

ICT AND ST IN EDUCATION: TOWARDS NEW SCHOOLS IN SMART CITIES

TIC E TS NA EDUCAÇÃO: RUMO ÀS NOVAS ESCOLAS NAS CIDADES INTELIGENTES

TIC Y TS EN EDUCACIÓN: HACIA NUEVAS ESCUELAS EN CIUDADES INTELIGENTES



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ABSTRACT: The study aims to identify how Information and Communication Technologies (ICTs) and Social Technology (ST) contribute to education in intelligent schools and cities. For this purpose, a literature review was conducted covering topics such as ICTs, ST, innovative schools, and smart cities. Considering that technology is often presented as a solution to social problems, this principle also applies to the educational context. However, ST questions these concepts, raising the discussion about the extent to which ICTs are inclusive and non-selective. The contribution to the development of smart cities and schools aligns with the United Nations Sustainable Development Goals (SDGs), specifically SDGs 4, 9, 10, and 11. The research adopted a bibliographic and documentary approach, characterized as exploratory, with a qualitative focus and essential nature.

KEYWORDS: Social technology. Information and Communication Technology. Smart schools. Technologies in education.

RESUMO: O estudo visa identificar de que maneira as Tecnologias da Informação e Comunicação (TICs) e a Tecnologia Social (TS) contribuem para a educação em escolas e cidades inteligentes. Para isso, foi realizada uma pesquisa bibliográfica abordando temas como TICs, TS, escolas inteligentes e cidades inteligentes. Considerando que a tecnologia é frequentemente apresentada como uma solução para problemas sociais, esse princípio também se aplica ao contexto educacional. No entanto, a TS questiona esses conceitos, levantando a discussão sobre até que ponto as TICs são inclusivas e não seletivas. A contribuição para o desenvolvimento de cidades e escolas inteligentes está alinhada aos Objetivos do Desenvolvimento Sustentável (ODS) da Organização das Nações Unidas (ONU), especificamente os ODS 4, 9, 10 e 11. A pesquisa adotou uma abordagem bibliográfica e documental, caracterizando-se como exploratória, com foco qualitativo e natureza básica.

PALAVRAS-CHAVE: Tecnologia social. Tecnologia da Informação e Comunicação. Escolas inteligentes. Tecnologias na educação.

RESUMEN: El estudio tiene como objetivo identificar de qué manera las Tecnologías de la Información y Comunicación (TIC) y la Tecnología Social (TS) contribuyen a la educación en escuelas y ciudades inteligentes. Para ello, se realizó una investigación bibliográfica que aborda temas como TIC, TS, escuelas inteligentes y ciudades inteligentes. Considerando que la tecnología se presenta con frecuencia como una solución para problemas sociales, este principio también se aplica al contexto educativo. Sin embargo, la TS cuestiona estos conceptos, generando debate sobre hasta qué punto las TIC son inclusivas y no selectivas. La contribución al desarrollo de ciudades y escuelas inteligentes está alineada con los Objetivos de Desarrollo Sostenible (ODS) de las Naciones Unidas (ONU), específicamente los ODS 4, 9, 10 y 11. La investigación adoptó un enfoque bibliográfico y documental, caracterizándose como exploratoria, con enfoque cualitativo y naturaleza básica.

PALABRAS CLAVE: Tecnología social. Tecnologías de la Información y Comunicación. Escuelas inteligentes. Tecnologías en la educación.

Introduction

The use of Information and Communication Technologies (ICTs) in Brazil began in the 1970s, a period marked by growing interest in the application of computers in education, similar to developments in North America and Europe (Valente; Almeida, 1997). few years later, in the early 1980s, through public policies implemented by the Federal Government and the Ministry of Education (MEC), ICTs began to gain significance, initially in a modest manner, through projects in higher education aimed at creating the National Policy for Informatization of Education (Moraes, 2012; Valente; Almeida, 2020).

In this context, from the 1980s onwards, there was a significant push towards digital inclusion in society, facilitated through professional training programs and insertion initiatives, along with the continuous education of teachers, all geared towards the digital inclusion of the population. However, despite governmental efforts, the efficiency of ICTs remains emblematic.

On one hand, in administrative and logistical activities, Information and Communication Technologies (ICTs) are widely integrated and defined, encompassing administrative tasks, logistics, and school management, among others. However, in the realm of core educational activities, divergences occur, especially in teaching and learning processes.

