Smart Cities and Digital Inclusion in Education: The Role of Public Administration in Bridging the Digital Divide

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Abstract: The development of smart cities has been widely associated with technological innovation and improved urban efficiency. However, its implications for social outcomes, particularly in the field of education, remain insufficiently explored. In this context, digital inclusion emerges as a critical dimension for ensuring that the benefits of smart city initiatives are equitably distributed across all segments of society. This paper examines the relationship between smart city development and digital inclusion in education, with a focus on the role of public administration in addressing the digital divide. It argues that the effectiveness of smart city initiatives cannot be assessed solely through technological indicators, but must also consider their capacity to foster equitable access to digital educational resources for all citizens. Building on literature on smart governance, digital inclusion, and public administration, the study conceptualises digital inclusion in education as a multidimensional construct encompassing access to digital infrastructure, digital skills, and meaningful use of educational technologies. The analytical framework highlights the role of public administration as a key actor in designing and implementing policies that support inclusive digital transformation. Methodologically, the research relies on document analysis of public policies and smart city frameworks, with a focus on extracting good practices. This approach allows for a systematic identification of institutional patterns and structural barriers that shape digital inclusion in education within urban contexts. The expected findings suggest that while smart city initiatives create opportunities for enhancing educational access, their impact is uneven and often constrained by structural inequalities and limited administrative capacity. The study highlights the importance of targeted public policies and governance mechanisms in bridging the digital divide effectively. The contribution of the paper lies in linking smart city development with digital inclusion in education, offering a governance-oriented perspective that emphasises the role of public administration in ensuring equitable and sustainable digital transformation.

Keywords: Smart cities, Digital inclusion, Education, Digital divide, Public administration, Smart governance, Romania

1. The Main Concepts: Smart Cities, Digital Inclusion, Education, Digital Divide

The concept of the smart city continues to attract significant attention in both academic literature and public administration practice. Although there is no universally accepted definition, numerous scholars emphasise its multidimensional nature and its dependence on the local institutional, economic, and political context in which it is implemented (Meijer & Bolívar, 2016).

In the academic literature, a smart city is generally conceptualized as an urban environment in which information and communication technologies (ICT) are integrated into urban infrastructure to facilitate data collection, enhance the management of the urban environment, and improve residents' quality of life (Bastos et al., 2024). Consequently, the smart city should not be understood as a universal model but as a transformation process adapted to the specific needs and characteristics of each community. The evolution of the concept reflects a shift from a predominantly technology driven approach, focused on digital infrastructures and advanced information systems, to a holistic perspective in which the city is viewed as a complex and interconnected ecosystem (Vrabie & Dumitrașcu, 2018).

Although the concept of the smart city is fundamentally associated with the use of technology for data collection and analysis, as well as with the development of technology-enabled infrastructure, its significance extends beyond the technological dimension to encompass important social considerations. From this perspective, the smart city is structured around six main pillars of action: Smart Economy, Smart Mobility, Smart Environment, Smart People, Smart Living, and Smart Governance (Bastos et al., 2024). Each of these pillars follows a sustainable development-oriented approach, ultimately aiming to enhance citizens' well-being and quality of life.

Within this framework, technology is considered a means rather than an end in itself, serving to support economic development, environmental sustainability, the efficiency of public services, and citizens' well-being (Albino et al., 2015).

Contemporary definitions of the smart city place particular emphasis on improving quality of life, fostering active citizen participation in decision-making, developing human and social capital, and promoting both digital and social inclusion. A smart city is characterised by its ability to leverage data, knowledge, and innovation to address

urban challenges in a sustainable, transparent, and citizen-centred manner (Nam & Pardo, 2011). In this context, public administration plays a crucial role in coordinating digital transformation processes and mitigating digital divides that limit equal access to the educational and social opportunities created by new technologies (The OECD Digital Government Policy Framework, 2020).

From my perspective, a smart city can be understood as a developed and sustainable urban environment with a strong citizen-centred orientation, in which public administration recognises citizens' needs and considers technology-driven solutions to improve the efficient use of available resources. This is precisely why the smart city concept is particularly relevant: it places citizens at the centre of the urban ecosystem, while promoting sustainable, future-oriented solutions that are responsive to current needs and evolving societal demands.

Before addressing the concept of digital inclusion, it is necessary to understand the transformative potential of digitalization and its broader implications for society. Digitalization represents both a future-oriented perspective and a development trajectory that increasingly permeates most areas of human activity. It can be understood as a process involving the creation, implementation, and application of digital systems and technologies, as well as the transformation of the instruments, such as objects, systems, and technologies, through which the state, society, and individuals interact (Katrin, 2022).

