UNIVERSITY OF LJUBLJANA
FACULTY OF PUBLIC ADMINISTRATION

UNIVERSITY OF RIJEKA
FACULTY OF ECONOMICS AND BUSINESS

Doctoral dissertation

PROSPECTS OF DIGITALIZATION IN FOSTERING EQUAL ACCESS TO PUBLIC SERVICES WITHIN DIFFERENT SOCIOECONOMIC CONTEXTS IN NORTH MACEDONIA

Tanja Paneva

Ljubljana, November 2025

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PROSPECTS OF DIGITALIZATION IN FOSTERING EQUAL ACCESS TO PUBLIC SERVICES WITHIN DIFFERENT SOCIOECONOMIC CONTEXTS IN NORTH MACEDONIA

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I, the undersigned Tanja Paneva, doctoral candidate of the joint doctoral study programme Governance and Economics in the Public Sector, with enrolment number 04210476, I am the author of the doctoral dissertation entitled Prospects of Digitalization in Fostering Equal Access to Public Services within Different Socioeconomic Contexts in North Macedonia.

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ABSTRACT

Access to public services is fundamental to sustaining and improving the quality of life for individuals and advancing the overall social development. Benefits of access are expressed in the opportunities for participation in all societal domains. Driven by the public ethos, governments have the responsibility to ensure equal access to public services and support the process of public value creation. The public value produces socially accepted outcomes, including fairness, trust, and legitimacy, with effects depending on contextual factors. In response to barriers that have consistently burdening in-person access to public services, governments relied on Information and Communication Technology (ICT) as a potential remedy. However, the increased reliance on digital technologies has exposed the extent to which access disparities can exacerbate social inequalities, leaving marginalised populations further behind. Instead of removing physical barriers, digital solutions often introduce barriers of a new kind. Prior research has confirmed that access disparities spill over from the offline to the digital domain, with resources being the main source of inequalities. This research expands on that premise and aims to identify the specific barriers to access and propose enablers accordingly.

The research focus is the case of North Macedonia and the challenges and opportunities related to access to public services. The research integrates an exploratory sequential design, consisting of a qualitative phase with interviews to explore citizens' perceptions, and a quantitative phase comprising survey of citizens. The research statistically confirms that sociodemographic and socioeconomic variables influence the incidence of barriers in offline and digital access to public services. The findings also confirm the spillover of specific barriers from the offline to the digital domain and explain their transformation in the process. This approach could contribute to targeted efforts for inclusive and effective digital solutions, by understanding the needs of groups facing barriers, and at the same time identifying the nature of the specific barriers. The practical implications of this study could inform policymakers in developing inclusive strategies that 1) enhance early stages of digital transformation processes and 2) effectively address barriers that impede access to public services by implementing customised solutions corresponding to users' contextual circumstances. Additionally, the theoretical contribution of this research lies in advancing the conceptual understanding of barriers and enablers as central in the broader study of access inequalities.

Keywords: digital equality, digitalization, socio-digital inequalities, equal access, public services, barriers, enablers.

POVZETEK

OBETI DIGITALIZACIJE ZA IZBOLJŠANJE ENAKOSTI PRI DOSTOPANJU DO JAVNIH STORITEV V RAZLIČNIH SOCIALNO-EKONOMSKIH KONTEKSTIH V SEVERNI MAKEDONIJI

Dostop do javnih storitev je bistvenega pomena za ohranjanje in izboljšanje kakovosti življenja posameznikov ter za splošni socialni napredek. Koristi dostopa se kažejo v možnostih za sodelovanje na vseh družbenih področjih. Vlada ima v skladu z javnim etosom odgovornost, da zagotovi enakopraven dostop do javnih storitev in podpira proces ustvarjanja javne vrednosti. Javna vrednost prinaša družbeno sprejemljive rezultate, vključno s pravičnostjo, zaupanjem in legitimnostjo, pri čemer so učinki odvisni od kontekstualnih dejavnikov. V odgovor na oviran osebni dostop do javnih storitev, se vlade zanašajo na informacijsko-komunikacijsko tehnologijo (IKT). Vendar pa povečana odvisnost od digitalnih tehnologij razkriva, da lahko razlike v dostopu povečajo socialne neenakosti in položaj marginaliziranih skupin prebivalstva še poslabšajo. V želji da bi odpravile fizične ovire, digitalne rešitve pogosto uvajajo ovire nove vrste. Prejšnje raziskave so potrdile, da se razlike v dostopu prenašajo iz offline v digitalno okolje, pri čemer so viri glavni vzrok za neenakost. Ta raziskava nadgrajuje to premiso in si prizadeva identificirati konkretne ovire pri dostopu ter v skladu s tem predlagati ukrepe za izboljšanje.

Na primeru Severne Makedonije se raziskava osredotoča na izzive in priložnosti povezane z zagotavljanjem enakosti pri dostopu do javnih storitev. Raziskava je zastavljena na preiskovalnem sekvenčnem modelu, ki obsega kvalitativno fazo z intervjuji za ugotavljanje mnenj državljanov, in kvantitativno fazo, z anketno raziskavo med državljani. Rezultati raziskave statistično potrjujejo, da sociodemografske in socioekonomske spremenljivke vplivajo na pojav ovir pri dostopu do javnih storitev v fizičnem in digitalnem svetu. Ugotovitve potrjujejo tudi prelivanje določenih ovir iz fizičnega v digitalni svet in pojasnjujejo njihovo preoblikovanje v tem procesu. Ta pristop lahko prispeva k usmerjenim prizadevanjem za vključujoče in učinkovite digitalne rešitve, saj opredljuje naravo ovir in omogoča razumevanje potreb skupin, ki se soočajo z njimi. Ugotovitve te študije lahko oblikovalcem politik pomagajo pri razvoju vključujočih strategij, ki 1) izboljšujejo zgodnje faze procesov digitalne transformacije in 2) z uvajanjem prilagojenih rešitev, ki ustrezajo kontekstualnim okoliščinam uporabnikov, učinkovito odpravljajo ovire pri dostopu do javnih storitev. Poleg tega raziskava teoretično prispeva k konceptualnemu razumevanju ovir in spodbujevalcev kot osrednjih elementov v širši študiji neenakosti pri dostopu.