The literature is not unanimous regarding the use of ICTs in education. Some studies present significant results on the subject (Valente; Almeida, 2017), while others highlight difficulties and challenges, which may be similar to contexts in other countries (Costa, 2004; Liu; Huang, 2005; Vanderlinde; Aesaert; Van Braak, 2015). From a new perspective, Social Technology (TS) questions some foundations of ICTs in education. The use of technology, depending on how it is employed, can result in social inclusion or exclusion (Batista; Freitas, 2018).

In this context, Smart Schools and Smart Cities play a fundamental role in the utilization of Information and Communication Technologies (ICTs), without disregarding the social aspect addressed by Social Technology (TS). The new models of cities and schools, now labeled as bright due to emerging technologies of the 4th Industrial Revolution, continuously seek to promote social inclusion without impeding the technological advancement of society (Hoel; Mason, 2018; Means, 2018; Moore; Ellsworth, 2014).

Considering that the educational and technological issue has political, economic, social, and ideological foundations, bibliographic and documentary research was conducted, composed of books, legislations, theses, and scientifically relevant articles, with the aim of analyzing such issues.

There is a paradigm that the use of technology in the educational sphere is treated in a salvational manner (Silveira; Bazzo, 2009). However, any evolution can only be considered beneficial when aligned with social inclusion and without social inequalities. In this sense, the school is committed to the "(...) formation not for science as a thing in itself, neutral and independent, but as a social activity, with a social origin and end, and therefore politically, economically, and culturally committed and referenced" (Von Linsingen, 2007, p. 17, our translation).

Given the conflicts present in the literature related to the use of ICTs in education compared to TS, the research question that gave rise to this study is: how can ICTs and TS contribute to education in intelligent schools and cities? To achieve the general objective, the following specific objectives are addressed:

- Define the concepts of ICTs and TS;
- Define the concepts of Smart Cities and Smart Schools according to the literature;
- Analyze the conflict between ICTs and TS;
- Identify the role of ICTs and TS in the context of smart schools and cities.

Historically, human development is directly linked to manufacturing and improving tools, techniques, and technologies. Like other areas affected by technological development, the educational sector is also capable of creating social inequality, which is why Social Technology studies it. Nevertheless, education is guaranteed by the *Carta Magna* (Brasil, 1988, art. 205, our translation), which establishes that "Education [...] shall be promoted and encouraged with the collaboration of society, aiming at the full development of the individual, their preparation for the exercise of citizenship, and their qualification for work."

In this sense, in the words of Batista and Freitas (2018, p. 124, our translation): "(...) it is important for educators to reflect on the role that technology plays in society and pedagogical practice, as it is permeated by conflicts of specific social, political, and economic interests".

Information and Communication Technology (ICT)

As a result of the technological revolution of recent decades, society as a whole has undergone various transformations. The field of education was no different, as it assumed the responsibility of preparing individuals to live and interact in the reality of technological innovations (Huberman, 1973; Libâneo, 2015).

Among the many meanings associated with the word "technology" (Blanco; Silva, 1993; Castells, 1999; Oliveira, 2001; Subtil; Belloni, 2002; Kenski, 2018), it can be said that they are products of human labor used for the benefit of society. In the last decade, Bévort and Belloni (2009) already asserted that Information and Communication Technologies (ICTs) would be integrated into the school environment, resulting from the pressure of the technology market and society to adapt to new standards and changes.

The use of technology in education is outlined in both administrative and pedagogical aspects, as mandated by the National Education Guidelines and Bases Law (LDB 9394/96, our translation):

Article 32. Elementary education, with a minimum duration of eight years, mandatory and free in public schools, aims at the basic formation of the citizen, through:

I - the development of the capacity to learn, with the fundamental means being the full mastery of reading, writing, and arithmetic.

Article 36. The curriculum of high school will observe the provisions of Section I of this Chapter and the following guidelines:

I – it will highlight basic technological education, the understanding of the meaning of science, literature, and arts; the historical process of societal and cultural transformation; the Portuguese language as a tool for communication, access to knowledge, and the exercise of citizenship.

Nevertheless, ICTs, in addition to being used as educational tools, are also widely adopted in school management, aiming to improve and contribute to schools' administrative and pedagogical practices (Masetto, 2015). Initially, they were employed as a means for online enrollment, document issuance, or even teacher lesson preparation. In the current context, given the extensive use of ICTs, the school management team aims to develop projects that stimulate different educational sectors, including digital learning projects, educational software, institutional, educational websites, research, and educational assessment (Oliveira; Lima, 2016). According to Kenski (2018, p. 93), technological evolution redesigns the classroom into a new virtual learning environment.

