulates and transforms very quickly. The Internet has become an almost infinite repository of data and knowledge, but also a space where knowledge is constantly revised, challenged, and replaced. "What was knowledge yesterday is now outdated", bringing us to a phenomenon that imposes a major challenge on individuals and institutions: the need for continuous adaptation, permanent learning, and a keen critical spirit to distinguish what is relevant, reliable, and up to date. Instead of static knowledge acquisition, we are now invited to participate in a dynamic process of constructing and reconstructing knowledge [1].

Schools need to rethink their role in the light of Information and Communication Technologies (ICT). In the past, the school operated as a space for transmitting and reproducing information, where the teacher was the main source of knowledge and the student a passive recipient. However, with the advance of ICT, this model has become increasingly obsolete. This is one of the main factors contributing to the current state of education in Portugal.

ICT offers tools that promote collaboration, democratic access to information, and the possibility of building knowledge in an active, critical, and shared way. Digital platforms, virtual learning environments, educational social networks, and other technologies allow students to collaborate with teachers and even with external experts, overcoming the physical and temporal limits of the traditional classroom.

The great challenge, therefore, lies in changing the institutional culture of the school. This requires a pedagogical transformation in which teachers take on the role of mediators and facilitators of learning, promoting the development of competences such as autonomy, critical thinking, creativity, and the ability to solve problems collaboratively.

Another important factor in this change has to do with teachers' ongoing training. Teachers need to be unafraid of taking risks and stepping out of their comfort zone, seeking out training that will enable them to use ICT in the classroom. Investment in technological equipment and the construction of a pedagogical vision aligned with the principles of a more inclusive education, contextualised and connected to the real world, are other factors that the Ministry of Education should take into account to change the direction of education [15].

In this sense, it is important to clarify the following question: What is the role of the school in today's knowledge society? Although much is said about the information society or the knowledge society, the school is still considered to be a means of democratising society and should be of free and equal access for all. In schools, we have an enormous diversity of students with diverse cultural levels and diverse experiences, coming from a non-homogeneous information society and in constant technological evolution. It is important that the school, in conjunction with political power, point to diversified and flexible curricular models, which promote the ability to "learn to learn", in stimulating learning environments that take into account the changes that society is undergoing, seeking to offer a diversity of knowledge through the exchange and sharing of interests and experiences, and that meet the interests and skills of students and help to reduce school failure and social exclusion.

We have been witnessing a differentiation of teaching models, and the school has turned to valuing both formal and informal learning, which is reflected throughout life, adapting education and training to the world and the surrounding society and, consequently, to the world of work and employment.

Another pertinent aspect is the lack of updating of curricula.Traditional models of curriculum design, often centred on fixed content, isolated subjects, and transmissive teaching, no longer meet the demands of today's world, which means that some subjects have fewer and fewer students, and sometimes the school cannot obtain the minimum number of students required to open a class.

In the past, the school was the main (and often only) holder and transmitter of knowledge. Today, this role has been decentralised. Students have access to multiple sources of information—often in real time—and expect teaching that is more dynamic, relevant, and adapted to reality. This means that the curriculum needs to stop being just a set of contents to be complied with and become a flexible structure that favours meaningful learning, interdisciplinarity, complex problem-solving, and the development of essential skills for the 21st century [21].

If the school manages to welcome and develop within itself the new tools and methodologies available, its role will prove to be fundamental insofar as it prepares students for active life, for cooperative work, for solving authentic problems, and for promoting the construction of knowledge. ICT, which is at the heart of the information society, must play a central role in the school's functioning if we want it to achieve the educational success required by the society in which it operates [23].

2.4. Qualitative Research

Qualitative research is the natural approach to understanding the concepts, ideas, or dimensions that we can find with respect to our central themes; it allows us to investigate relationships between categories that may be subject to change during the research process [24].

Thus, we can observe things and worry less about measuring them [25]. Whether we opt for a more naturalistic model, looking at voice and subjectivity, or a more constructivist model, following characteristics of the social world that emerge naturally, the important thing is whether we can highlight extraordinary attributes of everyday life [26].

Qualitative research helps us understand what is important to people [27], giving us access to a more subjective meaning than other approaches. Over the years, this has become known as the pluralisation of lifeworlds [28]. Qualitative research is a generic term for a unified research programme with different objectives and procedures [28]. It also follows two basic principles: coding and categorisation on the one hand, and text in context on the other [28]. However, it is essential to note that qualitative research—especially in our case,

with an exploratory study through textual analysis—has also evolved due to development. This technological change influences the type of qualitative research [28].

Currently, Qualitative Data Analysis (QDA) and Computer-Assisted Qualitative Data Analysis Software (CAQDAS) are fundamental not only for data analysis but also for supporting the Qualitative Data Analysis process [29]. QDA software (MAXQDA) is a word processor that facilitates the researcher's writing, promoting qualitative research [28]. Depending on the programme, it also facilitates the representation of data, structures in the data, and findings through graphical maps. Through these, we can increase the quality of qualitative research. QDA software increases the validity of analyses [30,31], allows for the consolidation of research [29,32], and facilitates sampling decisions [30]. With QDA software, data management becomes easier, and various techniques are supported, using the definition of pointers to retrieve indexed text segments; build electronic cross-references, which can be used to jump between tickets; facilitate researchers' comments; define links between index worlds using variables and a filter; facilitate the retrieval of related text segments; and facilitate the retrieval of quantitative attributes from the database [30].

Thus, we have seen the significant impact and help of technological software, and even with the concern of some authors that this may distract researchers from the analytical work itself, it helps in reading, understanding, and contemplating texts and other sources [28]. Computers can drastically affect the research process and outcomes, from unacceptable restrictions on analysis to the unexpected opening of new possibilities [33].

This research employed a qualitative approach, aiming to gain an in-depth understanding of participants' perceptions regarding the use of ICT in the classroom and how this use alters the classroom dynamics. Qualitative research assumes that reality is subjective and socially constructed, and it is best suited to exploring perceptions, beliefs, and experiences in their natural contexts.

We collected data through three focus groups with six primary and secondary school teachers. The focus groups allowed us to investigate subjective aspects that would be difficult to ascertain through quantitative methods or individual interviews. The inclusion criteria were that they were class teachers who owned a computer or laptop and used it in the classroom. We excluded all teachers with educational support or zero hours, because they could not apply computer use during the teaching process.

2.5. Leximancer Tools

The digital world has brought considerable changes in various areas (e.g., information systems, service provision, goods acquisition), and it is plausible that the same has happened in education, opening up a range of potential gains for the educational process. Although the use of Information and Communication Technologies by students in entertainment and social relations is undeniable, this does not seem to be the case in terms of teaching and learning, and it is unclear whether the digital element mediates teaching activities systematically and consistently. For this study, we chose to use CAQDA Leximancer software (version 4.5, Leximancer Pty Ltd., Queensland, Australia), a typical data extraction tool that enables textual analysis of documents, identifies high-level concepts, and provides key knowledge and actionable insights through models, interactive visualisations, and data reports.

The Leximancer tool, aided by Computer-Assisted Qualitative Data Analysis (CAQDA) software, allowed us to conduct qualitative research that enabled us to analyse the links between the main ideas and ICT, and that could also help us explore possible future studies to deepen and discover more about this emerging concept. Leximancer can search, add, remove, and merge terms and extract semantic (meaning) and relational information [34]. It can also detect key concepts based on their similarity and association with other words,

using machine learning to generate and classify its glossary for each dataset [35]. It has been used in an academic research environment in business, sectoral, social, cultural, education, leisure, and tourism studies [2], showing a wide range of research in which this software has helped in data analysis. Leximancer does not need to search, as it can show us the fusion concepts generated automatically from the text [34,36].

As a text mining tool, it provides conceptual maps using well-established methods to extract key concepts from texts [37]. Conceptual maps are very effective for identifying document trends and quickly understanding the new domain, allowing one to explore, in detail, the overall scope of the textual domain of the body [37]. Leximancer has proven its analysis to be reliable [38] and stable, equivalent to inter-coder reliability [39], producing stable maps for studies [37].

This allows us to deeply analyse the collected data and the results obtained, providing research, theoretical analysis, substantive content, and certainty [25,40], which are very important for any researcher.