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LIST OF ABBREVIATIONS

CI	Community Informatics
DEG	Digital Era Governance
DOI	Diffusion of Innovations
EC	European Commission
eID	Electronic Identification
eIDAS	Electronic Identification, Authentication and Trust Services
EIF	European Interoperability Framework
EU	European Union
GDPR	General Data Protection Regulation
ICT	Information and Communication Technology
IR	Industrial Revolution
ITU	International Telecommunication Union
MDT	Ministry of Digital Transformation
MISA	Ministry of Information Society and Administration
NPG	New Public Governance
NPM	New Public Management
NPS	New Public Service
NTES	Nomenclature of Territorial Units for Statistics in North Macedonia
NWS	Neo-Weberian State
OECD	Organisation for Economic Co-Operation and Development
PAR	Public Administration Reform
PPT	People, Process, Technology
SAO	State Audit Office
SCT	Social Cognitive Theory
SI	Social Informatics
SQB	Status Quo Bias
TAM	Technology Acceptance Model
TPB	Theory of Planned Behavior
TRA	Theory of Reasoned Action
UN EGDI	United Nations E-Government Development Index
UN EPI	United Nations E-Participation Index
UN LNOB	United Nations Leave No One Behind
UN SDGs	United Nations Sustainable Development Goals
UMEGA	Unified Model of Electronic Government Adoption
UTAUT	Unified Theory of Acceptance and Use of Technology

"Combatting inequalities requires a collective consciousness arising from individual changes in perspectives around the barriers that groups of people encounter in achieving beneficial outcomes, instigated through changes in people's everyday environments and networks."[1]

Helsper, 2021, p.47

1   INTRODUCTION

Access to public services is the forefront of interaction between citizens and the public institutions. This interaction further defines trust in the system and delineates the trajectory of overall social development. In that regard, liberal democracies worldwide strive to align access to public services with the good governance principles – providing equal access opportunities in a fast, reliable, and convenient manner while nurturing accountability, responsiveness, and transparency. However, conventional practices precipitated issues expressed in proximity, costs, geographical location, red tape, and complex bureaucratic procedures (Van Dijck & Steen, 2023; Brinkerhoff et al., 2018; Jacobs et al., 2012; Ziller et al., 2010) among the many, burdening access to public services. The sustained effort to streamline access urged governments to seek out alternatives to replace existing practices.

The momentum of widespread internet diffusion, especially evident over the past two and a half decades, promoted Information and Communication Technology (ICT) as a viable solution to the persistent issues. The success stories from the private sector (Kitsing, 2011, 2017) further reinforced the idea of implementing digital interventions. Introducing ICT in the public sector added to unfolding the transformative impact of digital technologies, making digitalization a buzzword in the reform agenda of public administrations worldwide. The appropriation of technology brought forth the promise of making public services a click away from citizens while boosting efficiency for both users and service providers (Roseth et al., 2018; Androniceanu & Georgescu, 2021). Nevertheless, despite the myriads of benefits and anticipated outcomes of enhanced equality of access and optimisation of service delivery, digitalization in the public sector has introduced multi-layered intricacies.

From a developmental perspective, access to public services is fundamental to providing the basic conditions for sustaining and improving the quality of life for individuals while fostering sustainable progress for communities (Lee, 2021;

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[1] In summary of different theoretical approaches to inequalities.

Jackson, 2021; Reyes Plata & Galindo Perez, 2020). At a micro level, the benefits of access are expressed in opportunities for individuals to participate in the public economic, political, and social life (Van Dijk 2013, 2020), as a starting point for the fulfillment of human rights. At a macro level, benefits of access contribute to the creation of public value by fostering communities of social inclusion, justice, fairness, and accountability (Moore, 1995, 2019; Lindgren et al., 2019; Cordella & Bonina, 2012). In this sense, a number of studies argue that equal societies perform better against key indicators of social and economic progress than societies with higher inequality indices (Fleurbaey, 2018; Stiglitz, 2012; Wilkinson & Pickett, 2009, 2010). As a result, the pursuit of equalising access opportunities to public services for all societal groups becomes inherently linked to overall better performance of societies.

Ideally driven by the public ethos, governments' actions and public policies should strive to promote public interest and meet citizens' demands (Lindgren & Jansson, 2013). The expected outcome of public value creation in this context legitimises governments and empowers the role of the citizen. First conceptualised in the field of public management, the public value framework referred to the engagement and optimisation of resources used by public managers in addressing the legitimate needs of customers (Moore, 1995). Later deliberations shifted from the mere managerial to a broader social perspective considering the principles upon which governments' policies should be based, acknowledging both the process and the outcome of the public value creation (Bozeman, 2007); and encompassing the deontological stance of how collectively owned, public assets are utilised to support the common welfare (Moore, 2014). In other words, the public value framework serves as a guide to which extent governments' actions meet citizens' demands and how much those actions contribute to the individual and collective well-being.

Along these lines, the public value governance framework naturally evolved the role of the citizen from a simple service-recipient to an active participant and a co-creator in the service creation related processes (Distel & Lindgren, 2023). Attuned to these developments, public administration paradigms moved beyond the purely market-driven and customer-oriented New Public Management (NPM) (Hood 1991; Dunleavy & Hood, 1994) to the collaborative and networked nature of the New Public Governance (NPG) (Osborne 2006; Bryson et al., 2014). In addition, the New Public Service (NPS) framework proposed by Denhardt and Denhardt (2000, 2015) refined the quality of the government-citizen interaction from 'steering to serving', prioritising citizen-centred, value-driven governance based on responsiveness and integrity over entrepreneurship and exercise of bureaucratic authority. However, to balance the democratisation of processes with the pursuit of efficiency, the hierarchy-driven Neo-Weberian State (NWS) (Pollitt & Bouckaert, 2011) highlighted the role of professional and accountable public administration that adheres to the evolving demands of the 21st century public sector reforms, delivering services in equitable and inclusive

manner (Bouckaert, 2023). The integration of ICT in the public sector introduced the shift to the Digital Era Governance (DEG) grounded in the needs-based, holistic approach in the course of digitalization of administrative processes (Dunleavy et al., 2006). In the context of enabling equal access to public services, ICT in the public sector makes technology embedded in the public value creation. Therefore, the public value framework requires a user-centred and customised approach by governments when designing access policies and strategies in regard to equipping citizens with the necessary tools, skills, and knowledge to access the new, digital communication channels, making sure no groups are left behind.