ICTs and cyberspace, considered new pedagogical spaces, offer broad possibilities and challenges for cognitive, affective, and social activities for both students and teachers, spanning all levels of education, from kindergarten to university. For these possibilities to materialize, it is crucial to adopt a new perspective: "[...] More than the instrumental and restricted nature of using technologies for tasks in the classroom, it is time to broaden the horizons of the school and its participants, that is, everyone" (Kenski, 2018, p. 66, our translation).

It is important to emphasize that, for the implementation of these changes in school structures, it is necessary to train students, monitors, and administrators in the pedagogical use of equipment, especially teachers who may not be familiar with these technologies. This requires investment in personnel and materials (Oliveira; Lima, 2016).

When incorporating ICTs, the teacher must remember that the aim is not to replace conventional teaching techniques but to integrate technology into the existing educational process (Oliveira; Lima, 2016). Each tool and system used in the teaching and learning process has unique characteristics that can be employed according to the educational objectives of the discipline, allowing the content to be developed in class to be complemented by technology (Tedesco, 2004).

Social Technology (TS)

As per the definition presented earlier, technology can be considered everything produced and perfected by humans with the aim of satisfying their needs, from the most basic to vital, in the pursuit of evolution and quality of life (Batista; Freitas, 2018). Due to constant evolution, the technological process has undergone transformations and adaptations. Initially, it sought to support societal activities, whereas currently, it has acquired other dimensions, such as profit generation and wealth accumulation, which consequently has led to social inequalities (Batista; Freitas, 2018).

A definition of social technology proposed by the Institute of Social Technology (ITS, 2005) is as follows: "a set of techniques, transformative methodologies, developed and applied in interaction with the population and appropriated by them, representing solutions for social inclusion and improvement of living conditions." Another accepted and current concept is that social technology "comprises products, techniques, or reusable methodologies developed in interaction with the community that represent effective solutions for social transformation" (Correio, 2011, p. 1, our translation).

Dagnino (2004) and Novaes and Dias (2010) assert that Social Technology (TS) emerged as an opposition to Conventional Technology (CT), and the evolution of this movement has added more complex characteristics and elements to TS, with greater potential to transform the reality of marginalized societies. According to Roso (2017, p. 19, our translation), the foundations of TS confront the hegemonic model of education in today's society:

Unlike CT, TS aims at the local development of technology according to the needs, objectives, and interests of social groups that generally are on the margins of market logic. Therefore, TS is configured as a non-traditional way of understanding Science, Technology, and Society (STS) relations, shifting the origin of the demand for technical solutions, primarily from market logic to society, to populations that become considered relevant social groups.

Batista and Freitas (2018) affirm that technology should serve society, capable of meeting human needs and reducing social differences, especially in the educational field, by providing conditions to the most needy and breaking limits and paradigms imposed by poverty. In summary, social technology focuses on the emancipation of the involved actors, with users being the most important. This means that technology is developed and practiced in interaction with the population and integrated by it (Barbieri; Rodrigues, 2008).

Technologies are considered social when, based on their potential, they provide conditions to improve the quality of life in society, generating changes in various sectors, including education. Additionally, they must meet aspects of simplicity, low cost, easy applicability, and the generation of social impact (Medeiros *et al.*, 2015).

Smart Cities

The concept of Smart Cities does not have a specific definition, resulting from interdisciplinarity and conceptualization. Although there is no single and consolidated definition in the literature, the concept of Smart Cities is often associated with the fields of technology and innovation, which would serve as instruments to solve various urban problems (Trindade *et al.*, 2017).

Smart cities would be capable of making intensive use of knowledge and creativity (Kourtit; Nijkamp, 2012), promoting greater social participation in decision-making

(Giovannella, 2012; Dameri, 2017) and increasing transparency in the democratic process of public administration.

Although relatively new, the concept of smart cities would still be linked to the roots of Elkington's sustainability tripod (1994), aligning the development of the population with social, economic, and environmental biases. Within this concept, there is increased participation and attraction of human capital in addressing social problems (Meijer; Bolívar, 2016; Giovannella, 2012; Dameri, 2017) and intelligent management of natural resources (Caragliu; Bo; Nijkamp, 2011).

Komninos (2008; 2018, our translation) defines smart cities as "territories with a high capacity for learning and innovating, based on the population's creativity, knowledge creation institutions, and digital and communication structure". There is significant integration with the concepts of the Triple Bottom Line, and the relationship of Smart Cities with human, social, and environmental perspectives is evident.