Leximancer in Comparative Perspective: A Scientifically Validated Approach to Textual Analysis

Recent advances in computational text analysis have positioned Leximancer as a uniquely powerful tool for qualitative and mixed-methods research. Unlike manual coding software (e.g., NVivo by Lumivero, Atlas.ti 24), Leximancer employs machine learning algorithms to automate concept extraction and thematic mapping, significantly reducing interpreter bias while enhancing reproducibility [41]. This algorithmic objectivity addresses a critical limitation of traditional qualitative methods, where coder subjectivity can compromise reliability [42]. Leximancer's visual analytics capabilities further distinguish it from its competitors. Its dynamic concept maps and heatmaps quantify semantic relationships in ways that manual tools cannot replicate [43]. For instance, a study comparing Leximancer with MAXQDA demonstrated that Leximancer's co-occurrence networks identified latent themes in large corpora that human coders overlooked [44,45]. This is particularly valuable for hypothesis generation in exploratory research.

The software's capacity to process vast datasets (10,000+ documents) with consistent accuracy makes it indispensable for big-text research. Its multilingual validation [46]also expands its utility across diverse linguistic contexts. However, Leximancer is less suited for deep hermeneutic analysis [47], and parameter tuning remains essential for optimal results. Leximancer offers unparalleled advantages for studies requiring systematic, scalable, and statistically valid text analysis. Its integration of machine learning with visual analytics bridges a critical gap between qualitative depth and quantitative rigour.

2.6. Data Preparation and Analysis—Procedure

Qualitative Data Analysis was conducted using Leximancer 4.5 software, which automatically extracted concepts and themes based on semantic associations in the textual corpus. The research corpus consisted of the transcripts of three focus groups, which were previously organised and reviewed to ensure textual consistency and participant anonymity. Leximancer generated conceptual maps that visually represented the main emerging themes as well as the frequency and proximity of the identified concepts. Although manual coding was not applied, the results were interpreted based on the theoretical framework adopted and the study objectives, ensuring the methodological consistency and interpretative validity of the data.

By applying the three focus groups to primary and secondary school teachers, we aimed to obtain answers without testing hypotheses that had already been formulated, so there were no control groups or other validation strategies.

Eighteen teachers, aged between twenty-seven and fifty-two, took part in the focus group, comprising eleven females and seven males. All of the participants were Portuguese.

In qualitative research, data saturation is a fundamental criterion for determining the end of information gathering. Saturation occurs when adding new participants or documents does not identify themes, categories, or patterns relevant to the study's objectives [48]. This point marks the sufficiency of the corpus to adequately answer the research questions and guarantee the necessary analytical depth.

In this study, saturation was reached after three focus groups with teachers, in which the recurrence and consistency of emerging themes were observed. The progressive analysis of the collected material indicated that the discourses began to exhibit repetitive patterns, without the emergence of significant new information. This finding followed the principle of theoretical saturation, as proposed by [49], in which the collection is interrupted when the analytical categories are sufficiently developed in terms of properties and variations.

Multiple procedures were adopted for data validation to guarantee the research's credibility, reliability, and methodological rigour. Initially, the triangulation process of sources was employed, involving a comparison between different focus group sessions and teacher profiles (gender, teaching cycle), which enabled the identification of consistency in the information across other contexts. In addition, the Leximancer software contributed to internal validation by providing an automated and standardised analysis of the speeches, reducing the interference of subjective biases in the identification of central concepts.

Interpretive validation (or peer validation) was also carried out. The thematic categories were reviewed by researchers outside the study, who analysed the coherence between the raw data and the interpretations made. This collaborative process strengthened the reliability of the analysis by ensuring that the findings faithfully represented the participants' discourses.

Finally, transparency in describing the methodological procedures and maintaining an auditable record of the analyses (including transcripts, concept maps, and software reports) contributed to the traceability of the results. This confirmed the criteria for scientific validity in qualitative research.

In selecting the teachers who participated in the focus groups, we outlined as inclusion criteria teachers who taught in Portuguese public schools, had classes, and owned a computer.

Using focus groups to collect data, we developed an interview guide with questions previously validated with four teachers from a primary and secondary school in the municipality of Loures, parish of Santo António dos Cavaleiros, district of Lisbon.

We moderated the focus group using a semi-structured guide and maintained a neutral stance throughout the session. The sessions were not timed and lasted between 85 min (the shortest) and 145 min (the longest). Additionally, they were recorded and transcribed to facilitate subsequent intersubjective analysis.

All participants in the focus groups were informed in advance about the research objectives and the voluntary nature of participation. Informed consent was obtained in writing before the start of the sessions, in accordance with the ethical principles established by the ISCTE. The confidentiality of the information shared was guaranteed, and the participants were informed that they could withdraw from the study at any time without prejudice. To protect the identities of those involved, the data were anonymised during transcription, replacing proper names and identifiable references with codes or pseudonyms. In addition, only researchers directly involved in the analysis had access to the original recordings, which were stored securely and subsequently deleted after the transcription and validation of the data. The interviews were conducted using a semi-structured script, maintaining a neutral stance throughout the session.

During the discussions, the participants were encouraged to share their everyday experiences, the ICT they use most frequently in a classroom context, and their use's impact on their students' learning. The focus group guide included the following questions: What does ICT mean to you? What is ICT for you? How is ICT present in your lessons? Do you use ICT to research, teach new content, or do homework? How do you structure your lessons? Are they more expository or interactive? What do you think about the possibility of ICT replacing school books and transforming the educational process into a more hybrid model, in which students become more autonomous and responsible for constructing their knowledge? In your opinion, is ICT a means of facilitating learning or an obstacle to it? How do you feel when you use ICT in a classroom context to develop your students' cognitive skills? Do you have the necessary training/knowledge to use ICT in your teaching practice? Do you have all of the necessary conditions to use/apply ICT in the classroom context?

After the focus groups, we transcribed and created folders. Each folder corresponded to a question from the focus group script, with all of the answers given by the participants to the respective question in each folder. We created nine folders, each corresponding to a question from the focus group script. The text files were uploaded and analysed one by one using Leximancer, paying particular attention to merging similar words (or reducing those that have singular and plural forms) or words with the same semantic root (e.g., world and worlds) and removing others—such as definite and indefinite articles—that were not significant for this study (e.g., a, as, or the).

After this procedure, conceptual maps were created so that we could analyse them according to our research question, objectives, and theoretical and conceptual reviews of the literature. These conceptual maps can be repeated as necessary [50]. It is important to note that the conceptual maps produced by Leximancer illustrate the main concepts extracted from the articles (Figures 1–9), and a group of concepts is considered to be a theme with some standard text [50].

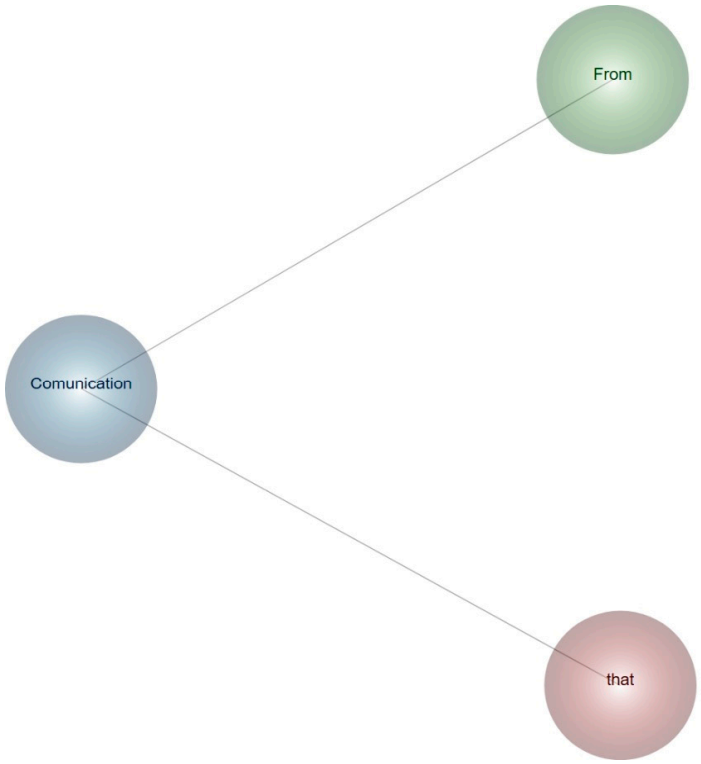

Figure 1. For you, what does ICT mean?