From an administrative perspective, digitalization is primarily used to facilitate interactions between the state and citizens by transforming information into digital formats and by enabling the provision of more accessible and efficient public services. In a broader sense, digitalization can be regarded as a global development trend aimed at increasing efficiency and transforming multiple dimensions of citizens' lives, encompassing areas such as the economy, business, public services, education, and everyday activities.

From a pedagogical perspective, digitalization can be understood as a strategy for integrating digital technologies into the everyday life of individuals and society. However, the effective integration of technology requires more than simply providing access to digital tools. Citizens also need to develop the knowledge and skills necessary to understand, use, and benefit from these technologies in ways that respond to their individual and societal needs. This aspect highlights the close relationship between digitalization and digital inclusion, as the benefits generated by technological development can only be fully realised when individuals possess the necessary opportunities and capabilities to participate in an increasingly digital society.

The literature distinguishes between the concepts of digitization and digitalization. Digitization refers primarily to a technical process focused on converting information from analogue into digital formats. Digitalization, in contrast, is regarded as a broader socioeconomic process, as it concerns the ways in which the decisions of individuals and organizations to adopt and use digital technologies generate changes in social practices, organizational processes, and societal structures (Gradillas & Thomas, 2025).

Education represents a fundamental pillar of societal development and a key determinant of a city's long-term progress and competitiveness, as it contributes to the development of the knowledge, skills, and values required by future generations of citizens. The quality of educational systems influences individual opportunities and social mobility, as well as the capacity of communities to adapt to technological, economic, and social transformations. Consequently, the success of smart city initiatives depends, to a significant extent, on the development of an educated, digitally skilled, and civically engaged population (OECD, 2019; UNESCO, 2021).

A well-educated population constitutes an essential component of societal development, as higher levels of educational attainment are strongly associated with employment, higher earnings, social mobility, and the capacity to adapt to technological and economic change. An important source of evidence supporting the idea that education contributes to societal development is Education at a Glance 2024: OECD Indicators, published by the Organisation for Economic Co-operation and Development (OECD). The report examines education systems, the outcomes of educational institutions, the impact of learning, Sustainable Development Goal 4, and numerous other relevant aspects that highlight the importance of education for individuals and society as a whole (OECD, 2024).

According to the statistics presented in the report, higher levels of educational attainment provide individuals with better employment opportunities and greater economic security. On average, across OECD countries, 87% of adults with tertiary education are employed, compared with only 60% of those who have not completed upper secondary education (OECD, 2024). The high participation of educated individuals in the active labour force represents an essential driver of economic development. Therefore, education contributes to societal development across multiple dimensions, influencing not only economic outcomes but also broader social outcomes (OECD, 2024).

Digital inclusion represents a fundamental lever for enhancing access to education and improving the quality of the educational process, thereby contributing to the development of citizens better prepared to navigate and adapt to ongoing social, economic, and technological transformations (*UNESCO, 2021*). Digital inclusion is fundamentally described as the effort to ensure all individuals, irrespective of their socioeconomic status, location, gender, ability, or other factors, have access to and can effectively utilize information and communication technologies (ICTs) (Baecker, 2019). This concept extends beyond mere access to digital tools, encompassing the idea that digital engagement enables participation in contemporary society: educationally, economically, and socially (Baecker, 2019).

The relationship between smart cities and education is multifaceted and mutually reinforcing. On the one hand, smart city technologies create opportunities to improve educational access, quality, and efficiency through digital learning platforms, data driven decision making, and innovative pedagogies. On the other hand, education provides the human capital, digital competencies, and civic engagement necessary for the successful implementation and sustainability of smart city initiatives. (UNESCO, 2021) (European Commission, 2020)

Moreover, education contributes to reducing inequalities and fostering digital inclusion by enabling citizens to access and benefit from digital services and technological innovation effectively. Therefore, educational policies and digital learning opportunities should be regarded as essential components of smart city strategies, particularly in efforts to bridge the digital divide and promote inclusive urban development (*Planul de acțiune pentru educația digitală*, 2026).

The digital divide represents a disparity in access to and effective use of digital technologies, creating or reinforcing inequalities in areas such as education, employment, and access to economic opportunities (Jin, 2024). In this context, public administration plays a crucial role in addressing these disparities by developing and implementing policies aimed at ensuring equitable access to digital infrastructure, services, and skills. Its role extends beyond the provision of technological infrastructure, encompassing the creation of an inclusive digital environment in which all citizens have the opportunity to participate in and benefit from digital transformation.