Nevertheless, the United Nations Agenda (ONU, 2015) itself includes the concept of smart cities as a driving force for sustainable economic growth, enabling the improvement of service delivery in various areas (digitalization, use of renewable energy, etc.).

Smart Schools

Innovative schools should be equipped with comprehensive, inclusive, and sustainable management systems, adopting new learning methodologies and Industry 4.0 advancements efficiently (Lorenzo *et al.*, 2021). The presence of Information and Communication Technologies (ICTs) in schools is continually increasing (Hassan; Geys, 2016). Many countries worldwide, including developing countries, are investing in implementing ICT equipment and resources in schools, even those with limited financial resources (Kozma; Vota, 2014).

Technology should be used as a tool to enhance education, as the foundations for change are pedagogical and not merely technological (Mogas *et al.*, 2020). It would be futile, distracting, or even counterproductive if the change led to undesirable situations, such as social isolation, in case personalization promotes uncontrolled individualism. Personalized learning is not inherently favorable.

The dynamics of technological developments in education require people to acquire new digital skills and adapt to new situations (Zulkarnaen *et al.*, 2019). The paradigm shift in learning organizations inevitably demands a revision of the vision of education and its role.

Teaching is considered a process to initiate, facilitate, and sustain self-learning, self-exploration, and self-realization of students, so teachers must play a fundamental role as facilitators or mentors capable of supporting students' learning with technology (Ibrahim; Razak; Kenayathulla, 2013).

Within this new paradigm, intelligent learning environments have been gaining prominence in scientific literature. To be considered intelligent and provide effective solutions, a learning environment must allow the identification of student characteristics, provide necessary resources and tools, automate learning processes, and assess their outcomes (Huang *et al.*, 2013).

Intelligent learning environments use digital, adaptive, and environmentally sensitive devices to promote more agile learning (Koper, 2014), providing insights to enhance teaching conditions. Therefore, the historical context presented in this article deepens the understanding of how Fourth Industrial Revolution technologies impact these environments and smart education. Industry 4.0 technologies encompass the Internet of Things, cloud computing, artificial intelligence, and others.

Innovative Schools incorporate these technological innovations into schools, complemented by pedagogical innovation, improved communication and management processes, and inclusive projects and decisions toward sustainability. The smart school directly addresses four of the Sustainable Development Goals (SDGs) (Nações Unidas, 2018), quality education (SDG 4), industry, innovation, and infrastructure (SDG 9), reduced inequalities (SDG 10), and sustainable cities and communities (SDG 11).

Methodological Procedures

This study aims to identify how Information and Communication Technologies (ICTs) and Social Technology (TS) can contribute to education in intelligent schools and cities. It is exploratory research with a qualitative approach and essential nature, using literature review and documentary research as methodological procedures.

According to Denzin and Lincoln (2006), qualitative research involves an interpretative approach to the world, meaning that its researchers study things in their natural settings, seeking to understand phenomena in terms of the meanings people attribute to them. According to Gil (2008), exploratory research aims to familiarize oneself with a topic that is still little known or explored.

Considering that both technology and education incorporate political, economic, social, and ideological issues that are reflected in the challenges of using them in the educational process, a literature review was conducted using Google Scholar, Scopus, and Scielo databases, in addition to consulting books and scientific articles, and a documentary search for national (Federal Constitution of Brazil, 1988; National Education Guidelines and Bases Law, 1996) and international legislations (ONU).

Regarding the use of technology in education and its contributions, the following references were highlighted: Huberman (1973); Blanco and Silva (1993); Castells (1999); Oliveira (2001); Subtil and Belloni (2002); Bévort and Belloni (2009); Libâneo (2015); Oliveira and Lima (2016) and Kenski (2018).

Concerning Social Technology, the following works were privileged: Dagnino (2004); Barbieri and Rodrigues (2008); Novaes and Dias (2010); Roso (2017); Medeiros *et al.* (2015); Batista and Freitas (2018). For the concepts of Smart Cities, the following were adopted: Komninos (2006); Caragliu, Bo and Nijkamp, (2011); Kourtit and Nijkamp (2012); Giovannella (2012); Tomor *et al.* (2019); Dameri (2017); Trindade *et al.*, (2017). Finally, for Smart Schools, the authors worked were: Ibrahim, Razak and Kenayathulla (2013); Kozma and Vota (2014); Huang *et al.*, (2013); Koper, (2014); Hassan and Geys (2016); Means (2018); Zulkarnaen *et al.* (2019); Mogas *et al.* (2020).