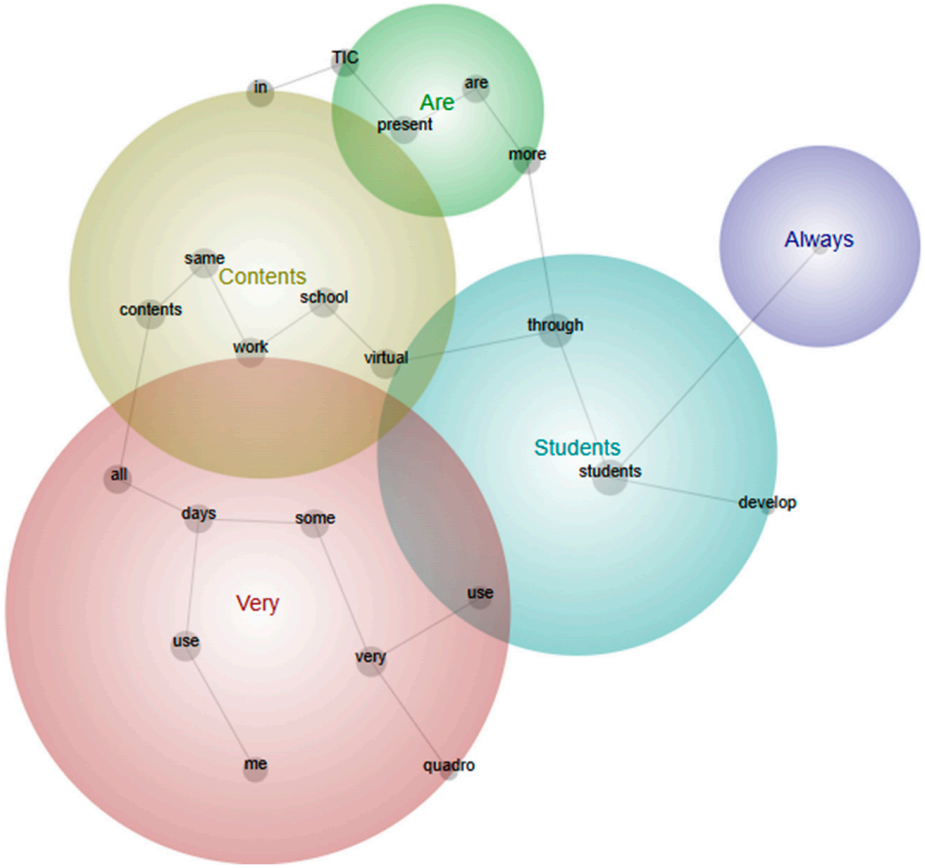

Figure 2. How is ICT present in your classes?

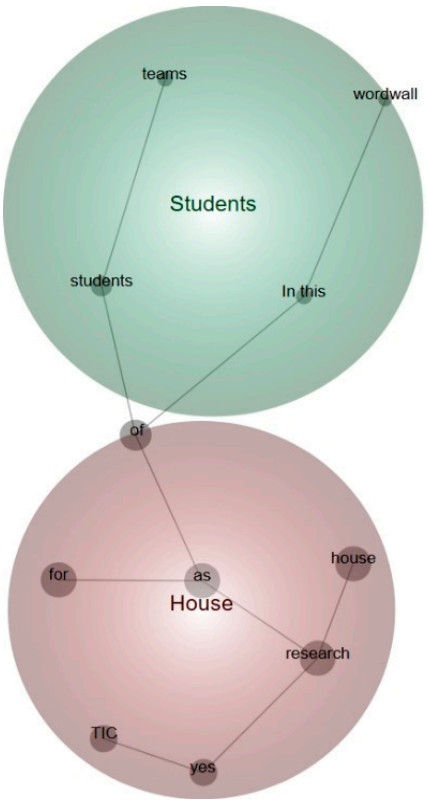

Figure 3. Do you use ICT as a way of research, teaching new content, or doing homework?

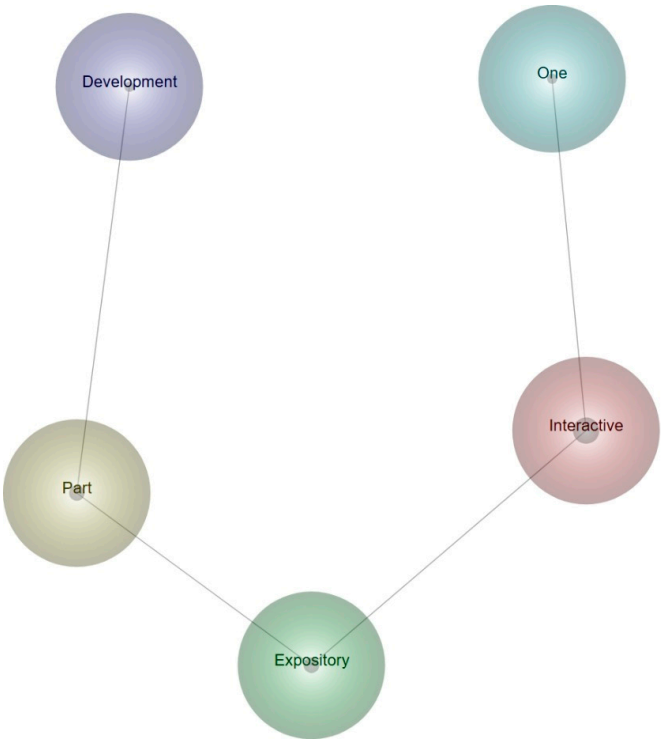

Figure 4. How do you guide your classes? In a more expository sense, or in a more interactive way?

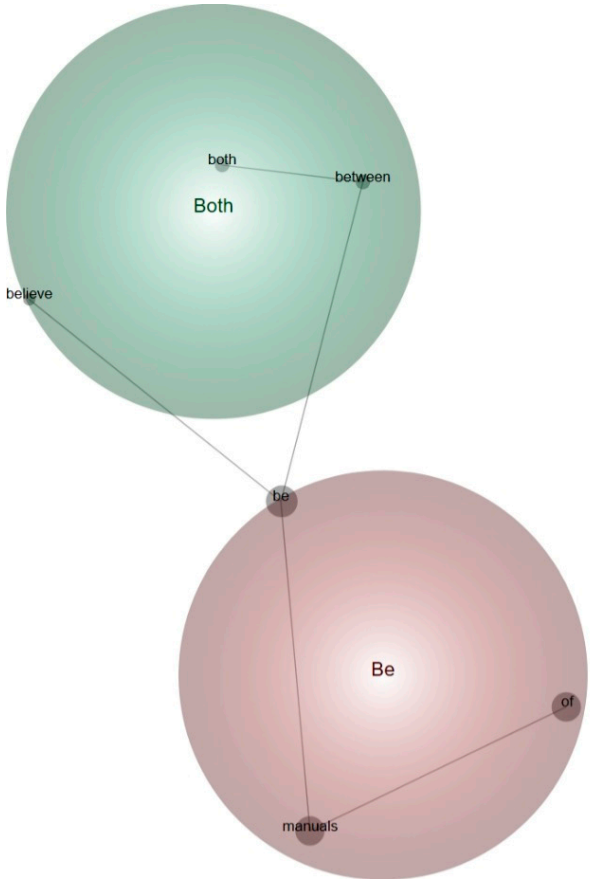

Figure 5. What do you think about the possibility of ICT replacing school textbooks and transforming the educational process into a more hybrid model. in which students become more autonomous and responsible for building their knowledge?

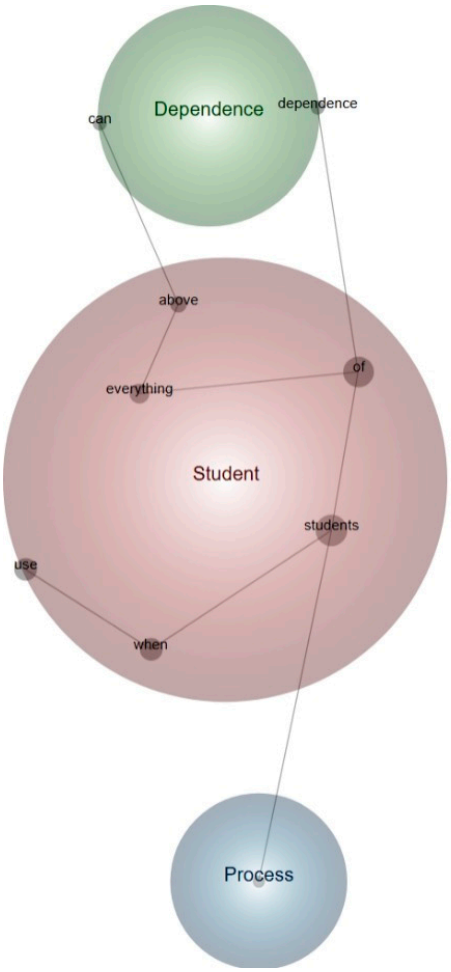

Figure 6. In your opinion, is ICT a means of facilitating learning or an obstacle to it?

