Digital Inclusion and Social Cohesion in Smart Cities: Overcoming Barriers in the Digital Age

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Abstract. In the era of smart cities and digital transformation, ensuring digital inclusion has become a critical factor in fostering social cohesion and equitable urban development. While digital technology brings unprecedented opportunities for development, education, and civic engagement, barriers such as limited infrastructure, financial constraints, digital literacy gaps, and social exclusion continue to hinder full digital inclusion. This article explores the complex challenges of the digital divide and its impact on marginalized groups, including older adults, low-income households, migrants, and rural communities. Through a critical review of literature and policy analysis, this study examines key obstacles to digital inclusion in smart cities and evaluates the European Union's response to these challenges through policy interventions, broadband expansion, digital skills programs, accessibility standards, and affordability measures. Additionally, the paper highlights strategies to enhance digital participation, such as citizen engagement, inclusive urban planning, and public-private partnerships. Through the analysis of EU initiatives and emerging policy approaches, this research contributes to the discourse on digital equity and provides insights into building smart, sustainable, and inclusive urban environments. The findings emphasize the need for integrated, cross-sectoral strategies to bridge the digital divide, ensuring that all citizens can access and benefit from the digital economy and society.

Keywords. Social Cohesion, Digital Inclusion Barriers, Smart Cities, Digital Divide, Social exclusion
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1. Introduction

Digital inclusion is a crucial factor for social and economic development in the modern era, as access to and use of

digital technologies have become an integral part of everyday life, education, work and social participation. In a world that is changing rapidly due to the digital revolution, inequality in access to technological capabilities can intensify already existing social and economic discrimination (Helsper, 2008). The European Union (EU) and international organizations, such as the United Nations (UN), have adopted policies and programs that aim to reduce these inequalities, through the expansion of digital infrastructure, education and the promotion of digital access (European Commission, 2021).

Digital inclusion includes both access to the internet and or/any devices along with the capability of people to use technologies in order to equally participate in the information society. Losing this ability drives in digital exclusion which in turn affects mostly elderly people, people with low income, migrants and rural communities (Correa & Pavez, 2016, Gorelova et al, 2023). Usually, the reasons for digital exclusion concern economic, social, cultural and academic inequalities that discourage equal participation in a society. In addition, social exclusion and digital divide are two important factors that need to be understood so we can clarify the importance of digital inclusion. Social exclusion refers to the inability of people to participate in social, economic and cultural activities, a situation that can be caused by many factors such as lack of access to basic services and inadequate social networking (Sanders, 2020, Karelis et al., 2024). At the same time, the digital divide describes inequalities in access to and use of digital technologies among different social groups or geographical areas. Factors that contribute to the digital divide include lack of digital skills, the technologies' cost and geographical isolation (Damodaran et al., 2015). Since technological developments evolve over time, the digital divide constitutes a dynamic phenomenon. Even today, regardless of improvements in the deployment of high-speed networks, there are many people who do not have access to reliable internet connections (or cannot afford them), particularly those from rural and remote areas (Mervyn, Simon, & Allen, 2014). Moreover, age and educational levels can create such gaps, with elderly people and those with low educational levels facing such challenges (Tomczyk et al., 2023).

Addressing the challenges of digital divide and social exclusion requires a multifaceted strategy that involves technological infrastructure, fostering digital literacy, and implementing policies that ensure inclusivity and equitable access to technology. In the context of this research, the main obstacles to achieving digital inclusion will be examined, as well as strategies that can contribute to mitigating inequalities and promoting a more inclusive digital environment. This research contributes towards this purpose, to systematically identify the key barriers to digital inclusion and examine the extent to which the European Union's policies and initiatives address each of these challenges. In this context, both barriers and the EU-specific strategies are examined, while assessing the effectiveness of these initiatives in promoting a more inclusive digital environment.

The rest of this study is structured as follows: In section 2 background information is provided, necessary for landscaping the field we examine. Section 3 reveals our methodology which underlies our research. Section 4 presents barriers to digital inclusion while section 5 highlights EU efforts in addressing these barriers. In section 6 an analysis of means of mitigation is presented, followed by conclusions and directions for future research steps in Section 7.

2. Research Methods

The study adopted a qualitative approach with secondary data (scientific literature and policy documents) analysis and further data triangulation.