Digitalization in this regard is seen as the transformative promise to revolutionise all aspects of human functioning carrying the potential to combat structural inequalities and achieve the long sought sustainable economic development (Ranchordás, 2022; Sylvain, 2016). The EU Agency for Fundamental Rights (2023) acknowledges the processes of demographic ageing and digitalization as the two major transformations shaping the future of Europe. Equating it to the power of past industrial revolutions (IR), Schwab (2016) referred to the process of new technologies intertwining every aspect of human life as the Fourth Industrial Revolution (IR 4.0), wrapped in the juxtaposition of great efficiency potentials and concerns related to adaptation, inequalities, and security. Now standing at the brink of IR 5.0 and the potential of further human-machine collaboration, it is essential to prioritise the human-centred policy developments and utilising technology as tools "made by people for people" (Schwab, 2016, 2024). Noble et al. (2022) depicted a timeline of past innovations and framed the potential of digitalization and smart machines as next in the scale of human evolution (Figure 1):

Figure 1: Timeline of industrial revolutions and innovations

Steam power-shift from manual to machine production ca. 1750-1850

Binary and advanced computers to automate processes ca. 1930-2000

Optimising the potential of human-machine collaboration ca. 2020 and ongoing

IR 1.0   IR 2.0   IR 3.0   IR 4.0   IR 5.0

Electricity and mass production ca. 1850-1930

Datafication and smart technologies ca. 2000-2020
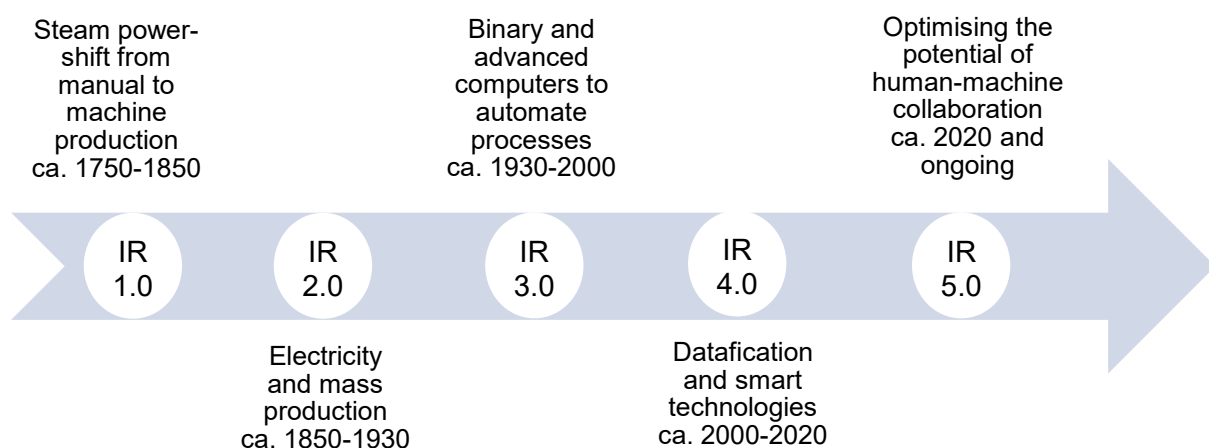
Source: Adapted from Noble et al. (2022)

While technological advancements gallop ahead in all superlatives to maximise, benefit, simplify, and streamline processes, paradoxically some societal groups are now at greater risk of being left behind (Sylvain, 2016; Larsson, 2021; Ragnedda 2017, 2018; Helsper, 2021). Transferring communication channels from the traditional, offline means to the digital realm in the context of access to public services, makes technology an indispensable resource of participation embedded in the public value creation (Ragnedda, 2017; Ranchordás, 2022; Lindgren & Jansson, 2013). These developments incited the question whether all citizens will be equipped with the necessary tools, skills, resources and knowledge to equally access public services in online format. In other words, the main concern is whether digitalization will equalise access opportunities, transcending challenges in physical sense, or impose barriers of a new kind, making the socially excluded digitally excluded as well (Ragnedda 2018; Larsson, 2021; Ranchordás, 2022). On the other hand, public administration reforms that employ digital solutions aspire to respond to the diverse user demands in a fast-paced environment. These endeavours tend to adopt the bottom-up approach with citizens in the role of co-creators of strategies, policies or matters of public interest. Contrary to the expectations, when tailoring policies, users' demands are often neglected on the account of implementing generic solutions that in time prove not to be in line with users' needs resulting in discrepancies jeopardising equal access opportunities for different sociodemographic and socioeconomic groups.

This dissertation explores the prospects of digitalization to foster equal access to public services by taking a user-centred perspective, identifies the access barriers and proposes enablers as perceived by citizens in the role of users. The study approach considers individual characteristics at the micro level and the broader, environmental influences at the macro level, aiming to understand how barriers vary across different socioeconomic contexts and to design inclusive strategies accordingly. The research design applies the twin approach, examining both barriers and enablers in offline and digital access, acknowledging the transition to digital access and recognising that offline access remains the only option for some citizens.

While previous research focuses primarily on the unequal distribution of resources as generating inequalities this dissertation takes this stance as a constant, a fact or reality, but expands the focus on barriers being a product of contextual and environmental settings, policies, or strategies. Through a mixed-method approach and primary data collection from users, the research's ultimate goal is to identify the equitable conditions or enablers, that can tackle barriers tied to specific socioeconomic contexts and achieve equal access opportunities. The research is set in the context of North Macedonia, a country making decisive steps to digital transformation of the public sector, yet still lagging behind in practical implementation compared to the European context. The research approach, the conceptual

background, and recommendations based on findings, can be broadly applied to environments in the early stages of digital transformation aiming to ensure equal access opportunities.

1.1 LEGAL AND POLICY RELEVANCE OF EQUAL ACCESS

Given its critical role in advancing social development, the right to equal access to public services stands as a firmly established international legal standard. The cornerstone of human rights protection, the Universal Declaration of Human Rights (1948) guarantees that "everyone has the right of equal access to public services in their country" (Article 21). In the same line, Article 25 of the International Covenant on Civil and Political Rights (1966), another foundational pillar of international human rights law, enshrines the right to equality of access to public services along with the right of participation in public affairs.

Within the European context, the corpus of the European Union (EU) legislation sets equal and universal access as paramount to achieving sustainable future in a digital transition reality. This endeavour is legally grounded in the Charter of Fundamental Rights of the European Union (2000) and the Treaty of the EU (1992) envisaging the right to good public administration (Article 41 of the Charter) and the core value of fundamental respect for human rights (Article 2 of the Treaty). Furthermore, aligning with the 2030 Digital Compass vision and the targets of the Digital Decade policy program (2022) of having 100% of key public services accessible online by 2030, the European Declaration of Digital Rights and Principles (2023) advocates for solidarity and inclusion in the digital transformation process making sure nobody is left behind. The provisions of the European Accessibility Act (2019), Directive (EU) 2019/882 also envisage accessible services for everyone with particular attention to the needs of people with disabilities. These policy goals apply to the EU Member States and aspiring candidate countries to foster digital transition undergirded by tailored strategies ensuring equal access opportunities for all, considering the marginalised and groups at risk of exclusion.

In addition, the EU's commitment to establishing the Electronic Identification (eID) and operationalising the EU Digital Identity Wallet across Member States by 2026 aims to simplify and facilitate access to both digital private and public services (EC, n.d.). These initiatives are legally grounded in the electronic Identification, Authentication and Trust Services (eIDAS) Regulation (EU) No 910/2014 which set the basis for secure cross-border electronic transactions and the mutual recognition of eIDs among EU Member States following common criteria (EC, 2025). To address practical interoperability challenges and ensure legal harmonisation across the EU, the Regulation (EU) No 2024/1183 amended the original eIDAS and adopted the European Digital Identity Regulation (EC, 2025). This framework introduced the EU

Digital Identity Wallet that enables storage and cross-border electronic exchange of documents and data in a safe and reliable manner. As the exposure of personal data online is associated with certain risks, the eID initiatives are framed in accordance with safety, security, and data protection standards outlined in the General Data Protection Regulation (GDPR), Regulation (EU) 2016/679. These developments highlight the need for continuous efforts to advance digitalization processes in EU candidate countries, enabling them to keep pace with the eID initiatives and ensure balanced digital progress across Europe.