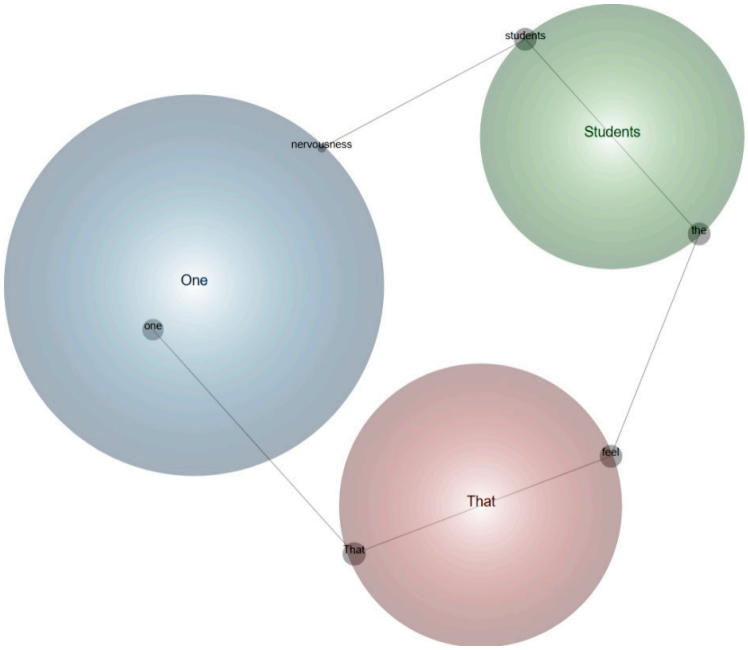

Figure 7. What kind of feeling do you have when you use ICT, in the classroom context, to develop your students' cognitive skills?

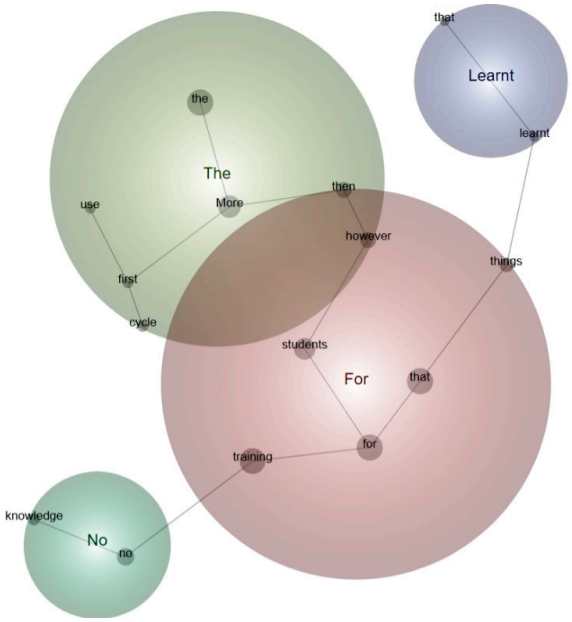

Figure 8. Do you feel that you have the necessary training/knowledge to use ICT in your teaching practice?

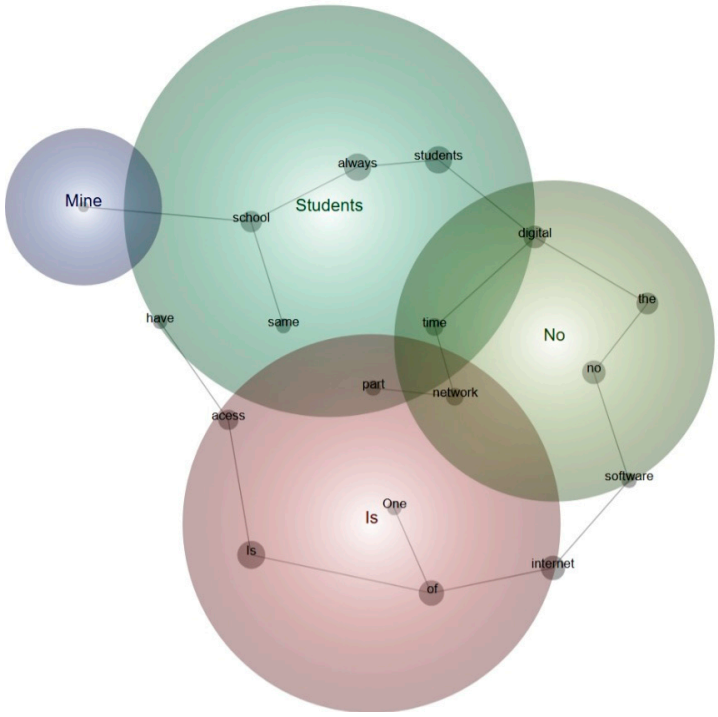

Figure 9. Do you have all of the necessary conditions to use/apply ICT in the classroom context? What are the biggest constraints?

3. Results

Gathering Data—Results

The average age of the participants in the three focus groups was thirty-seven. The inclusion criteria provide further details about the participants.

In line with the objectives defined at the beginning of this study—to understand teachers' perceptions of Information and Communication Technologies (ICT), identify the most commonly used tools, and analyse their impact on teaching practice—the results obtained reveal a realistic, complex, and deeply contextualised picture of the integration of ICT in

everyday school life. Through automated semantic analysis of focus group transcripts, it was possible to capture significant discursive patterns that highlight the transformative potential of ICT and the existing structural obstacles. The original contribution of this study lies not only in the empirical content collected from practising teachers but also in the innovative methodological choice of using Leximancer as an inductive tool for qualitative analysis, dispensing with traditional manual coding. This approach enabled the mapping, in an objective and transparent manner, of concepts emerging in teachers' discourse, thereby providing practical evidence to inform educational policies, ongoing teacher training, and pedagogical approaches that are better suited to the contemporary digital reality.

When presenting the results, we decided to show the complete tables for the following reasons:

Transparency: Readers can see the whole landscape of concepts, not just the top few. This avoids cherry-picking and supports reproducibility.

Contextual Richness: Sometimes lower-ranked concepts (e.g., 10–30%) are significant, especially in niche or nuanced discussions.

Pattern Recognition: Seeing the full spread helps identify clusters, outliers, or unexpected associations between concepts.

Supports Deeper Analysis: Researchers can cross-reference relevance with co-occurrence, likelihood, and theme connectivity for richer interpretations.

A qualitative approach, based on content analysis and thematic analysis, was used to analyse the data from the focus groups. The analytical process involved identifying keywords, recurring expressions, and units of meaning, whose relevance was determined by their frequency, context, and alignment with the research objectives.

A qualitative approach was used to analyse the focus group data, based on content and thematic analyses.

Regarding the meaning of the acronym ICT (Figure 1), we observed that Leximancer produced three themes (teachers' communication to and from their students regarding their task as transmitters of pedagogical knowledge) with similar relevance (Table 1), which means that these were the main concepts expressed by the participants in the focus groups. We can also analyse the fact that this concept must evolve and how it positions itself in our lives; therefore, more research needs to be carried out to realise its future reality.

Table 1. For you, what does ICT mean?

Concepts	Score	Percentage
Communication	2	100
From	2	100
That	2	80

Since the 1990s, with the popularisation of the Internet and personal computers, a movement has begun to introduce these technologies into schools. However, using ICT has not always meant a profound transformation in the pedagogical model. For a long time, the teacher remained at the centre of the process, using the new tools only to expand the means of presenting content, such as selecting a digital book, showing a film, doing research, or recommending a website. This model still reflects a traditional teaching logic, in which the student only receives information. However, the true potential of ICT lies in its ability to promote student autonomy, personalised learning, interactivity, and the development of digital and critical skills. Therefore, the need to introduce ICT must be accompanied by a change in the educational paradigm that values the active construction of knowledge, collaboration, and student leadership [51]. However, "working with these technologies in schools requires reflection on mass education, since ICT operates in mobile,

interactive, decentralised, non-hierarchical and constantly changing networks" [52]. This has been the main obstacle in schools with obsolete networks, weak signal levels, and little or no technical support, and schools are often at the mercy of the goodwill of teachers from the IT department, who provide technical support and repair some equipment.