Data Collection: The research began by making queries for publications relevant to the topic on Google Scholar using the keywords "Digital inclusion in smart cities", "Barriers to digital inclusion", and "Smart city equity challenges" conducted in September 2024. The criteria to include the publications in the study were that they had to be published in 2008 and later, they were focusing on smart cities and urban digital inclusion, and addressing citizen-centric approaches. We deliberately omitted the exclusion criteria in order to explore the broader range of topical academic literature.

Data Selection and Analysis: The selected literature was analysed using a thematic analysis approach. During the "Data Selection and Analysis" step we identified the most common barriers to digital inclusion in the scientific literature. Specifically, the analysis resulted in six primary barriers which are *infrastructure, economic, educational, social and cultural, policy and regulatory, and psychological and perceptual challenges.* Following the identification of barriers, during the next step of our research we retrieved key strategies for countering digital disadvantage presented in the literature, with a focus placed on policy initiatives, infrastructure development, digital literacy, accessibility, and affordability. In addition, real-life examples of effective practices were included to enrich the research with authentic field experiences.

Focus on the European Union: We explored EU initiatives (policies and frameworks) to provide evidence on the ways to tackle digital inclusion barriers in Europe. This included an in-depth review of policies, frameworks, and strategic documents from the European Union, such as the 2030 Digital Compass and NextGenerationEU. The aim was to assess how these initiatives address the identified barriers and to evaluate their effectiveness in promoting digital inclusion across diverse member states. The findings were then thoroughly analysed to gain an extensive

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comprehension of the dynamics of the studied field both on scientific and political levels.

Mapping: Finally, we conducted a systematic mapping of the identified barriers against the identified EU initiatives, policies and frameworks. In a few words, we aligned each barrier with specific EU initiatives, policies, and frameworks to evaluate the degree of alignment between the barriers and the EU responses and highlight gaps, overlaps, and areas of strong intervention. This approach provided deeper insights into the effectiveness and comprehensiveness of the EU's strategies in promoting digital inclusion.

During this phase, a qualitative stance was conducted with secondary analysis of scientific literature and policy documents. To seek out relevant EU initiatives, policies, and frameworks for dealing with digital inclusion in a systemic manner, a focused research methodology was adopted, with a thorough and stringent selection process in place.

The research began with a critical review of policy and literature, with a specific focus placed on formal documents of the EU, strategic documents, and regulating policies. European Commission and European Parliament reports and documents, together with other European Union agencies such as the Digital Economy and Society Index (DESI) and 2030 Digital Compass, were key sources involved. All these sources provided key information about the ongoing digital transformation agenda in the EU and its commitment towards lessening digital inequalities.

To further restrict selection, a specific keyword search was performed via Google and academic databases, including Google Scholar, and Scopus, and via official databases of the European Union, including EUR-Lex, European Commission Publications, and the EU Open Data Portal. Search keywords included "Digital inclusion policies EU," "Smart cities && EU digital equity," "EU frameworks && digital transformation," "EU barriers && digital inclusion && strategies," and "European actions && digital divide." Criteria for selection involved relevant and updated policies and programs for access, literacy, infrastructure, and inclusion.

Following the selection of resulted policies, a comparative mapping and classification exercise was performed in an attempt to map each initiative in a systematic manner in relation to the six most important digital inclusion barriers: infrastructure, economic, educational, social and cultural, policy and regulatory, and psychological and perceptual barriers. Mapping revealed in detail how such policies contribute towards lessening digital inequalities, even when not explicitly under social cohesion and digital inclusion programs. Most of the shortlisted initiatives address key structural barriers through augmented digital infrastructure, enhancing digital competencies and workforce capabilities, augmented access for disadvantaged groups, and cybersecurity and trust in cyberspace. Cross-referral with academic studies and case studies, in addition to critical analysis, examined the effectiveness and impact of such EU actions.

While some of the identified EU policies and initiatives are not explicitly framed under digital inclusion or social cohesion, they were selected based on their direct and indirect contributions to bridging digital inequalities and fostering a more inclusive digital society. These initiatives collectively address key structural challenges by ensuring equal access to digital infrastructure, enhancing digital literacy and skills, and promoting inclusive and secure digital participation.

3. Barriers to Digital Inclusion

Digital inclusion is of major importance to ensure that people and communities have access to and can effectively use digital technologies to improve their quality of life. However, there are many barriers that hinder this goal creating a digital divide that leads to disadvantaged groups.