2. Good Practices and their Implementation

All these concepts are interdependent and foundational to modern urban development oriented toward citizens' well-being. Their relevance becomes particularly evident when they are implemented in an integrated and sustained manner, potentially generating significant long-term benefits.

A relevant example that supports one of the objectives of this paper and illustrates how urban digital initiatives can influence education in a smart city is the Chicago Connected programme. Launched in 2020, the programme aimed to provide free high-speed Internet access to eligible Chicago Public Schools students and their families. The initiative was designed to address the digital divide and remove barriers to students' participation in remote learning (*Chicago Connected*, f.a.).

The implementation of the programme took place in the context of the COVID-19 pandemic, which significantly accelerated the adoption of digital technologies across various areas of public life, including education. The pandemic highlighted not only the importance of digital infrastructure but also the need for individuals to possess the skills required to use digital technologies effectively. For educational institutions, digitalisation became particularly important, as the closure of schools required the rapid adoption of alternative forms of teaching and learning in order to ensure the continuity of the educational process.

An evaluation conducted by the University of Chicago Consortium on School Research found that the Chicago Connected programme was associated with changes in students' engagement in online learning and academic performance, although the effects varied according to students' prior academic achievement (*Chicago Connected, f.a.*). These findings suggest that expanding digital connectivity can support educational participation, however, access to technology alone does not necessarily lead to improved educational outcomes. Rather, digital infrastructure needs to be accompanied by educational, social, and institutional support that enables students to use technology effectively.

The Chicago Connected programme therefore illustrates how digital initiatives implemented at the urban level can contribute to educational participation and help address digital inequalities (*Chicago Connected Broadband Access*, f.a.). At the same time, the example demonstrates that the educational benefits of smart city initiatives depend not only on the availability of digital infrastructure but also on the institutional capacity to ensure that citizens, particularly students and families facing socioeconomic barriers, are able to access and use these technologies effectively.

Within the smart city ecosystem, education is primarily provided through educational institutions, including schools, colleges, and universities. These institutions play a central role in the development of smart cities, acting as key drivers of knowledge, innovation, digital transformation, and social inclusion.

In the academic literature, universities are often regarded as 'the cradle of creative solutions'. They have significant potential to develop and introduce disruptive solutions that contribute to societal well-being through advanced research, innovation, and the establishment of testing and experimentation centres (Zambroni De Souza et al., 2024).

From another perspective, educational institutions play a key role in advancing smart education by leveraging emerging technologies such as the Internet of Things (IoT), data analytics, and immersive learning environments. These technologies can contribute to the personalisation of learning, enhance accessibility, and foster the critical thinking and digital skills required in the 21st century (Dimitrova et al., 2024).

Technology, in turn, is an indispensable instrument: digitalisation is no longer optional but a prerequisite for effective, transparent, and inclusive public services. Yet technology should remain a means rather than an end, supporting economic development, environmental sustainability, service efficiency, and social inclusion (Nam & Pardo, 2011).

An important example of a programme addressing education, digitalisation, digital inclusion, and administrative implementation is Romania's National Recovery and Resilience Plan (PNRR). The European Union provides an enabling framework and financial support that national and local administrations translate into education-focused digital inclusion measures. Through the PNRR, Romania accesses funding from the European Union's Recovery and Resilience Facility to implement reforms and investments across six pillars, including the green transition, digital transformation, smart, sustainable and inclusive growth, social and territorial cohesion, health and economic, social and institutional resilience, and policies for the next generation, including education (*Planul Național de Redresare și Reziliență - Oportunități de finanțare UE*, f.a.).

From an administrative perspective, the PNRR mechanisms for providing digital equipment to schools operate through complementary procurement models established by official guidance and linked to specific milestones and targets. Under the centralised model, the relevant line ministry issues the funding call and establishes minimum technical requirements, while the needs reported by schools through county-level educational authorities are aggregated to support the procurement of standardised equipment, such as interactive panels, laptops, and desktop computers. These investments are intended to strengthen digital competences and contribute to greater educational inclusion. Following procurement, the equipment is delivered to schools, while local authorities and educational institutions are responsible for its receipt, inventory, and reporting in order to document the achievement of the established targets (*Planul Național de Redresare și Reziliență - Oportunități de finanțare UE*, f.a.)

As a result, numerous schools have been able to expand their digital resources through PNRR-funded investments. Interactive panels, laptops, and other digital tools have been introduced to support teaching and learning while also strengthening students' digital competences. Beyond the provision of equipment, such investments can contribute to the broader digital transformation of education by facilitating educational processes, strengthening communication between schools and families, and creating new opportunities for student participation. In this regard, digitalisation can be understood not merely as the introduction of technological tools into educational institutions, but as a broader process through which public administration supports more inclusive and accessible educational services.