According to the question "How is ICT present in your classes?", we found that Leximancer highlighted the words students, attraction, I use, and very (Figure 2), which can convey the idea that, in their daily life, the teachers are concerned with making their teaching model attractive to their students and, thus, use ICT as an essential tool.

In Table 2, we find the concepts associated with the second question of the focus group, where we can see that the teacher's use of ICT in everyday life aims to make teaching a process developed in conjunction with virtual reality and with everything that involves ICT. The changes brought by ICT to the world of education push for new understandings and learning approaches that combine the different ways of learning. Today, education is part of a world of constant digital innovation that the teacher needs to accompany, through the necessary training, to stay in the right place and avoid becoming obsolete in their way of teaching.

Table 2. How is ICT present in your classes?

Concepts	Score	Percentage
Students	8	100
Attraction	7	88
I use	6	75
Very	6	75
ICT	5	62
Virtual	5	62
All	5	62
Days	5	62
School	5	62
Always	3	38

In relation to how ICT is used in the classroom context and what its objective is (Figure 3), Leximancer highlights three fundamental concepts: research, students, and ICT. This means that for some teachers, ICT helps the students search for detailed and truthful information when completing their homework, according to the task asked of them (Table 3).

Table 3. Do you use ICT as a way of research, teaching new content, or doing homework?

Concepts	Score	Percentage
Search	9	100
Students	6	67
ICT	5	58
Home	4	47
Teams	3	38

The relevance of the research concept reveals the importance of ICT in students' learning and in their ways of coping with adversity throughout the process. Through research, the student can remove any doubts that arise and quickly continue with their learning. Education today cannot be limited to the simple transmission of ready-made content. The focus must be on developing competences that enable students to learn continuously, autonomously, and critically throughout their lives—the so-called "learning to learn".

This approach aims to train active individuals who are capable of searching for, selecting, interpreting, and transforming information into useful knowledge, as well as generating new knowledge. This is especially relevant in a world of constant change, where knowledge is renewed rapidly and new situations demand creativity, adaptability, and critical thinking. By emphasising autonomy and proactivity, this vision of education breaks with the traditional model of the student as a passive recipient of information. In its place, it places the student as the agent of their own learning, encouraging the collaborative construction of knowledge, the resolution of real problems, and the strategic use of ICT as tools to enhance learning [53].

Observing the results regarding the type of class (Figure 4) that the teachers lead in their daily life, we see that there is a connection between the expository class and the interactive class, which gives the idea of a hybrid teaching system where the teacher adapts the model in relation to the subjects and the type of students with whom they develop them (Table 4).

Table 4. How do you guide your classes? In a more expository sense, or in a more interactive way?

Concepts	Score	Percentage
Interactive	4	100
Expository	3	75
Part	3	75
Development	3	75

Regarding the question of whether textbooks can be replaced by ICT (Figure 5), making the teaching process a more hybrid model in which the student becomes more autonomous and responsible for constructing their knowledge, teachers express their preference for the traditional, resorting to textbooks as the preferred means to use in the classroom (Table 5).

Table 5. What do you think about the possibility of ICT replacing school textbooks and transforming the educational process into a more hybrid model, in which students become more autonomous and responsible for building their knowledge?

Concepts	Score	Percentage
Manuals	6	100
To be	5	83
Both	2	33
I believe	2	33

We cannot ignore that many of today's teachers completed their initial training when the digital age was a utopia and a completely unknown world, which will inevitably influence their pedagogical beliefs and attitudes. Teaching practice is primarily guided by teachers' pedagogical beliefs and convictions—in other words, their view of teaching, learning, and the role of the student and teacher in the classroom. Even with the advancement of educational technologies, they are only incorporated meaningfully when they make sense within these convictions. In other words, the mere presence of technology in schools does not guarantee its effective integration into the teaching–learning process. Suppose that teachers view teaching as centred on content delivery, for example. In that case, they tend to use technology to support this logic, perhaps only as a slide projector, to access digital books provided by the publisher, or to access videos on YouTube.

On the other hand, if their pedagogical approach values active, collaborative, and investigative learning, they are more likely to use ICT to promote projects, research, and meaningful interactions. Teachers' pedagogical beliefs act as powerful filters that directly

influence the acceptance, rejection, or adaptation of new methodologies and tools [54]. Thus, if teachers see teaching as merely the transmission of content, they use digital technologies to reinforce expository practices, such as slide presentations, access to digital books, or instructional videos. It is essential that teachers critically reflect on their practices, revisit their beliefs about the role of the teacher and the student, and understand ICT as a mediator of active, collaborative, and meaningful learning [54,55]. We need to create conditions for teachers to rebuild their professional identity in the face of the demands of the networked society, which is more than just teaching them how to use tools. Therefore, rather than investing in infrastructure, it is essential to invest in teacher training—not only technical, but mainly pedagogical—so that they can reflect on their practices and reconfigure their beliefs in light of the potential of technology. Educational innovation depends, first and foremost, on a change in mindset on the part of the key players in the process [56].

Teachers face a significant challenge in their daily school life: the tension between the desire (or even awareness) to innovate in their teaching practice and the external pressures shaping it. Many teachers recognise the value of more innovative, student-centred, technology-supported, or skills-based teaching methods but feel constrained by various factors, such as outdated and extensive curricula that prioritise the quantity of content to be delivered over the quality of learning; standardised assessments, which require memorisation and single answers, hindering more creative and reflective approaches; and institutional or bureaucratic requirements that consume teachers' time and energy. The lack of institutional support or continuous training makes teachers feel insecure about trying new practices. The expectations of parents and school management are often more focused on immediate and traditional results than on innovative training processes. In this scenario, teachers feel that "success"—often measured by test results, pass rates, or programme completion—is conditioned by criteria that do not favour innovation. This leads to frustration and demotivation and hinders the development of a school culture that is more open to change. It is therefore essential that any proposal for pedagogical innovation is accompanied by structural changes in the education system and greater recognition of the value of practices that prioritise the holistic development of students [57]. Many teachers are sceptical about the importance of ICT in unlocking the learning process (Table 6) of students with learning difficulties. As can be seen, the teachers revealed that the most important factor is the students themselves, and that the success of the process depends mainly on their performance and willingness to learn.

Table 6. In your opinion, is ICT a means of facilitating learning or an obstacle to it?

Concepts	Score	Percentage
Students	9	100
Use	5	56
Dependence	2	22
Process	2	22

This difference can generate insecurity in teachers, but at the same time it alerts us to the need for pedagogical mediation strategies that value both teachers' experience and students' technological fluency. Many teachers who are currently working received their initial training when computers and the digital age had not yet been implemented in schools and no one imagined that they would have as much influence on education as they do today.

Today, any student can search the Internet for data that allows them to learn and develop cognitive skills.

Analysing teachers' perceptions about the development of their students' cognitive skills through ICT (Figure 7), we found that most relate the process to some nervousness and lack of confidence in using digital tools (Table 7).

Table 7. What kind of feeling do you have when you use ICT, in the classroom context, to develop your students' cognitive skills?

Concepts	Score	Percentage
That	9	100
Students	8	89
Feel	8	89
One	8	89
Nervousness	2	22

Technological resources in an educational context promote new ways of teaching and learning and have initiated new forms of dissemination and democratisation of learning. Today, teachers' challenges in handling technological resources in their classes are recognised.

A big gap in initial teacher training is insufficient preparation for the pedagogical use of Information and Communication Technologies (ICT). Although the curriculum guidelines recognise the importance of digital skills in the teaching–learning process, many higher education courses still marginally treat this dimension, with little integration into pedagogical practice.

The consequence is a disparity between what the government advocates—which values the integration of ICT—and the reality of the classroom, where teachers often find themselves unprepared to use these tools critically, creatively, and in line with learning objectives. Recognising the importance of teacher training at this level is therefore essential not only for developing students' digital skills but also for promoting social and cognitive skills that are increasingly required in a society marked by interconnectivity and constant technological transformation [37]. However, there is still a long way to go at this level. Alongside these are operational difficulties, associated with the lack of material resources or even the teacher's lack of working conditions, which can leave them with less positive feelings (Table 8).

Table 8. Do you feel that you have the necessary training/knowledge to use ICT in your teaching practice?