Despite the rapid evolvement of technology, especially if we consider the expansion of broadband networks, many rural regions lack reliable internet access, which in turn limits opportunities for economic development, education and social engagement. The urban-rural divide remains a persistent issue, as cities enjoy high-speed connections and advanced digital services, while rural communities struggle with slow, unreliable, and costly internet options (Sanders, R., 2020; Helsper, E., 2008; Correa, T., & Pavez, I., 2016). A typical example can be considered the deployment of 5G which, despite its promise to tackle such challenges, is progressing unevenly in smaller and remote areas with delays in its adoption.

Economic barriers is another critical barrier, part of digital inclusion, especially for low-income families and marginalised groups. Regardless of the European Union's efforts to reduce internet services' cost, financial difficulties prevent many individuals from accessing any possible online resources (Sanders, R., 2020; Mervyn, K., Simon, A., & Allen, D. K., 2014; Samodaran, L. et al, 2015). Economically disadvantaged groups, such as unemployed or migrants are unable to afford high monthly subscriptions or the cost of purchasing digital devices (Mervyn, K., et al., 2014; Samodaran, L. et al, 2015). In addition, economic inequalities can be found among the EU member states that worsen the issue (Helsper, E., 2008; Mervyn, K., et al., 2014), e.g., Germany and Sweden achieve high levels of digital inclusion in comparison to Bulgaria and Romania.

A significant part of the population, especially the elderly and those with low levels of formal education, lack the necessary digital literacy skills to effectively engage with digital technologies. The European Commission's Digital

Economy and Society Index (DESI) reveals that a high level of citizens in the EU have poor basic digital competencies, holding them back from accessing and taking part in online goods and services (Damodaran et al., 2015). Four out of ten adults lack poor basic digital competencies, and one in six professionals in ICT is female, (Virkkunen, H., 2024). Inequalities in access to training programs deepen, with rural and disadvantaged areas not having educational programs for developing competencies in a virtual environment (Sanders, 2020). Poor competencies in a digital environment hinder access to significant information, work and social contacts in an emerging virtual world (Helsper, 2008).

Social and Cultural Barriers also play a pivotal role in digital exclusion, with age inequalities being one of them. Elderly people across the EU countries face difficulties in adopting new technologies, a situation that leads to digital divide (Tomczyk et al., 2023). Many older individuals consider digital tools complex and intimidating, leading to their isolation from the benefits of the digital age we are living in. Furthermore, people with disabilities face accessibility challenges that make it difficult, or sometimes impossible, for them to use any digital devices. Although progress has been made in developing assistive technologies and accessible web design, barriers to the widespread implementation of inclusive digital solutions persist (Damodaran et al., 2015, Sanders, 2020).

Policy and Regulation, particularly those related to cybersecurity and privacy, constitute barriers to digital inclusion. Growing awareness of cyber threats, data breaches, and privacy violations has led some individuals to avoid online platforms altogether. Even though regulations such as the General Data Protection Regulation (GDPR) are important for personal information sharing, their complexity prevents smaller businesses and individuals from fully engaging with digital services (Sanders, 2020, Damodaran, L., 2015). Striking a balance between ensuring user privacy and promoting digital participation remains a challenge for policymakers.

Psychological and perceptual barriers further contribute to digital exclusion, especially among elderly people who often exhibit the known 'fear of technology'. Distrust or anxiety about digital tools, security, privacy and usability limit their willingness to adopt digital tools (Damodaran, L., 2015, Tomczyk, Ł. et al., 2023). At the same time, many individuals lack confidence in using technologies effectively, a situation that leads to the avoidance of using them and the digital divide.

It is evident that the rapid expansion of internet usage over the past decade has profoundly transformed global communication, commerce, education, and daily life. In 2010, approximately 30% of the global population was online; by 2020, this figure had doubled to 60%, and as of October 2024, it reached 67.5% (A. Petrosyan, 2024). This surge has been driven by advancements in broadband infrastructure, affordability of mobile technology, and increasing reliance on digital services. However, access alone does not guarantee equal participation in the digital world. Long-standing barriers including financial constraints, access barriers, and computer illiteracy persistently exclude significant parts of society. For instance, financial inequality and unaffordability have been long-standing deterrents to computer access (Taylor, D., & Packham, G., 2016). Also, the lack of supporting infrastructure keeps many out of range of accessing the web, electricity, and connectivity, undermining even the best efforts at digital inclusion. That paradox compels full-fledged approaches to digital inclusion that go beyond connectivity in order to make everyone effective in participating in the web economy and society.