Following developments in using digital government to advance societies, the Recommendation on Digital Government Strategies (2014) of the Organisation for Economic Co-operation and Development (OECD) calls upon using digital technologies by governments to create public value through producing goods and services matching the needs of citizens, grounded in the justice, fairness, efficiency, and effectiveness.

Another bastion of human rights protection, the Council of Europe firmly upholds the principles of equality and non-discrimination in ensuring all individuals enjoy their fundamental rights and freedoms. Its foundational treaty, the European Convention on Human Rights (1950), formally referred to as the Convention for the Protection of Human Rights and Fundamental Freedoms, guarantees the political and civil rights of individuals, setting standards for equal treatment and the rule of law. In addition, the European Social Charter (1961) and the Revised European Social Charter (1996), guarantee the protection of social and economic rights, emphasising the equal access to essential services considering the position of vulnerable groups. The European Social Charter is regarded as the Social Constitution of Europe, with respective articles embodied in the architecture of the EU human rights law (Council of Europe, n.d.). Over the years, these supranational legal instruments have been amended and supplemented by protocols to reflect current social needs and legal developments.

In that regard, the Council of Europe recognises the importance of the internet in influencing the opportunities on access to services and participation in public life. To ensure participation, while at the same safeguarding privacy and data protection in the digital domain, several key conventions have been developed: the Convention for the Protection of Individuals with regard to Automatic Processing of Personal Data (Convention 108, 1981) and its modernised version Convention 108+ (2018), the Convention on Cybercrime (2001), and the Framework Convention on Artificial Intelligence and Human Rights, Democracy and the Rule of Law (2024), each of them considered a pioneering framework or acting as the first legally binding instrument in their respective field (Council of Europe, n.d.). Furthermore, acknowledging the potential of the internet to create public service value, the Council

of Europe developed the Digital Agenda 2022-2025 to ensure that offline rights are fully enjoyed in the digital environment. The Digital Agenda 2022-2025 sets three goals summarised as 1) consolidating the existing digital regulation by supporting the implementation of Council of Europe standards; 2) responding to new challenges and taking advantage of the opportunities provided by emerging digital technologies, by developing new legal instruments or adapting and updating existing ones as appropriate; and 3) accompanying member States for a digital transition with European values based on Council of Europe standards through monitoring and cooperation activities (Council of Europe, 2022). Some of the key priorities of the Digital Agenda include fighting growing social inequalities and poverty, with an emphasis on non-discrimination and promotion of access opportunities for vulnerable groups. The legal and policy framework of the Council of Europe solidifies the position of individuals in pursuing dignified life, with digital governance based on fairness, equality, and inclusion. The Digital Agenda notes that social inequalities can be either reduced or reinforced by digital technologies, which touches upon the key question of this dissertation: unveiling the potential of digitalization as a catalyst for overcoming offline barriers and equalising access opportunities.

The relevance of equal access to public services in improving individual and community well-being is further reinforced with the United Nations (UN) 2030 Agenda for Sustainable Development (2015), operationalised through the 17 UN Sustainable Development Goals (UN SDGs). The UN SDGs address a plethora of challenges concerning global prosperity and advancement, unequivocally dedicated to eradicating poverty and tackling inequalities. Equal and universal access to public services is deemed pivotal in contributing to the achievement of the overall commitments. In this regard, one of the targets of No Poverty (SDG 1) calls for guaranteeing that by 2030, "all men and women, with an emphasis on the poor and the vulnerable, will have equal rights to economic resources, basic services and appropriate new technology" (SDG 1, target 1.4). Furthermore, equal opportunities to access public services in fair, transparent and cost-efficient manner would accelerate achieving the goals of Reduced Inequalities within and among countries (SDG 10); building Sustainable Cities and Communities (SDG 11); and promoting Peace, Justice and Strong Institutions through building effective, inclusive and accountable institutions for all (SDG 16). In terms of access to specific services, equality of access to public services is inextricably linked to providing conditions for Good Health and Well-Being (SDG 3); ensuring Quality Education (SDG 4); achieving Gender Equality (SDG 5); providing access to Clean Water and Sanitation (SDG 6); Affordable and Clean Energy (SDG 7); and securing conditions for Decent Work and Economic Growth (SDG 8). Finally, Industry, Innovation and Infrastructure (SDG 9) directly advocates to support fostering innovation through increased access to ICTs and aiming to provide universal and affordable access to the Internet (SDG 9, target 9.c). Achieving the SDGs is enhanced with the "Leave No One Behind" (LNOB)

principle, making sure there is a steady progress for all population groups with "equality and non-discrimination at the heart of sustainable development" (UN, 2016). These commitments reflect how equal access to public services is intertwined as a general pattern in achieving the SDGs; the *sine qua non* for building strong, fair, and resilient communities of empowered individuals having the equal opportunities for a dignified and sustained quality of life.

1.2 SCIENTIFIC RESEARCH FIELD

The interplay of technical and social elements in the process of introducing technology in the public sector led to the convergence of the traditionally separate fields of social sciences and technical sciences. Namely, in the conventional understanding of the political system of Easton (1965), citizens address their demands (input) to the political system (state institutions and bodies) that meets citizens requests and delivers policies accordingly (output). This input-output model is the base of legitimate functioning of the state systems still relevant and applicable in contemporary terms. At a first glance, the input-output model concerns political science and administrative sciences. However, making technology a mediator in citizen-government communication brings information science into play as well. Therefore, while former means of interaction involved traditional, face-to-face forms of communication, nowadays digital means require specific set of skills and knowledge as a prerequisite for participation.

Following the transformative shift in all aspects of government-citizen communication and public sector operation, digitalization related themes became a matter of interest in the intersecting scope of political science, administrative science, and information systems science (Figure 2). Political science in this regard is interested in how government-citizen relation is shaped with implications on participation, democracy, inclusion, and public value creation; administrative science focuses on how technical solutions would shape administrative processes with implications on efficiency, transparency, accountability, and good governance principles in general; and information systems science strives to deliver innovative solutions that accomplish the expected social goals, while at the same time meeting performance and security standards. Ideally, the convergence of political science, administrative science and information systems science would produce innovative, user-centred, value-driven, and efficient policy solutions.