Concepts	Score	Percentage
To	15	100
Training	15	100
More	11	73
Students	10	67
knowledge	4	27
Cycle	2	13
First	2	13
To use	2	13

The highlighted benefits and potential of the aforementioned difficulties, as well as the benefits and potential highlighted in research on this topic in the educational field, overlap with the less positive part.

The fact that teachers desire to learn and improve their pedagogical practice through ICT is not enough, as there are constraints unrelated to the student/teacher binomial in this entire process. The lack of a network in most schools, obsolete equipment, lack of technical

support, and the accumulation of hours for ICT teachers, who often act as teachers and IT technicians at the same time, means that most teachers report a negative feeling (Table 9).

Table 9. Do you have all of the necessary conditions at your disposal to use/apply ICT in the classroom context? What are the biggest constraints?

Concepts	Score	Percentage
No	13	100
Students	12	92
Always	12	92
Internet	11	85
Digital	9	69
School	8	62
Network	5	38
Time	5	38
Software	5	38
Part	4	31

In analysing the question about the existing/necessary conditions to use/apply ICT in the classroom context, we found that teachers have negative feelings that may be related to some disbelief in the education system in which they are integrated.

Among the main obstacles mentioned by teachers was the lack of adequate infrastructure, such as the absence or insufficiency of technological equipment (computers, tablets, projectors), as well as limited Internet access, which is often unstable or non-existent in many educational institutions, especially in rural areas.

The lack of technical and pedagogical support in schools also makes it difficult to solve technical problems and develop strategies that integrate ICT into the curriculum effectively. Finally, regional and socio-economic inequalities further exacerbate these constraints, creating a scenario of digital exclusion and limiting the transformative potential of ICT in education. All of these factors block teachers' intentions to implement ICT in their daily school life.

4. Discussion

It is important to emphasise that we did not carry out an exhaustive statistical count but, rather, a critical interpretation of the speeches, trying to understand the meanings attributed by the participants to the topics discussed. Thus, the selection and interpretation of the information were not based on criteria of numerical representativeness but on the conceptual relevance and argumentative density of the verbalised content.

The analysis thus favoured the most significant aspects of the collective discourse, allowing for the construction of analytical categories that express the main perceptions, experiences, and opinions that emerged during the focus groups.

From the qualitative analysis of the data collected from the three focus groups held with primary and secondary school teachers, several specific conclusions about the use of Information and Communication Technologies (ICT) in the classroom context were identified.

Firstly, most teachers recognise the importance of ICT as a tool that enhances teaching/learning, contributing to student motivation and developing digital competences essential in the 21st century. However, it was also observed that there is a significant variation in the level of familiarity and mastery of these technologies among teachers, which directly impacts the quality and frequency of their use in the classroom.

Another relevant point was the identification of institutional and structural barriers that hinder the effective integration of ICT into everyday school life, such as the age and

insufficiency of equipment, limited Internet access, and the lack of adequate continuing training in the pedagogical use of these tools. Teachers reported the need for greater institutional support to overcome these difficulties.

Qualitative research using focus groups is particularly appropriate for exploring teachers' perceptions, experiences, and challenges when using Information and Communication Technologies (ICT) in an educational context. However, like any methodological approach, this strategy has limitations that must be recognised and discussed to situate the results within their proper epistemological contours.

A first limitation refers to the subjective and situated nature of the teachers' responses. The opinions expressed during the focus groups reflect particular experiences, often shaped by institutional factors, technological infrastructure conditions, the level of digital training, and the socio-economic context of the school. This makes it difficult to generalise the data, although qualitative research aims more towards an in-depth understanding of the phenomenon than statistical extrapolation [29]. Another challenge concerns the dynamics of focus groups, where there can be imbalances in participation: Some teachers tend to dominate the discourse. In contrast, others are more reserved, influencing the diversity and representativeness of the voices. In addition, social desirability bias can lead participants to tone down criticism or adopt stances more in line with institutionally accepted discourses on ICT integration, especially in school environments where there is pressure for innovation [30].

The composition and heterogeneity of the groups can also be a limitation. Significant differences in subject areas, teaching levels, teaching experience, and technology familiarity can make it difficult to identify common patterns while enriching the discussion. This balance between diversity and coherence must be carefully considered in the analysis [32].

With respect to data processing, although the use of support software such as Leximancer can make analysis more systematic and transparent, there is still a risk of reducing interpretative complexity if the results are not contextualised based on a critical reading of the raw material [41]. Automated analysis, although practical, does not replace the analytical sensitivity of the researcher, who must ensure that the meanings attributed to the discourses reflect their nuances.

In addition, some logistical barriers, such as time constraints, teachers' diary restrictions, or conducting the groups in a remote format (when applicable), can affect participants' involvement or compromise the quality of interaction, especially in contexts of teacher work overload.

Despite these limitations, the qualitative approach using focus groups remains a crucial methodological tool for gaining an in-depth understanding of teachers' perceptions and practices regarding the use of ICT in the classroom. Transparent recognition of these limitations contributes to the rigour and scientific integrity of the research.

The Internet and ICT have had a transformative impact on education, reflecting wider changes in society. Through the Internet and its easy access, the ways in which we teach and learn have undergone a profound overhaul. Education, historically shaped by rigid, centralised structures, is now incorporating tools that allow for greater flexibility, personalisation, and interactivity in pedagogical processes.

This transformation, however, does not happen uniformly or automatically. It requires a reconfiguration of the roles of the teacher, student, and methodology, so the use of ICT goes beyond simply replacing analogue media with digital media. The real potential for innovation arises when these technologies are integrated critically and pedagogically, responding to technical requirements and contemporary social and cultural challenges, such as digital inclusion, critical thinking, and lifelong learning [36].

ICT shifts the teacher's role from a mere transmitter of knowledge to someone who develops skills, joining the virtual and empirical worlds as learning contexts. Therefore, the challenge for education, beyond the use of ICT as a teaching tool, is to understand the cultural and cognitive changes brought about by the digital and online world, and to adapt the school, the educator, and the pedagogies to this new reality. This context is both local and global.

Despite the enthusiasm surrounding the transformative potential of ICT, there is still scepticism based on the lack of clear, rigorous, and widely accepted metrics to measure its pedagogical effects accurately. This methodological vagueness contributes to the polarisation of opinions. While some studies point to gains such as greater student motivation, personalisation of learning, and access to diverse resources, others highlight the superficiality of specific uses, technological dependence, or the reproduction of traditional practices with new tools. Thus, the effectiveness of ICT depends less on the technology itself and more on how it is integrated into the pedagogical context, teacher training, and the teaching strategies adopted.

This ambiguity in measurement also reinforces the need for more refined qualitative and quantitative research, which considers contextual variables and is not limited to short-term indicators such as test performance [37]. This work aims to understand teachers' concerns and the barriers to using ICT in their teaching practice. At the same time, we realised that most teachers still feel uncomfortable using tools that they have not mastered 100% due to a lack of continuous training in this area, and that they fear that students born and raised in a technological world will master this area naturally. Problems related to obsolete equipment and the lack of a network make it difficult to use ICT and sometimes discourage teachers from being held hostage by a process that they cannot control, jeopardising the success of their lessons. These include proactivity, collaboration, interdisciplinarity, and the student researchers responsible for their learning [37].

However, we can implicitly observe practical implications in which the adoption of ICT in pedagogical processes points to possible gains in performance for both students and teachers.

The results demonstrate that ICT is an increasingly indispensable resource for an advanced educational model, geared towards the needs of today's students and aimed mainly at their social, personal, and cognitive development. This educational process needs to be reinvented and updated with new technological trends.

When discussing innovation in education, Ref. [40] points to the need for teachers to reframe the curriculum. Teachers have to re-signify the curriculum through activities and practices that favour new approaches, creating bridges between what students should learn and the technological tools and environments that surround them. In a society increasingly invaded by and dependent on new technologies, education is seen as an analogue area, where digital technology presents integration difficulties.

More recently, the context of the COVID-19 pandemic demanded that government authorities around the world adopt emergency public policies to reduce the impact of the pandemic [6]. As of March 2020, the social distancing measures suggested by the World Health Organisation (WHO) suspended face-to-face classes in most countries, imposing a new educational methodology designated as emergency remote teaching (ERE).

The digital world has brought about considerable changes in several areas (for example, in information systems, in the provision of services, in the acquisition of goods, etc.), and it is plausible that the same has happened in education, opening up a range of potential gains for the educational process. Suppose that, in entertainment and social relations, the student's use of Information and Communication Technologies is undeniable in utilitarian questions of

teaching and learning. In that case, this does not happen without realising whether the digital element systematically and consistently mediates the pedagogical activities.