To make these trends concrete, the following two charts present a graphical depiction of worldwide expansion in terms of internet use over time in relation to ongoing obstacles to digital access. The first chart (Figure 1) plots overall expansion in terms of internet use and yet reveals that a considerable part of society continues to have difficulty accessing and utilizing digital technology. The second chart (Figure 2) continues to dissect these obstacles, defining them in terms of economic, access, and digital skill-related obstacles, and underlines the necessity for focused interventions.

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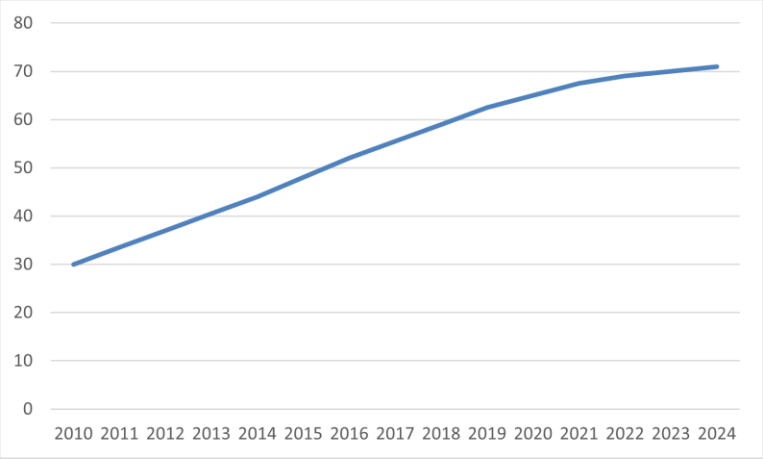

***Fig. 1**: Global Internet Penetration*

Figure 1 reflects the global expansion in internet use between 2010 and 2024. According to statistics compiled by the International Telecommunication Union (ITU, 2023) and Statista, 30% of 2010's population had access to the Internet, rising to 67.5% in 2024 (ITU, 2023; Statista, 2024). This sustained expansion is an indication of significant improvement in technology infrastructure, a fall in price for mobile devices, and an overall rise in the use of digital services in industries such as education, medical care, and business.

However, increased access to the web alone will not necessarily enhance fair digital inclusion. There are a variety of regions, most prominently developing countries and rural communities, with persistent barriers in terms of financial restrictions, infrastructure, and low digital capabilities. All these barriers arise even when connectivity keeps growing. Observations of the OECD and the World Bank point out that access, significant as it is, must accompany investments in digital capabilities and price-affordable alternatives in order to allow everyone to make an effective contribution to the digital economy (World Bank, 2016; OECD, 2021).

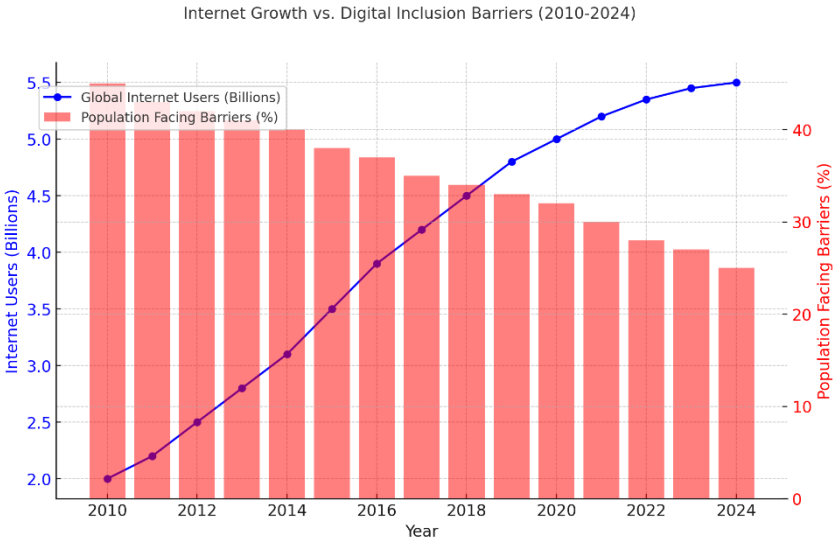

***Fig. 2**: Global Internet Growth vs. Digital Inclusion Barriers*

Figure 2 reveals the steady rise in global internet users from 2 billion in 2010 to approximately 5.5 billion in 2024, demonstrating the increasing digital connectivity worldwide. However, the chart also highlights that despite this growth, a significant portion of the population continues to face digital inclusion barriers, with 45% experiencing challenges in 2010 and 25% still affected in 2024. The trend, even in its demonstration of a decline in barriers over a period, identifies that access to the web alone cannot secure fair access and use of the information society and