As explained by Chen et al. (2021), the elements of the transformative processes correspond to the People-Process-Technology (PPT) framework initially developed by Leavitt (1964) as a four-component model, people, structure, task, and technology, referring to changes within organisations; and later adapted by Scheiner (1999) addressing contextual developments related to computer security by keeping

"people" and "technology", and merging "structure" and "task" into "process". The PPT framework has been extensively applied as conceptual foundation in scholarly research in solving information technology problems (Grant & Mergen, 1996), organisational knowledge management (Pee & Kankanhalli, 2009) and to matters related to developing smart solutions in different fields (Chen et al., 2021). The interdisciplinary scientific approach and the PPT framework imply that all elements involved in transformative processes should act in synergy to achieve holistic and sustainable organisational or societal change.

Figure 2: Dissertation's interdisciplinary scientific research field

Political Science
People

Administrative Science
Process

Information Systems Science
Technology
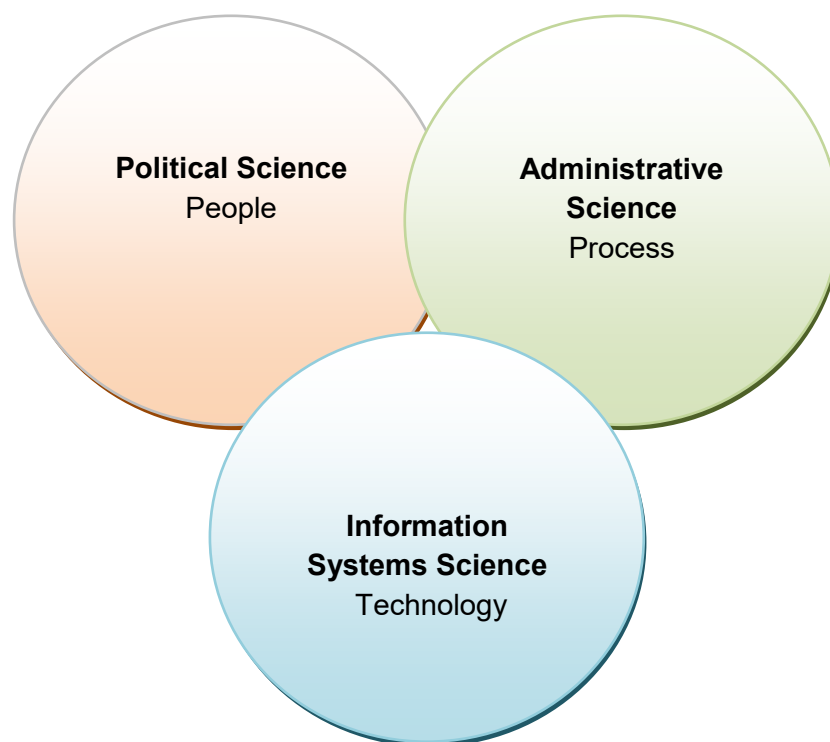
Source: Adapted from Chen et al. (2021), Scheiner (1999), and Leavitt (1964)

Other interdisciplinary areas of research where socio-technical elements intersect include the fields of Social Informatics (SI) and Community Informatics (CI). SI is considered a broader field concerned with the design, use, and social impact of ICT within institutional and cultural contexts (Kling, 2000, 2007). In a broader sense, SI provides a framework for studying human-technology interactions among the multitude of evolving ICT effects on daily life within work, organisational, and wider social settings (Rosenbaum et al., 2024). CI, on the other hand, is a bit more focused on technology empowering communities, contributing to social justice, solidarity, and supporting the overall communal development (Stillman & Denison, 2014; Gurstein, 2007). CI in particular, examines how technology can be made accessible and

usable to everyone by providing conditions in response to community needs rather than offering digital by default solutions, especially in the context of underserved communities and excluded populations (Markazi et al., 2024; Stillman & Denison, 2014; Gurstein, 2007). In conclusion, both SI and CI adopt the human-centred approach in designing organic and inclusive solutions that would bring out the most of potential of technology to benefit people and communities.

1.3 RESEARCH BACKGROUND

Literature studying the effects of technology on access primarily focuses on the potential spillover of inequalities from the social to the digital domain (Helsper 2012, 2021; Ragnedda et al., 2022; Ragnedda & Ruiu, 2017; Asmar et al., 2022; Robinson et al., 2015; Halford & Savage, 2010; DiMaggio et al., 2004). These concerns arise from the assumption that the ones lacking resources in the social domain are much likely to be excluded from the digital domain as well (Helsper & Van Deursen, 2017; Ragnedda et al., 2022; Helsper, 2012). This inequality spiral further jeopardises the position of disadvantaged groups in society, declining their chances of quality choices, and affecting all areas of life. Pioneering research in the field approaches this issue through the broader lenses of access to the internet and new technologies in general as a precondition of further engagement in the network society (Castells, 1996, 2000; Van Dijk, 1999; DiMaggio et al., 2004). In this vein, scholars explored the origin and meaning of social and digital inequality (Helsper & Van Deursen 2017; Robinson et al., 2015; Hargittai, 2021); the relationships that exists between them (Helsper 2008, 2021; Van Dijk, 2005; Van Dijk & Hacker, 2003); the corresponding fields and links between social and digital exclusion (Helsper, 2012); whether digital inequalities reinforce and amplify social inequalities (Ragnedda et al., 2022; Hargittai, 2018) and whether technology-driven reforms make the "rich digitally richer" (Helsper & Van Deursen, 2017). Some of the studies are conceptually anchored in the notions of social capital and digital capital discussing whether networks and resources from the social fields are replicated in the digital domain (Helsper, 2012; Chen, 2013; Helsper & Van Deursen, 2017; Ragnedda, 2018; Ragnedda & Ruiu, 2017; Ragnedda et al., 2020). The inextricable links between the social and digital spheres indicate that examining the social dimension is inevitable as interwoven in understanding digital inequalities.

A substantial body of literature discusses the successive levels of access disparities emerging due to the multilayered nature of exclusion in the digital domain (Van Dijk 2005, 2020; DiMaggio et al., 2004; Ragnedda & Ruiu, 2017; Lythreatis et al., 2022; Van Deursen & Van Dijk, 2014; Van Deursen & Helsper, 2015). The initial signs of access inequalities emerged in the dawn of internet use in the mid-1990s as noted by Van Dijk (2002) and DiMaggio et al. (2004). This period was predominantly marked by the dichotomy of *haves* and *have nots* (NTIA, 1995) denoting the *digital*

divide or the division between people who have access and the ones who do not (Van Dijk, 2002, 2020). However, this simple binary differentiation did not suffice to explain the sophisticated perplexities of access that remained even after physical access has been obtained (Castells, 2000; Ragnedda et al., 2022; Ranchordás, 2022; Van Deursen & Van Dijk, 2019).