However, as technologies evolve rapidly, so do the obstacles and demands placed on the education system. Schools were unprepared for such a drastic paradigm shift, and the fact that teachers do not feel completely confident in using ICT means that its implementation is slow and varies from school to school, because there is no well-defined guideline from the Ministry of Education.

Given this, it is essential that education stakeholders—policymakers, managers, teacher trainers, and the institutions themselves—recognise the need for robust, critical, and ongoing training for education professionals. Facing the challenges of the digital transformation involves much more than learning how to use tools; it is about developing pedagogical, ethical, technological, and social competences that make it possible to deal with hybrid learning environments, unequal access, and the constant need to adapt. This training cannot be one-off or optional—it needs to be a structural part of educators' initial and continuing training [39,40].Digital transformation in teaching is not new and, as a relevant subject, educational actors should be concerned and train professionals to face obstacles [25,58]. This transition assists in adapting to new technologies [59] and changes driven by COVID-19. The sum of all digital procedures needed to achieve a transformation that allows educational institutions to use digital technology optimally and beneficially is called digital transformation [39].

Analysing the data made it possible to respond to the proposed objectives: namely, to find out teachers' perceptions of Information and Communication Technologies (ICT), to identify the technologies most used in the teaching context, and to understand how these can transform the learning process and improve school results, especially for students with greater difficulties in the learning process. The participating teachers generally had positive perceptions of using ICT in teaching practice. They recognised its potential as a tool to support teaching and learning, particularly valuing its ability to diversify methods and promote student involvement.

As some of the teachers surveyed pointed out, "ICT helps to make lessons more dynamic and accessible, especially for students who are easily demotivated by traditional methods". However, concerns also emerged about the lack of ongoing training, the workload associated with technological integration, and the resistance of some colleagues to change. This duality shows that although there is openness to innovation, its full adoption still depends on adequate structural and training conditions.

The most widely used technologies include digital learning management platforms such as Google Classroom, Moodle, and Microsoft Teams, as well as interactive whiteboards, multimedia resources (videos, interactive presentations), and educational applications such as Kahoot and Quizizz. These tools are used, above all, to organise content, facilitate communication with students, and apply more interactive methodologies.

The choice of technology seems to be strongly linked to ease of use and accessibility for both teachers and students. However, it was noted that the use of these technologies varies significantly depending on teachers' digital familiarity and the technical support available in schools. When integrated pedagogically and intentionally, ICT has the potential to transform classroom dynamics. Teachers said these technologies make it possible to personalise learning, offer more immediate feedback, and promote active methods such as project-based learning, flipped learning, and collaborative online work. Such approaches contribute to greater student involvement and facilitate the construction of knowledge in a more autonomous and meaningful way. As one teacher pointed out, "Students become more protagonists of the process when they have access to tools that allow them to explore, create, and share.".

One of the most relevant aspects concerns the perception that ICT can be crucial in reducing inequalities in access to learning. Teachers reported that students with difficulties—whether due to special educational needs, disadvantaged socio-economic backgrounds, or poor academic performance—benefit from the use of adaptive digital tools, such as explanatory videos, reading with voice support, gamified activities, or platforms that allow them to learn at their own pace. However, important limitations have also been highlighted: unequal access to devices, unstable connectivity, and the students' lack of digital skills are factors that can aggravate rather than mitigate existing difficulties.

Thus, the transformation of the learning process depends not only on the introduction of ICT but also on how it is implemented and the support offered to teachers and students. The results point to a scenario in which ICT is seen as an ally in teaching, with great potential for promoting inclusion, innovation, and improving students' academic performance. However, this promise can only be realised if ongoing teacher training, investment in technological infrastructure, and clear pedagogical integration strategies place the student at the centre of the process, with special attention to those who need the most support during the learning process. However, the data also shows that the integration of ICT is not homogeneous. The use of digital resources varies significantly between schools and teachers, and it is influenced by factors such as familiarity with the technologies, the availability of technical support, and teachers' pedagogical beliefs [54,55]. In many cases, teachers still use ICT instrumentally, as an extension of traditional practices, limiting themselves to using digital platforms to distribute content or show videos.

In addition, teachers expressed concerns about the lack of ongoing training, the increased workload associated with technology integration, and the resistance of some colleagues to innovation. This finding reinforces the idea that digital transformation in schools requires more than the provision of technological resources: it requires structural investment in critical and continuous pedagogical training [10,60].

Another relevant point identified in the research concerns the role of ICT in promoting inclusion and reducing inequalities. Participants reported that students with learning difficulties, special needs, or those in situations of socio-economic vulnerability can benefit from adaptive digital tools, such as explanatory videos, software with reading support, or gamified activities. However, they also pointed out that unequal access to devices and the Internet, along with students' low levels of digital skills, can exacerbate existing inequalities [61].

The discussion of the results shows that, although teachers are open to innovation, the effective adoption of ICT as a pedagogical tool still depends on adequate structural conditions, continuous institutional support, and a coherent educational policy that values teacher leadership and the right of all students to quality learning. According to UNESCO (2021), digital transformation in education should be seen as a comprehensive process guided by values such as equity, inclusion and pedagogical innovation.

5. Conclusions

In addition, the research showed that despite initial enthusiasm for ICT, some teachers expressed concerns about the increased workload and the need to balance technological demands with traditional teaching practices. There were also mentions of the challenge of adapting content and teaching strategies to maximise the potential of digital technologies.

Finally, we found that participation in the focus groups stimulated collective reflection among teachers on their practices and challenges, highlighting the relevance of spaces for dialogue and the exchange of experiences in improving the integration of ICT in schools.

These conclusions provide essential data for formulating educational policies and teacher training programmes that take into account both the potential and the difficulties pointed out, to promote a more effective and contextualised use of ICT in the educational process.

In this context, tables are not intended to quantify or reduce the richness of the data but, rather, to present structured summaries of categories, themes, concepts, and emerging patterns, aiding in the understanding of the interpreted material. Using visual and structured representations, such as charts and tables, favours the visibility of analytical categories and allows the reader to more clearly follow the interpretative path that the researcher follows [62].

In this study, tables were used to summarise the themes identified in the focus groups with teachers, and to relate these categories to representative excerpts from the speeches, concepts generated by the Leximancer software, or the theoretical dimensions discussed. This resource helps reinforce the transparency and auditability of the analysis, which are fundamental principles for ensuring methodological rigour in qualitative studies [63].

In addition, the tables allow the reader to visualise the different perspectives of the participants comparatively, the relative frequencies of mentions, or even the evolution of specific ideas throughout the collection sessions. Rather than replacing discursive analysis, they function as complementary tools that facilitate the organisation of the report and enhance the scientific communication of the results.

Therefore, the choice to use tables in presenting qualitative results is justified not only for practical reasons but also epistemologically, as they contribute to the clarity, consistency, and readability of the findings while respecting the interpretative nature of the qualitative approach.

A relevant methodological limitation of this study is the exclusive use of automated semantic analysis. Although Leximancer 4.5 contributed to a systematic and inductive analysis of the data, its use does not address deeper levels of subjective interpretation, such as those that can be achieved through methods like thematic analysis [29] or narrative analysis [30]. This methodological decision was based on an epistemological stance oriented towards identifying emerging patterns more objectively and with less intervention by the researcher. Nevertheless, deeper interpretation requires techniques that reach discourse's symbolic, emotional, and contextual dimensions. We therefore recommend that future research complement automated approaches with interpretative qualitative analyses.

The data analysis enabled us to gain a deeper understanding of teachers' perceptions regarding the use of Information and Communication Technologies (ICT) in the school context. The results indicate that, in general, the participants recognise the potential of ICT to support teaching and learning, especially methodological diversification and increasing student involvement in school activities. This perception aligns with the authors of [64], who emphasised the role of digital technologies in promoting more active, collaborative, and meaningful learning.

Based on data collected from public primary and secondary school teachers, this study has provided an understanding of their perceptions of Information and Communication Technologies (ICT), identified the tools that they use most in teaching, and analysed their impact on everyday teaching. In general, the results indicate that most teachers recognise the pedagogical potential of ICT to enrich the teaching–learning process, making it more dynamic, interactive, and adapted to the needs of students.