economy. Long-standing barriers, including financial constraints, access barriers, and computer and information skills lack, expose a demand for proactive interventions and policies in closing down the digital divide.

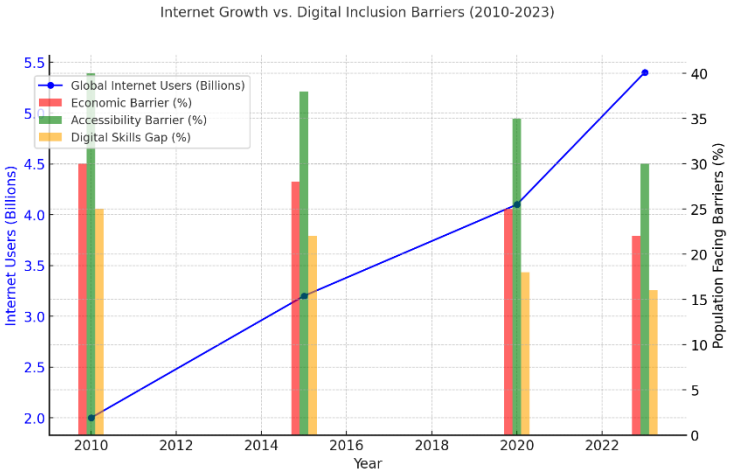

Fig. 3 *Internet Growth vs. Specific Digital Inclusion Barriers*

Figure 3 embarks on a deeper examination of barriers to full digital inclusion and organises them under three general categories: access, economic, and digital skill gaps. As per information, despite a drop in economic barriers over the years, beginning at 30% in 2010 and decreasing to 22% in 2023, lack of affordability continues to hinder access for poor segments of society. Accessibility barriers, which impacted 40% of the population in 2010, remain a significant challenge at 30% in 2023, reflecting the need for more inclusive digital infrastructure and services. Similarly, the digital skills gap has narrowed from 25% in 2010 to 16% in 2023, yet a considerable portion of the population still lacks the necessary competencies to fully participate in the digital world. These findings reinforce the importance of not just expanding internet access but also addressing the socioeconomic and educational factors that influence digital inclusion.

4. EU efforts to address and mitigate these barriers

The EU recognises there is an increasing digital divide and a pressing need, therefore, to promote digital inclusion for all citizens to enable them to participate in a digital economy and society. As digital technologies transform industries, education and everyday life, anyone lacking access to the infrastructure needed to use technology or lacking basic digital skills or affordable internet services, risks falling behind. Recognizing these challenges, the EU has implemented a series of policy initiatives, infrastructure investments, digital literacy programs, accessibility regulations, and affordability measures to create a more inclusive digital ecosystem. These efforts contribute to the goals of the 2030 Digital Compass towards a digitally empowered and technology sovereign European Union with connectivity, skill, cybersecurity, and innovation driving social and economic development.

The European Union has developed policy frameworks to make digital transformation work for everyone in society. Policies have been designed to give direction to member countries, companies, and public sectors for enhancing access, developing capabilities, and closing gaps in terms of digital engagement. The European Union long-term blueprint for digital transformation is the Digital Compass 2030. One of its most important objectives is to enable at least 80% of citizens to have minimum digital skills in 2030 and for all European homes to have access to gigabit connectivity. Having specific objectives, it creates a specific direction for enhancing digital inclusion and for having Europe competitive in a growing changing digital environment. The ESF+ (Social Fund Plus) scheme continues concentrated funding for training and work programmes for developing digital competences in disadvantaged groups, including low-income groups, immigrants, and jobseekers. ESF+ main objective is to reduce skill gaps and increase employability in an emerging digital jobs economy.