Despite the expectations to enhance universal access, the subsequent phases of internet diffusion introduced the *skills divide* instead, expressed in the differences of skills levels needed to access and benefit from internet use (Hargittai, 2002). More recent studies from the 2010s reveal the *third level digital divide* or the differences in usage and outcomes of the internet use across different groups (Van Deursen & Van Dijk, 2014; Van Deursen & Helsper, 2015; Ragnedda, 2017; Scheerder et al., 2017). These studies in particular, examine the benefits of internet use, assessing the outcomes of using the internet solely for entertainment, networking and social activities, or for seeking job opportunities, interaction with government, access to public services and other public participation purposes. The evolving and persistent dynamics of the digital access discrepancies calls upon a multileveled targeted approach as a strategy to simultaneously combat all levels of the divide (Helsper 2021; Ranchordás, 2022; Van Deursen & Van Dijk, 2015). In other words, systemic solutions need to be continuously provided until effective use is achieved.

Empirical evidence suggests that sociodemographic and socioeconomic factors tend to influence citizens' ability to access public services within different socioeconomic environments (Ramesh, 2021; Taipale, 2013; Mubarak et al., 2020; Gordon et al., 2020). These factors are related to personal characteristics (age, gender, ethnicity, disability, education, employment status, and income) or to the surrounding environment of the individual (place of residence, type of settlement, proximity to service providers, infrastructure, and available environmental resources). Besides demographics and socioeconomic factors, service characteristics (cost, simplicity of procedures, service design, transparency, efficiency, and responsiveness) could also play a part in affecting access opportunities (Yang, 2017; Ensor & Cooper, 2004; Trischler & Trischler, 2022).

Previous research often identifies the elderly, people with low education and low-income levels, people with disabilities, and ethnic minorities as being marginalised in the offline domain and in a greater risk of exclusion in the digital domain (Ragnedda et al., 2022; Tsatsou, 2021). On the contrary, younger age, higher levels of income and education are considered the most persistent predictors of having access and using digital technologies (Helsper & Van Deursen, 2017; Taipale, 2013). However, sociodemographic and socioeconomic factors should not be studied as a linear combination of variables as very often the barriers individuals face are shaped by the intersection of their distinct personal characteristics and environmental

circumstances. This insight is helpful in identifying within-group differences as it reveals the nuanced formation of disadvantages (Helsper, 2021). The intersectional approach in this regard calls for a systematic study of the different categories of personal, cultural, social, and economic characteristics that may contribute to compounded disadvantages (Helsper, 2021; Tsatsou, 2021; Vohra-Gupta et al., 2023). Additionally, Silva et al. (2017) suggest going beyond individual sociodemographic characteristics and considering macro variables such as public policies or welfare systems within the research context of interest.

The intertwined relation of offline backgrounds and the types of engagement in the digital domain has spurred research on the effect of traditional variables on access in digital terms (Ragnedda et al., 2022; Mariscal et al., 2019; Rashid, 2016; Chen & Wellman, 2004). At the same time, the socio-technical dimension of digital interactions has also drawn attention to the relevance of socio-psychological and cognitive factors. While some studies have found traditional variables to have strong impact on digital access (Martin & Robinson, 2007; Haight et al., 2016; Elena-Bucea et al., 2021) other studies (Yang, 2017) found cognitive factors to supersede. In the study of Yang (2017) the influence of traditional variables such as gender, educational attainment and IT literacy diminished on the account of the cognitive variables awareness, intention to use, and satisfaction. Several other studies highlighted the importance of the set of skills as a set of competences and knowledge needed to access the digital domain (Van Deursen & Van Dijk, 2011; Hargittai, 2010, 2019; Zhong, 2011); motivation as a factor that shapes the attitudes towards using or not (Reisdorf & Groselj, 2017; French et al., 2019); and social support as the link between social and digital inclusion (Asmar et al., 2020; Reisdorf & Rhinesmith, 2020). In the context of access to public services the concept of trust, specifically trust in government, is also found to be decisive in access channel choice (Mensah & Adams, 2020; Mensah, 2019; Bélanger & Carter, 2008; Tolbert & Mossberger, 2006). This research trajectory aligns with the need to combine traditional, cognitive and socio-psychological variables in the attempt to first understand disparities in offline access; and then identify which factors enable or impede access in digital terms once physical and technical conditions have been obtained.

1.4 CONCEPTUAL FOUNDATION

Conceptually, the broader field of socio-digital inequalities studies encompassing barriers to access is framed along two philosophical approaches – inequalities of outcomes, the *resources approach* (Bourdieu, 1986, 2018); and inequalities of opportunities, the *capabilities approach* (Sen 1979, 1992, 2000; Nussbaum, 2000). Both approaches aim to provide conceptual understanding of inequalities, while having different starting points regarding sources of disparities. The resources

approach traces inequalities to the differences of resources one has in the fields of economic, social, and cultural capital, considering the effects of unequal systemic distribution of goods (Bourdieu, 1986, 2018). The capabilities approach, on the other hand, focuses on capabilities as real freedoms or opportunities of what people can do with the goods or resources they have (Sen, 1979). As people have different characteristics and capacities, or *functional diversity* (Toboso, 2011), to transform resources into valuable outcomes, everyone should be provided with the appropriate conditions to achieve equality of opportunities (Sen, 1992). Turning resources into beneficial outcomes in Sen's capabilities' approach depends on *conversion factors* meaning the combination of individual characteristics and abilities, socio-political, and environmental conditions (Robeyns, 2005; Robeyns & Byskov, 2011, 2023). The discussion on resources and opportunities is central to this dissertation as it delineates the theoretical stance this dissertation takes in identifying access barriers and proposing potential solutions to access inequalities.

A number of studies depart from the Bourdieusian resources approach to explain the spillover of inequalities from the social to the digital domain, based on the resources allocated across different fields of social and digital capital (Verwiebe & Hagemann, 2024; Calderon Gomez, 2021; Halford & Savage, 2010; Ignatow & Robinson, 2017; Helsper, 2012; Helsper & Van Deursen, 2017). Conversely, advocates of the capabilities approach argue that addressing and eliminating barriers through policy solutions results in equalising opportunities (Toboso, 2011; Kleine 2009, 2013; Zheng, 2009; Oosterlaken, 2012; Stillman & Denison, 2014; Fleurbaey, 2018). In this context, barriers refer to any circumstances that prevent individuals from converting resources into valuable outcomes. Helsper (2021) tends to synthesise the two approaches by expanding on the resources-based perspective of structural inequalities, while acknowledging the perspective of capabilities scholars that resources are not the sole determinants of advantage and disadvantage. However, a sole emphasis on opportunities would also be counterproductive as people in better off positions would constantly transform opportunities into more resources (Helsper, 2021) thus perpetuating the cycle of inequality.