The most widely used technologies are valued for their functional nature and their ability to promote student engagement and motivation. However, the data also highlight significant challenges, such as work overload, the need for continuous training, and unequal access to technologies by students, which can compromise the effectiveness and equity of ICT use. The analysis of the impact of ICT on teachers' daily lives revealed both

opportunities for innovation and risks of professional burnout. Particularly relevant was the finding that ICT can be a powerful tool to support students with difficulties if used with pedagogical intent, sensitivity to individual needs, and adequate support. ICT changes the role of the teacher from a mere transmitter of knowledge to someone who develops skills, bringing together the virtual and empirical worlds as learning contexts.

Therefore, besides using ICT as a teaching tool, the challenge for education is understanding the cultural and cognitive changes brought about by the digital and online world, and adapting schools, educators, and teaching methods to this new reality. This context is both local and global. ICT is neither a threat nor the alchemy of the 21st-century school. Instead, it is a partner for teachers and students, facilitating new educational practices that are more in tune with the world we live in, and where the role of teachers is becoming increasingly important in teaching and learning processes. At the beginning of the 20th century, teachers reappeared as irreplaceable elements in promoting learning and strengthening integration processes that respond to the challenges posed by diversity and the appropriate use of new technologies. In the current context, marked by rapid social, cultural, and digital transformations, the role of the teacher goes beyond the simple transmission of knowledge, becoming a pedagogical mediator and, at the same time, an agent of inclusion. Today, teachers and their work are fundamental to ensuring an education that values differences, promotes equity, and critically integrates technological resources into training processes.

Thus, even with the expansion of digital tools and the ongoing discussion about how they can benefit students, the role of the teacher remains untouched, contributing to a humanised, reflective, and contextualised approach to contemporary education [65]. In today's world, ICT is no longer just technical support. It has become a universal language—a form of expression, communication, creation, and problem-solving that permeates virtually all areas of life. Just as written language was, in its time, a cognitive and social revolution, today, ICT represents a new type of literacy, essential for active and critical participation in society. In addition to its use in education, ICT is a fundamental work tool. In almost all professions—from education to engineering, from medicine to commerce—knowing how to use digital resources, collaborative platforms, artificial intelligence, automation, and data analysis is no longer a differential but a basic skill.

Mastering these technologies means working more efficiently, innovating, solving complex problems, and adapting to constant market changes. This is what we want to demonstrate with our work. Integrating ICT into the classroom with the right balance will ensure that students achieve better academic results while developing their skills in line with the profile of each stage of education [66]. Incorporating ICT organically into the daily life of the school community—whether in face-to-face or virtual classes—is an essential step towards democratising access to knowledge. When technology is used intentionally and equitably in education, it levels the playing field, offering all students, regardless of their social, economic, or geographical background, the same opportunities to learn, communicate, develop skills, and actively participate in the educational process [67]. This integration goes beyond the occasional use of digital tools; it is a paradigm shift in which schools recognise technology as part of contemporary culture and the learning environment of students [68]. In doing so, it contributes to academic development and the formation of digital citizens who are better prepared for today's world. However, it is important to remember that access to ICT does not guarantee inclusion [69].

This access must be accompanied by teacher training, adequate infrastructure, effective public policies, and teaching practices that value diversity and the active participation of all students [16]. ICT plays an increasingly important role in schools. Recently, the pandemic that has devastated the entire world has led governments to adopt emergency public

policies to reduce its impact [28]. Through ICT, students have been able to develop their cognitive abilities, working individually and/or with classmates, even when physically distant. Teachers have used multimedia resources, educational games, and interactive videos to make their lessons attractive and promote their students' academic success. In this period of global chaos, ICT has played a key role in transforming schools, promoting innovation, collaboration, personalised learning, and the development of digital skills among students and, at the same time, among teachers who have developed their training to keep pace with this digital transformation. This study is critical at a time when digital technologies have become an integral part of everyday school life and teaching practice. Understanding teachers' perceptions of Information and Communication Technologies (ICT), the tools most used in the educational context, and the impact of ICT on teachers' professional lives is essential to guide the digital transformation of education based on evidence and pedagogical sensitivity. This study offers us a realistic, contextualised, and guiding view of the integration of ICT in education.

The results obtained have the potential to inform policy, improve teaching practices, and support students, making them a valuable contribution to a more innovative, inclusive, and 21st-century-ready school. All students have access to digital platforms and applications developed by publishers, which aim to make the educational process more facilitative and attractive. Thus, preparing students for the productive use of digital technologies will become another intervention area for teachers and one of their duties [2].

With teachers playing a key role in promoting digital literacy, it is important to emphasise that technology, however advanced, cannot replace human mediation in teaching/learning. Teachers need access to digital resources and specific training, pedagogical knowledge, and technical skills that enable them to integrate them critically, creatively, and contextually into their professional practice. This perspective is in line with the principles advocated by international organisations such as UNESCO, through its Institute for Information Technologies in Education, which recognises the importance of digital literacy as a fundamental skill for the 21st century and emphasises investment in teacher training as a central pillar for inclusive and effective digital education.

Therefore, recognising the importance of digital technology in education is a starting point, but making it a reality depends directly on the appreciation, training, and support of teachers, who are the true agents of change in contemporary classrooms [70]. Despite the investments made over the last fifteen years by the different governments that have overseen the Ministry of Education, many schools and teachers still face difficulties in integrating these tools meaningfully into teaching and learning processes. Some of the difficulties mentioned include the lack of adequate training, resistance to pedagogical change, rigid workloads, and educational policies that prioritise immediate results in standardised tests over pedagogical innovation. Teachers should use technology to explore other possibilities, such as collaborative work, personalised learning, computational thinking, and project-based learning (a modern school movement). It is essential to reform pedagogical practices and invest in continuous teacher training to rethink the entire school culture, so that technology ceases to be an adornment and becomes an integrated, critical, and pedagogical element in the daily life of schools in Portugal [52].

Thus, integrating technology into teaching practice should not be seen merely as a technical requirement or an adaptation to the digital world, but rather as an opportunity to rethink teaching and learning. The proposal to train teachers to act with discernment, ethics, and a transformative vision implies developing digital skills and a critical and conscious attitude towards social, cultural, and technological changes. To overcome the traditional approach to teaching, it is necessary to abandon the model centred on the transmission of content and adopt active and collaborative methodologies geared towards knowledge-

building. In this context, technology is more than a tool: it promotes autonomy, creativity, critical thinking, and continuous learning—essential skills in the 21st century.

By becoming active and collaborative agents, teachers and students build a co-authoring relationship in the educational process, where learning to learn becomes as important as the content itself. This paradigm shift requires continuous training, institutional support, and openness to pedagogical innovation [2]. The analysis confirms that the common practice in our schools is not yet the use of ICT as a daily routine for all teachers, particularly within the classroom for teaching and learning, and even less can it be said that there is no resistance to its introduction in schools. The presence of ICT in Portuguese schools is a reality. However, there is still much work to be done by leaders, both in promoting the use of ICT in schools and in training teachers in its use, particularly in the classroom for teaching and learning, and the consequent success of students at different levels of education.

This study emphasises that schools and ICT are destined to coexist, understanding and challenging each other, and that this understanding and challenge will give rise to knowledge and ICT that will be the future of both. This partnership leads us to an educational approach that combines face-to-face teaching with digital technologies. So-called hybrid teaching has several advantages for students, allowing them to use digital tools, making learning more dynamic and interesting, and giving students greater responsibility for developing their autonomy and discipline, while still supervised by the teacher in a classroom context.

The pedagogical use of technology facilitates the teaching–learning process, which promotes knowledge-building. Through our study, we found that the use of these resources brings about a significant change in learning, making classes more attractive and productive for students, who begin to produce their knowledge in a meaningful way, i.e., knowledge is not something finished, but something constantly constructed in the educational space. Students become more autonomous individuals who develop their creativity, and teachers become mediators of knowledge. The use of technology alone does not guarantee students' educational success. For the teaching–learning process to be meaningful, teaching practices must be modified, and teachers must seek appropriate training to keep pace with the evolution of society and the demands of their students.

Teachers should use ICT to enrich the teaching–learning process, building knowledge according to needs. The data analysis provided a better understanding of teachers' perceptions of using Information and Communication Technologies (ICT) in the school context. The results indicate that, in general, the participants recognised the potential of ICT to support teaching and learning, especially methodological diversification and increased student involvement in school activities. This perception is in line with those of authors such as [64], who emphasise the role of digital technologies in promoting more active, collaborative, and meaningful learning.

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