The Digital Skills and Jobs Coalition unites governments, employers, educational providers, and civil society in an attempt to bridge technology skills gaps. By developing collaboration, the coalition sees to it that workers and citizens have competencies in a position to join and contribute to the jobs marketplace and digital economy. Coding for All Initiatives supports coding education in schools and communities, preparing

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students, job seekers, and professionals for future technological careers. It enhances Europe's digital workforce by equipping individuals with essential programming skills. The Upskilling Pathways Initiative empowers adults with low digital skills, offering them individualized training in computer literacy, web use, and problem-solving in a virtual environment. The Digital Europe Program addresses educational and financial barriers through financing for high-level digital competencies and technological capabilities through projects. By focusing on sectors such as supercomputing, artificial intelligence, and cybersecurity, it enables citizens and businesses to thrive in a digital economy, filling gaps in digital competency and spurring innovation in member nations. The European Digital Skills Awards respond to educational barriers through a recognition and motivation of successful programs that have successfully developed citizens' digital competencies in the European Union. By offering such incentives, such awards promote best practice in digital training, challenging educational institutions to apply effective training programs for closing gaps in digital literacy.

To address the urban-rural digital divide, the EU invests in broadband expansion and connectivity projects to ensure that underserved communities can access high-speed internet and digital services. These initiatives are particularly crucial in rural, remote, and economically disadvantaged areas. The Connecting Europe Facility (CEF) programme provides funding for rural and disadvantaged areas in Europe for connectivity improvement. CEF aims at closing geographical gaps in access to connectivity through financing for high-speed infrastructure development, fiber-optic connectivity, and 5G rollout. WiFi4EU scheme brings free public WiFi hotspots to parks, libraries, public spaces, and community spaces in EU nations. In other words, it provides free and secure access for all, no matter geographical location, helping also in breaking down financial barriers to connectivity, especially for those who cannot afford a subscription at home. Both WiFI4EU & CEF support also the infrastructure development. The European Digital Innovation Hubs Network addresses infrastructure and educational barriers through access to technical expertise, training, and financial consultancy for companies and public administration entities. Hubs promote and enable use of digital technology and innovation, specifically in regions with a lack of development in terms of digital technology. The Digital Transformation Compass 2030 addresses infrastructure, educational, and financial barriers through ambitious citizen and business enablement through digital transformation objectives. It seeks to build digital competencies, infrastructure development, and stimulate economic development for assured access to the digital economy.

In parallel, the EU prioritized accessibility regulations to ensure that all individuals, including those with disabilities, can fully participate in the digital world. These regulations encourage accessibility by everyone web development, electronic goods and services, and electronic environments. The Web Accessibility Directive mandates compliance with accessibility for all public sector websites and mobile applications. It enables persons with disabilities to access, use, and enjoy electronic goods and services with no obstacles in between. EU Disability Strategy (2021-2030) deepens commitment towards electronic access through overcoming barriers to access for persons with disabilities in electronic technology. It promotes accessible technology, accessible electronic information, and access policies in private and public sectors.

Some EU countries have introduced subsidies, financial incentives, and tax rebates to make access to the digital economy more affordable. Specifically, in certain EU member states, governments provide financial aid to low-income households, helping them purchase laptops, tablets, and internet subscriptions. For example, Slovenia’s Digital Inclusion Act offers digital vouchers to specific population groups, enabling disadvantaged individuals to buy computer equipment. Additionally, the EU encourages businesses to invest in digital tools and workforce training by offering incentives and tax allowances. These policies support corporate investment in employee digital upskilling while also reducing the cost of personal technology investments.

The European Declaration of Digital Principles and Rights addresses social, cultural, and legislative barriers through an emphasis on protecting fundamental rights, developing digital competences, and granting access to digital technology for all in an equitable manner. It guides the EU’s journey towards an inclusive, citizen-centred digital transformation that considers citizens' diversity in terms of requirements. Mitigation of digital inequity will require a coordinated and overall approach. One of the most effective strategies for creating inclusive digital policies is through actively engaging citizens in developing them. Engaging communities in participatory design sessions enables one to make strategies specific to them. For instance, the European Commission’s 2030 Digital Compass incorporated feedback from a variety of stakeholders, including citizens, in creating its 2030 Digital Compass (Ginters E, 2022). Regional cooperation is yet another key one. Policies such as the European Union’s Digital Decade Policy Programme (Signorelli S, 2024) drive countries to work together, with best practice shared and common objectives harmonized. To ensure accountability, transparent reporting and regular audits have to be conducted. NextGenerationEU programs, for one, exhibit

such a practice through reporting twice a year regarding funding operations.