The Romanian case therefore illustrates how European funding and administrative mechanisms can be translated into concrete interventions at the local level, connecting digital transformation with educational inclusion. It also highlights the importance of administrative capacity in ensuring that investments in digital infrastructure reach educational institutions and contribute to meaningful improvements in the learning environment.

Beyond Romania, other European countries have developed similar initiatives aimed at using education and digitalisation as instruments for societal development while strengthening the relationship between public administration and citizens. Finland's education reforms over the past decade, for example, provide a relevant case for examining how administration-led approaches can connect smart governance with inclusive digital education.

At the national level, the Ministry of Education and Culture and the Finnish National Agency for Education steered the "New Comprehensive School" programme alongside a system wide "digital leap," financing devices, learning platforms, teacher professional development, and school level curriculum renewal (*Finland: A 2045 vision for comprehensive schools*, f.a.). Municipalities, legally responsible for basic education, implemented these measures locally through coordinated procurement frameworks, municipal ICT services, and school improvement plans, ensuring interoperability with national identity and data systems. Crucially, the reforms coupled access (devices, broadband, platforms) with meaningful use (teacher training, digital pedagogy, formative assessment tools), and with equity safeguards, such as municipal support for families lacking home connectivity or devices. This administrative design illustrates how national policy, municipal execution, and school level pedagogy can align to reduce digital divides while improving learning quality, an approach directly transferable to smart city strategies that prioritise citizen centred services and inclusive outcomes (Ministry of Education and Culture, 2016).

While providing digital infrastructure is essential, public administration contributes to reducing educational digital inequalities through a broader range of strategies and interventions. It plays a crucial role in designing and implementing evidence-based policies aimed at addressing digital disparities, including targeted programmes for disadvantaged groups and the continuous monitoring of educational inequalities (Adako & Ekundayo, 2025). Beyond ensuring access, public administration can support digital skills development programmes that enable students and educators to use technology effectively, which is essential for achieving meaningful digital inclusion. Its contribution therefore extends beyond the provision of infrastructure, encompassing policy development, digital skills development, inclusive educational content, targeted support for vulnerable groups, and the protection and promotion of digital rights.

In addition to the examples discussed above, several international initiatives further illustrate these dimensions of public administration's role. In the United States, the National Digital Inclusion Alliance (NDIA) represents an example of a collaborative approach to digital inclusion, working with local governments and other stakeholders to support initiatives such as community connectivity, public Wi-Fi access, and digital skills development (Adako & Ekundayo, 2025). At the European level, the Digital Education Action Plan (2021–2027) provides a strategic policy framework for adapting education and training systems to the digital age, with a particular emphasis on developing digital competences, improving digital education infrastructure, and ensuring that digital transformation contributes to inclusive and high-quality education (Adako & Ekundayo, 2025).

Taken together, these initiatives demonstrate that addressing educational digital inequalities requires a multidimensional approach in which infrastructure, skills, institutional capacity, and inclusive public policies are developed in parallel. This reinforces the argument that public administration is not merely a provider of digital infrastructure, but an active facilitator of digital inclusion and educational transformation.

3. Cross-case Findings

Considering the research question of this paper "To what extent does public administration in a smart city support digital inclusion in education?", the evidence and examples discussed above suggest that public administration plays a crucial role in advancing educational digital inclusion. As a key decision-making actor, public administration has the capacity to identify digital inequalities, establish priorities, allocate resources, and design and implement policies and programmes aimed at reducing disparities in access to digital technologies, skills, and educational opportunities.

In this context, public administration is responsible not only for identifying emerging needs and challenges but also for seeking sustainable solutions that respond to citizens' needs and contribute to long-term societal development. Effective intervention requires collaboration among multiple actors, including citizens, public institutions, educational institutions, technology and service providers, civil society organisations, and other relevant stakeholders, coordinated around shared objectives. At the same time, effective governance and timely decision-making are essential for maintaining the continuity of digital initiatives, ensuring accountability, and adapting policies to changing technological and societal conditions. Thus, digital transformation in education should be understood as a collective process in which coordinated action, clear standards, institutional capacity, and continuous feedback enable technology to function as a means of achieving inclusive and sustainable urban development rather than as an end in itself.