The literature review on the themes of ICTs (Information and Communication Technologies) and ST (Social Technology) covered a period of 30 years, considering the initiation and integration of new technologies into Brazilian Education. For Smart Cities and Smart Schools, the period covered was 20 years.

Results and Discussions

Given the numerous technological tools, especially employed in the teaching and learning process, Information and Communication Technologies (ICTs) emerge as a means to transform the pedagogical work of teachers in the classroom, contributing to expanding the competencies and methodologies of modern Education. Regarding the integration of these new technologies into the school environment, Santos (2005, p. 4) identifies two perspectives "[...] those that resist and even act with indifference to their entry into the educational area and those encouraged by fanciful proposals from consumer society" (p. 4, our translation).

There is a belief that high investments in technological resources in Education would be the solution to all educational problems (Kahlau; Schneider; Souza-Lima, 2019). In this sense, Silveira and Bazzo (2009) assert that, as the population gains access to new technologies, there is hope that they can solve various social challenges. Specifically in Education, it is expected that technologies address issues related to discipline problems, student disinterest, dropout rates, failure, abandonment, and low scores in external assessments, based on the Basic Education Development Index (IDEB) data.

Among the considerable advantages of using Information and Communication Technologies (ICTs) is the absence of geographical and political limits. People in different locations can participate in classes and interact simultaneously with the teacher during instruction. Additionally, there is the possibility of self-assessment by students through study platforms. In this perspective, the introduction of "[...] technologies into the educational environment can make the teaching and learning process more enjoyable, more engaging, and more meaningful for the learner and more dynamic for the educator" (Silva; Correa, 2014, p. 5, our translation).

Access to information through different communication channels has extended to various social strata and levels. However, it is crucial that information be transformed into knowledge, as we have not yet achieved the universalization of education despite the development of modern technologies. Moran *et al.* (2000, p. 12, our translation) argue that "[...] if teaching depended only on technologies, we would have found the best solutions a long time ago. They are important, but they do not solve the fundamental issues".

Silva and Correa (2014, p. 26, our translation) state that: "thinking about the teaching and learning process in the 21st century without the constant use of various technological tools is to fail to keep up with the evolution at the essence of humanity". It is imperative that technologies be used to promote social inclusion and not to serve the specific interests of privileged groups within society. Technological evolution is beneficial only when accompanied by promoting social inclusion and not exacerbating social inequalities (Batista; Freitas, 2018).

In this context, Social Technology does not emerge to restrict development but to present conditions for improving the quality of life in society, generating transformations in various sectors, including education (ITS, 2004; Dagnino, 2006). Moreover, it must meet aspects of simplicity, low cost, easy applicability, and social impact generation (Medeiros *et al.*, 2015). Investing resources in Information and Communication Technologies (ICTs) recklessly does not ensure the social well-being of all users and does not solve all problems but

guarantees only "[...] the maintenance of the social and material relations that, in the technical-economic infrastructure, ensure capitalist exploitation" (Dagnino, 2006, p. 46, our translation).

Education plays an essential role in societal modification, and technology serves as a means to achieve it. Together, they constitute a "fundamental dimension of social change, as the evolution and transformation of societies are constructed through the complex interaction of cultural, economic, political, and technological factors" (Soffner, 2014, p. 58, our translation). Just as technology should be at the service of society to meet human needs and reduce social disparities, its use in education should have the same purpose, especially providing conditions for the most in need to break the limits imposed by poverty (Dagnino, 2004; 2006; 2014).

When comparing Information and Communication Technologies (ICTs) and Social Technology (ST), it is possible to perceive that both seek to meet the demands of society. The resources of ICTs, although intrinsically geared towards consumerism and economic interest, have been able to elevate society to new levels in recent decades, specifically in the era of globalization (Kahlau; Schneider; Souza-lima, 2019). On the other hand, ST establishes the social factor as its primary object, using ICT but without causing exclusions. On the contrary, it involves the population in solving various problems (Dagnino, 2014; Batista; Freitas, 2018).

It is evident that both ICTs and ST are interconnected, and it is up to society/users (educators, administrators, students, parents) to use them correctly for a specific goal. There are countless possibilities in the educational field for what can be achieved, whether through the use of democratic school management (teachers, students, parents, administration, pedagogical team, and other staff) leading ST and educational technologies (ICTs).