The development of digital infrastructure is most critical in closing the divide, particularly in disadvantaged communities. Public-private partnerships generate additional momentum, such as with WiFi4EU (Kaššaj, M., & Peráček, T., 2024), in funding free public-space installation of WiFi in city councils through private companies for delivery. The integration of technology in current infrastructure also enables digital transformation. Cities such as Barcelona have incorporated smart sensors in public infrastructure in an attempt to make urban services and connectivity better.

The establishment of digital competences and literacy is key in developing an environment of inclusion. Community training programs, designed in collaboration with community groups, address specific individual requirements for individual groups. Interactive and gamificated platforms for training make skill development in a virtual environment accessible and exciting. Mentorship programs extend digital capabilities even further. In MIT's D-Lab (Smith, A., & Adams, N., 2022), experienced learners mentor students to co-create technology, and in Australia's Digital Mentors Program (Dezuanni, M., 2019), volunteers are trained to mentor others in enhancing their digital capabilities, with a view to creating knowledge spillover in communities.

To make tools and services accessible universally, development must be guided through universal approaches to design. Public sector websites have to abide by such standards under the EU Web Accessibility Directive (Ferri, D., & Favalli, S., 2018). Collaborative spaces like community access labs have a critical role in developing accessible tools for all. Implementation of access standards through audits and tracking strengthens compliance.

Affordability is a significant barrier to access, and simplifying access to subsidies can have a significant impact. Sliding scales in pricing frameworks make it even less costly through pricing in relation to incomes.

Effective digital inclusion strategies involve cross-cutting approaches with a high level of community and data-driven decision-making orientation. By having a variety of demographics involved in planning and rollout, programs can best react to community requirements. Participatory design processes in use in MIT's D-Lab and in the case of the platform in Barcelona demonstrate how citizen engagement can produce meaningful and inclusive outcomes. Data analysis is yet another powerful tool for sharpening and acting on strategies. There is an EU Digital Economy and Society Index tracking digital transformation in member nations. Public awareness programs serve a complementary role in creating awareness regarding programs and options that exist out there. Citizens become sensitized about their digital rights through the European Declaration of Digital Rights and Principles.

Table 1. EU mitigation measures to address Digital inclusion barriers

EU Initiatives/Policies/Frameworks	**Barriers Addressed**	**Description**
Digital Compass 2030	Educational, Infrastructure, Economic	Aims for 80% of citizens to have minimum digital skills and universal gigabit connectivity by 2030.
NextGenerationEU	Infrastructure, Educational, Economic	Funding for digital transition, infrastructure, skills training, and connectivity in disadvantaged regions.
ESF+ (Social Fund Plus)	Educational, Economic	Focused funding for digital competences development in disadvantaged groups.
Connecting Europe Facility (CEF)	Infrastructure, Geographical	Funding for broadband expansion and high-speed connectivity in rural and remote areas.
WiFi4EU	Infrastructure, Economic	Free public WiFi hotspots in parks, libraries, and public spaces across EU countries.
Digital Skills and Jobs Coalition	Educational	Collaboration to bridge technology skills gaps across governments, employers, and educators.
Coding for All Initiatives	Educational	Prepares students and professionals for future tech careers through coding education.
Upskilling Pathways Initiative	Educational	Individualized training for adults with low digital skills to improve competencies.
Web Accessibility Directive	Accessibility, Social and Cultural	Mandates accessibility compliance for public sector websites and mobile applications.