Nevertheless, despite the central role of public administration, several challenges may limit the educational impact of digital initiatives if they remain unaddressed. These include limited administrative capacity at the local level to design, procure, coordinate, and support complex digital initiatives; fragmented procurement processes

that may result in incompatible devices and platforms, increasing maintenance costs and undermining interoperability; insufficient investment in teachers' professional development and school-level IT support, which can constrain the meaningful use of digital technologies; and persistent inequalities in home connectivity and access to devices despite improvements in school infrastructure. Additional challenges concern data governance, including privacy, security, and accessibility requirements, which may complicate the integration of digital identity and learner-record systems. Furthermore, short-term funding cycles may support the initial implementation of digital initiatives without adequately covering long-term costs related to software licensing, equipment replacement, maintenance, and connectivity. Finally, weak monitoring and evaluation systems that focus primarily on outputs rather than educational and social outcomes may make it more difficult to adjust policies and ensure that digital investments effectively contribute to equity and inclusion.

These limitations do not diminish the importance of public administration; rather, they highlight the need for continuous improvement in the design, implementation, and evaluation of digital education policies and programmes. Existing initiatives and investments represent important resources with significant potential for further development, provided that they are supported by long-term planning, adequate institutional capacity, sustainable funding, and effective monitoring mechanisms. Therefore, the extent to which public administration supports digital inclusion in education depends not only on its ability to initiate digital programmes, but also on its capacity to sustain, adapt, and evaluate them over time.

4. Conclusions

Technology, digitalisation, and digital inclusion have become central dimensions of contemporary societal development and are increasingly important for building more sustainable, inclusive, and resilient communities. The analysis presented in this paper demonstrates that technology should be understood as a means rather than an end. Inclusive educational outcomes are more likely to emerge when public administrations approach the smart city as a governance framework, develop equity-oriented policies, adopt appropriate procurement mechanisms, and combine digital access with training, institutional support, and interoperability.

The relationship between education and the smart city is particularly evident through their shared objective of supporting social and economic development. Education represents an essential component of the smart city ecosystem and should not be considered separately from the broader processes of urban digital transformation. As illustrated by the examples discussed throughout this paper, smart city initiatives can create an environment in which administrative decisions, technological innovation, and educational development are brought together to respond more effectively to citizens' needs. In this context, educational institutions are not merely beneficiaries of digital transformation but also important actors in the development of knowledge, innovation, digital competences, and social inclusion.

The findings further indicate that the contribution of public administration to digital inclusion in education extends beyond the provision of digital infrastructure. Public administrations have a central role in identifying inequalities, designing and implementing policies, allocating resources, coordinating stakeholders, and ensuring that digital initiatives remain accessible and sustainable over time. However, the effectiveness of these interventions depends on administrative capacity, appropriate indicators, and the ability to monitor progress from the initial identification of needs through implementation and evaluation. Sustained collaboration among municipalities, educational institutions, civil society organisations, technology providers, and citizens is equally important.

The examples examined also demonstrate that providing devices and connectivity does not automatically eliminate the digital divide. Without adequate teacher training, technical support, interoperability, sustainable financing, and outcome-oriented monitoring, digital initiatives risk remaining focused on equipment distribution rather than generating meaningful improvements in educational participation and inclusion. Therefore, cities seeking to translate smart city initiatives into measurable educational progress should integrate inclusion into the design of digital policies, ensure meaningful use of technology, and adopt responsible and sustainable governance approaches. The importance of digital inclusion is further reinforced by the growing number of policies, programmes, and initiatives developed. These efforts reflect an increasing recognition that digital transformation can contribute to societal development only when its benefits are accessible to all citizens. Improving citizens' digital competences and ensuring equitable access to digital technologies can strengthen their ability to participate in education, public services, and wider social and economic life.

Consequently, the impact of public policies on the digital divide should not be assessed solely in terms of the infrastructure or resources provided, but also in terms of their capacity to generate sustainable and equitable

outcomes. Every policy intervention aimed at identifying and addressing digital inequalities represents an opportunity to better understand citizens' needs and to orient public action towards them.

In conclusion, public administration represents a key actor in addressing digital inequalities and creating the institutional conditions necessary for inclusive digital transformation. Education provides an essential foundation for individual and societal development, while digitalisation offers new opportunities to enhance access, participation, innovation, and public service delivery. Their integration within the smart city framework can therefore contribute to a more inclusive and sustainable model of urban development, provided that technological progress is accompanied by effective governance, adequate institutional capacity, and a sustained commitment to equity.

Ethics Declaration: Ethical clearance was not required for this study, as it relies exclusively on publicly available institutional documents and does not involve human participants or personal data.

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