In relation to the focus of this dissertation, examining equality of access within different socioeconomic contexts, different capabilities-based study approaches are presented. Several authors advocate the idea of leaving no one behind in the digital world (Hernandez & Roberts, 2018; Stillman & Denison, 2014) or giving "priority to the furthest behind" (Fleurbaey, 2018) in the endeavours of achieving sustainable development. These studies advocate for prioritising the needs of the worst-off groups in society through solidarity and redistributive mechanisms (Fleurbaey, 2018). Such approaches are to some extent anchored in the seminal work of Rawls (1971) upon which societies are organised to guarantee basic liberties to all and ensure provision of fair and equal opportunities to all primarily through redistribution

of goods and resources. However, the capabilities viewpoint slightly shifts the focus of goods to what people do with the goods (Sen, 1979). The ideal of equal opportunities, being the most universally supported concept of justice (Roemer, 2002), stirred further deliberations about the role of individual responsibility. In this regard, the path-breaking work of Dworkin (1981) distinguished between person's preferences as solely individual responsibility, and person's resources that are sometimes beyond individual control (Roemer, 2002). In other words, people should be held accountable for their preferences or personal choices on how they utilise the given opportunities, but the environment should be constructed in ways that facilitate equal opportunities for everyone. Although approaches in moral philosophy vary along conceptual lines, their intent complements in contributing to the social well-being, while their ontological reasoning provides a solid ground for addressing persistent real-life issues. Therefore, the discussion on resources and opportunities is a valuable guide for this dissertation in understanding the complex and nuanced nature of inequalities in the quest to offer appropriate solutions.

The responsibility of governments in this regard is understood as fulfilling the essential functions by providing the basic conditions required for continuous public service delivery, which aligns with the capabilities approach. Ever since the inception of the idea of the state, classical theories, reflected in the work of Aristotle and Plato, discussed core state functions as organising public life in communities, protecting the common good by establishing legal mechanisms to solve conflicting individual interests, and ensuring the conditions for the good life of citizens (Miller, 2022; Tuckness, 2024; Lloyd & Sreedhar, 2022). These functions as well constitute the source of governments' legitimacy.

However, excessive intervention in the name of the common good risks the creation of Leviathan, as metaphorically conceptualised by Hobbes at the time of modern state formation. On the other hand, a fully minimalistic role of the state as a "night-watchman" as proposed by Nozick (1974), leaves space for unregulated power dynamics and inequalities. Therefore, the balanced solution between the Leviathan and laissez-faire spectrums could be found in the Enlightenment liberal tradition of Locke for a state that creates conditions where individuals can pursue and enjoy liberty, life, and justice. In the same line, Dworkin (2002) argues that state intervention is not excluded, as it is sometimes necessary to provide the conditions and circumstances that serve as a starting point where everyone has equal opportunities for development by taking individual responsibility in the process.

Ideally, government interference should strike a balance between the common good and the human dignity (Drew, 2020). In other words, the decision-making process should be transparent and accessible to citizens, nurturing a sense of representation by providing space for citizen associations. This is the central premise of the

principle of subsidiarity, rooted in natural law. The principle of subsidiarity, however, acknowledges the instrumental role of governments – to protect the common good as a source of their legitimacy while allowing space for immediate local government levels or citizen associations to carry out certain functions by themselves (Drew & Grant, 2017). In the context of access to public services, this would mean governments ensuring the proper infrastructure, public transportation options, and accessible institutions for the offline access, or organising digital skills training, providing good quality internet connection, and promoting best practices to enhance trust for the digital public services. Once these basic conditions are met, it is then becoming individual responsibility which access channel is preferred by citizens.

While individual responsibility can generate personal barriers to access (e.g. lack of motivation), inadequate government policies produce structural barriers to access (e.g. limited availability of services in remote areas). The role of the governments in this regard is ensuring the essential conditions that create an enabling environment for subsidiarity to function. To conclude, governments' legitimacy stems from equal concern for all citizens (Dworkin, 2002) - not in a paternalistic sense of interfering into the private domain of the individual, but in the instrumental function of creating an environment of fairness and equal starting opportunities in which citizens can meaningfully engage in public life.

1.5 DEFINITION OF THE RESEARCH PROBLEM

The potential of digitalization to equalise access opportunities and exceed offline barriers is promising yet still creating discrepancies across various dimensions. Depending on policy strategies digital solutions can either reduce or amplify existing social inequalities (Ragnedda et al., 2022; Van Deursen & Helsper, 2015; Martin & Robinson, 2007). In other words, generic and digital by default solutions, that are not tailored to contextual circumstances and citizens' needs, risk making the socially excluded digitally excluded as well (Castells, 1996, 2000; Warren, 2007; Park & Park, 2017). Consequently, instead of achieving equality, digitalization exacerbates the opposite effect, translating offline barriers into barriers of a new kind. In the resources and appropriation theory, Van Dijk (2005, 2017) summarises the self-perpetuating loop of socio-digital inequalities in a subsequent spiral of social inequalities generating unequal access to digital technologies, which in turn limits participation opportunities hence, ultimately reinforcing social inequalities. Tailored and inclusive policies aimed at those of highest risk of exclusion could halt this cycle. Considering digitalization strives towards efficiency, sustainability, and equitable development a policy agenda of "prioritising the furthest behind" (Fleurbaey, 2018) should come forward. The multileveled nature of discrepancies occurring in digital access (Figure 3) adds another layer of complexity in approaching the solution to enabling equal access for all.

Figure 3: Timeline of internet diffusion and types of digital access divides
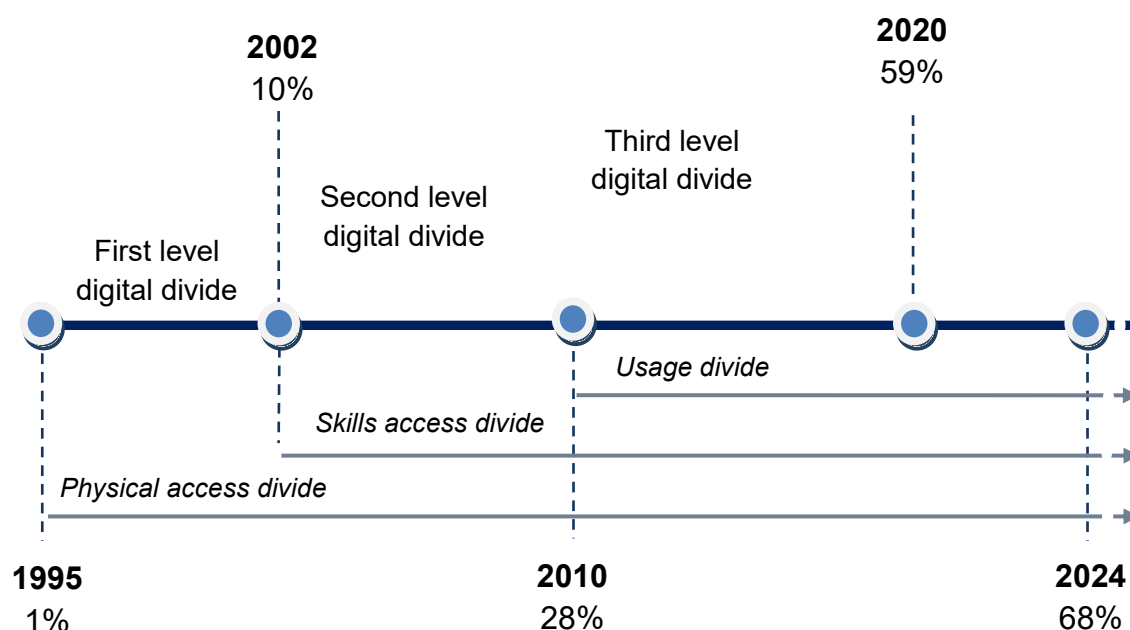
Source: Own, based on Van Dijk (2005), Hargittai (2002), Van Deursen and Helsper (2015)
Data source: International Telecommunication Union (ITU)