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EU Disability Strategy (2021-2030)	Accessibility, Social and Cultural	Promotes accessible technology and policies for persons with disabilities.
Digital Inclusion Act (Slovenia)	Economic	Provides digital vouchers for low-income groups to purchase computer equipment.
Digital Decade Policy Programme	Infrastructure, Educational, Policy and Regulatory	Sets goals for digital skills, infrastructure, business transformation, and digital public services by 2030.
Digital Services Act (DSA)	Policy and Regulatory, Psychological and Perceptual	Creates safer digital spaces by regulating online platforms and enhancing user protections.
Digital Education Action Plan (2021-2027)	Educational	Promotes high-quality, inclusive, and accessible digital education across Europe.
European Digital Identity (EUDI)	Policy and Regulatory, Accessibility	Provides secure digital wallets for citizens to access services across EU member states.
Cyber Resilience Act	Policy and Regulatory, Psychological and Perceptual	Enforces cybersecurity standards for internet-connected products to enhance digital trust.
Digital Agenda for Europe	Infrastructure, Educational, Economic	Maximizes the benefits of digital technologies for all EU citizens through improved access and digital literacy.
Horizon 2020	Educational, Infrastructure, Policy and Regulatory	Funds research and innovation projects, including those promoting digital inclusion and technological development.
European Regional Development Fund (ERDF)	Infrastructure, Geographical, Economic	Invests in ICT infrastructure in less developed regions to reduce the digital divide.
European Accessibility Act	Accessibility, Social and Cultural, Policy and Regulatory	Requires accessible design for products and services like computers and e-commerce to ensure inclusion of persons with disabilities.
Digital Europe Programme	Infrastructure, Educational, Economic	Funds projects in supercomputing, AI, cybersecurity, and advanced digital skills to accelerate Europe's digital transformation.
All Digital	Educational, Social and Cultural	Brings together organizations to empower citizens with digital skills, focusing on basic competencies, coding, and digital literacy.
European Digital Skills Awards	Educational	Recognizes initiatives that improve digital skills of EU citizens, promoting best practices in digital education.
European Digital Innovation Hubs Network	Infrastructure, Educational, Policy and Regulatory	Supports digital transformation by providing services and resources to governments and businesses through digital platforms.
Digital Transformation Compass 2030	Infrastructure, Educational, Economic	Sets ambitious goals for empowering citizens and businesses via digital transformation by 2030.
European Declaration on Digital Rights and Principles	Social and Cultural, Policy and Regulatory	Promotes principles for a digital transformation that respects European values and citizens' rights.

The EU's policies and initiatives to address digital inclusion barriers reflect a structured, multi-dimensional approach aimed at creating a more equitable digital society. By tackling key issues—such as infrastructure deficits, economic limitations, digital literacy gaps, social and cultural obstacles, and regulatory complexities—the EU reaffirms its strong commitment to closing the digital divide. These efforts align with broader strategies like the Digital Compass 2030, NextGenerationEU, and the Digital Decade Policy Programme, all designed to promote universal connectivity, enhance digital skills, and ensure accessible technology for all citizens.

Despite advancements in technology and policy interventions, significant challenges persist. Rural and underserved areas continue to struggle with infrastructure gaps, affordability remains a barrier for many low-income households, and marginalized groups still face digital exclusion due to limited skills or accessibility constraints. Additionally, the fast-paced evolution of digital technologies necessitates continuous policy adaptation to keep inclusion strategies effective and relevant in an ever-changing digital

landscape.

Moving forward, future research should focus on assessing the long-term impact of the EU's digital inclusion initiatives, evaluating their sustainability, scalability, and ability to adapt to emerging technological, economic, and social challenges. Comparative studies across EU member states could also offer valuable insights into best practices, policy effectiveness, and areas that require further intervention. As the digital landscape continues to evolve, ongoing assessment and targeted efforts will be crucial in ensuring that no one is left behind in Europe's journey toward full digital inclusion.

5. Conclusions

The EU is taking a well-rounded approach to breaking down barriers to digital inclusion, ensuring that everyone has the opportunity to benefit from technology. By addressing challenges like limited infrastructure, economic hardship, gaps in digital skills, and regulatory hurdles, the EU is making a strong push to close the digital divide. Initiatives such as the Digital Compass 2030, NextGenerationEU, and the Digital Decade Policy Programme all reflect a shared commitment to expanding internet access, improving digital literacy, and making technology more accessible to all.

However, despite these efforts, significant challenges remain. Many rural and underserved communities still struggle with poor connectivity, while affordability continues to be a major hurdle for low-income households. Marginalized groups often face exclusion due to limited digital skills or accessibility barriers, and the rapid pace of technological change means policies must constantly evolve to stay effective.

Looking ahead, it's crucial to assess the long-term impact of these initiatives—are they truly sustainable, scalable, and adaptable to future challenges? Comparative studies across EU member states could shed light on what's working and what still needs improvement. As the digital world continues to evolve, ongoing evaluation and targeted action will be essential to ensure that no one is left behind in Europe's journey toward full digital inclusion.

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