Discussing the use of ICT in education inevitably involves addressing digital inclusion, a concept widely discussed in intelligent cities that advocates the use of technology for problem-solving while promoting urban development, positioning ICTs as an indispensable means for progress (Dutta, 2011). With the advent of Smart Cities, new issues emerge, such as [digital] gentrification, which entails the exclusion of individuals lacking the skills to use technology. This phenomenon is addressed by ST (Hollands, 2008; Dagnino, 2014; Batista; Freitas, 2018).

In this context, it is crucial for smart cities to ensure digital inclusion. In this perspective, Mori (2012, p. 11, our translation) emphasizes that "digital inclusion has come to be seen as a right in itself and also as a necessary tool to guarantee civil, political, social, and diffuse rights." It is worth noting that mere access to technology is not sufficient but is part of the solution,

where people still need to understand how technologies could improve their living conditions and facilitate their daily lives (Ladeira; Moia, 2009).

Under the implementation of the concepts and possibilities of Smart Cities, it is relevant to emphasize the inclusion of people in Information and Communication Technologies (ICTs), not only as end-users but also in the planning, incorporating the concept of participatory governance. This principle is also present in Social Technology (ST), as pointed out by Dagnino (2002a) and others, advocating for the participation of the population capable of understanding its demands and proposing solutions to them.

Innovative schools and smart cities have incorporated the concepts of the Triple Bottom Line, also known as the sustainability tripod (Elkington, 1994), which establishes development based on three areas: economic, social, and environmental, without one area compromising the others. Thus, although there is the impression that Smart Schools and Smart Cities are merely centers of technology and innovation, it is known that environmental and social aspects have been considered. ST is intrinsically present, including all users in the new contexts of cities and schools.

Innovative schools are composed of three elements that reinforce the Triple Bottom Line concept presented earlier: technology (economic), inclusion (social), and environmental (environment). The first element of smart schools is technology. To collect data, Smart Schools typically provide the building with sensor networks that house education ubiquitously (De Freitas; Rousell; Jäger, 2019) using the Internet of Things (IoT) and cloud computing. Industry 4.0 is a strategic key in favor of pedagogical change (Lorenzo; Gallon, 2019; Lorenzo *et al.*, 2021), facilitating communication and management of all types of learning processes (Salimi; Ghonoodi, 2012).

The second component of smart schools is inclusion. Inclusive education involves specific support measures to meet individual needs, providing learning opportunities and participation for individuals through differentiated teaching methods in accessible formats, assisted devices, and necessary support services. This approach aims to empower all students, especially those from vulnerable groups, including individuals with learning, developmental, or intellectual disabilities (Brenes *et al.*, 2018).

The third element of smart schools is sustainability. Sustainability for smart schools encompasses energy efficiency, methods of environmental regulation, and any aspect necessary to achieve sustainable and environmentally friendly buildings. School buildings can use

Internet of Things (IoT) infrastructures to provide real-time monitoring and management, addressing issues of energy efficiency and education (Pocero *et al.*, 2017).

The present research did not provide concrete cases of the application of Information and Communication Technologies (ICT), Social Technology (ST), smart cities (Smart Cities), and smart schools (Smart Schools). It offers definitions that can be used in future research, such as case studies, to refute or reinforce the concepts discussed here.

Final considerations

With the purpose of identifying how Information and Communication Technologies (ICT) and Social Technologies (ST) can contribute to education in smart schools and smart cities, a brief introduction addressing the evolution of technology in the educational context was conducted. The concepts of ICT, ST, Smart Cities, and Smart Schools were explored in the theoretical foundation. Subsequently, in the discussion, an analysis was made of how each of these elements relates to and can contribute to and integrate into smart schools and smart cities.

Regarding ICT and ST, their need and growing presence in society become evident. The discussion should not focus on their acceptance but instead on how they can contribute to the learning process without excluding the socially less privileged.

After the analysis, it is envisioned that the future of society will be realized through smart cities and schools, environments imbued with innovation but maintaining the principles of sustainability, known as the Triple Bottom Line, promoting development based on technology without threatening social and environmental aspects.

As for future research perspectives stemming from this work, possibilities include (1) delving into the concepts and ramifications of ICT and ST through case studies in childcare, primary, and higher education institutions, exemplifying and measuring the concepts presented in this theoretical framework; (2) conducting research on smart cities and smart schools, considering the scarcity of nationally produced material on the subject compared to international production; and (3) investigating democratic school management related to ST, with the participation of all elements of the school community (teachers, students, parents, management, pedagogical team, and other staff) involved in educational and social goals.

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