The timeline of internet diffusion (Figure 3) presents the percentage of internet users worldwide as acquired from the ITU database. The timeline follows the evolution path of the digital divides, starting from 1995, considered a reference year for the emergence of digital access discrepancies. Thirty years later discrepancies persist. Despite the exponential growth of internet users, every subsequent phase of the divides introduced more sophisticated challenges. Starting from inequalities in digital tools and connectivity (physical access), different levels of competences and knowledge (skills access), to differentiation in use and achieving beneficial outcomes of using the internet (Van Dijk 2002, 2005; Hargittai, 2002; Van Deursen & Van Dijk, 2019; Van Deursen & Helsper, 2015; Castells, 1996, 2000; DiMaggio et al., 2004). Although an estimated 5.5 billion people use the internet in 2024, disparities are still evident, especially along the urban-rural divide and across low-income regions (ITU, 2024). On a global level, this trend indicates that disparities in access do not affect all countries in a chronological or linear manner but rather depend on a country's stage of digital development. At a country level, this suggests that while some groups are facing the first level divide, others lag behind in types of usage calling for tailored policy solutions. There is growing evidence that enabling effective use goes beyond mere connectivity or possession of digital tools (Ranchordás, 2022; Van Deursen & Van Dijk, 2019; Neille & Penn, 2015). Therefore, encouraging internet use for public participation or access to public services requires considering additional factors that shape citizens' attitudes toward using digital channels for these purposes. The constantly evolving nature of the divides in combination with

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continuous technological advancements suggest the possibility of fourth level divide unfolding, while some of the previous challenges remain unaddressed.

The general assumption of this dissertation is that barriers to access to public services are a product of the environment; a consequence of generic policies that are not responsive to citizens' demands (Table 1). Governments, responsible for creating a favourable digital environment that promotes social equity should also consider the needs of populations with limited access to technologies or no prior digital experience.

Table 1: Conceptual support to the research problem definition

Author/source, year	Conceptual contribution
Helsper, (2021)	Both our physical and digital environments are constructed in ways that facilitate or hinder certain behaviours and interactions.
UN Universal Values. Principle Two: Leave No One Behind (n.d.)	Many of the barriers people face in accessing services are not a lack of availability of resources, but rather the result of discriminatory laws, policies and social practices that leave particular groups of people further behind.
Stiglitz, (2015)	Inequality is not inevitable, but a consequence of policies.
Toboso, (2011)	Disability does not originate with individual's limitations but with society's limitations in taking the specific, functional requirements of individuals into consideration.
Gurstein, (2007)	Communities have different characteristics, requirements and opportunities that require tailored ICT interventions and development strategies.
Oliver, (2004, 2013)	Barriers are product of disabling environments and not individual's functional limitations.
Sen, (2000)	Relational exclusions may in some cases emerge from deliberate policies that exclude some people from some opportunities.

Source: Own, consolidated from Helsper (2021), the UN LNOB (2017), Stiglitz (2015), Toboso (2011), Gurstein (2008), Oliver (2004), and Sen (2000)

Table 1 presents the conceptual support for the assumption that barriers stem from untailored policies and external circumstances. This is the central approach of the thesis in proposing the potential solution for enabling equal access to public services within different socioeconomic contexts. Helsper (2021) emphasises the role of the environment in shaping the circumstances that support or impede our interactions. The works of Stiglitz (2015) and Sen (2020) identify the source of inequalities in inadequate and discriminatory policies. This stance is deeply embedded in the UN principle of leaving no one behind calling for addressing barriers to reverse unequal distribution of resources and opportunities (UN, 2017). Understanding the issue of access inequalities is often framed in disability studies. In the context of ICT and equality of opportunities, disability is a socially constructed category to denote the functional diversity of every individual (Toboso, 2011). The social model of disability (Oliver 1983, 2013) in that regard, points out that environments, rather than individuals, create disabling barriers to opportunities. To accommodate to the diverse needs within communities, environments should adapt by designing and implementing tailored ICT strategies and interventions (Gurstein, 2007). The presented arguments contribute to the dissertation's approach in identifying barriers to access and proposing pathways of potential solutions.

1.6 DESCRIPTION OF THE LOCAL RESEARCH CONTEXT

To contextualise the research problem, this section illustrates key developments in the field along with an overview of key digital parameters specific to the local setting. This dissertation focuses on the case of North Macedonia, a country undergoing modernisation of its public administration while prioritising digitalization of public services. North Macedonia is a landlocked country located in the Balkans with a population of about 1.8 million residents (State Statistical Office, 2022) and classified by the World Bank (n.d.) as an upper-middle income economy. The country has the candidate status to the European Union (EU) since 2005. The public administration reforms stem from both practical demands for optimised service delivery and the key prerequisites for EU integration, aiming for a greater transparency, efficiency, and user-centred public services. Following global developments on fostering technology to enhance public governance processes, the country has made continued efforts to advance the information society. The first initiatives in the field date back to the early 2000s when the country began developing the policy and legislative framework for processes commencing with the prefix "e" – denoting all activities related to electronic data exchange and electronic public service delivery. The subsequent Public Administration Reform (PAR) Strategies over the years have set digitalization as paramount to achieving a modern and accountable public administration. Figure 4 illustrates the milestones in the country's digitalization processes, based on information available from the designated ministries and the government.

Figure 4: Timeline of key digitalization milestones in North Macedonia

2000 - 2005
- Inception of the development of the e-Government concept (2000)
- Law on electronic data and electronic signature (no longer in force) (2001)
- "e-Macedonia for everyone" initiative (early 2000s)
- e-Declaration prepared by an expert body to establish the institutional basis for advancing the information society (2002)

2005 - 2010
- National Strategy for Information Society Development and Action Plan (2005)
- The first version of the e-services portal uslugi.gov.mk portal is launched (2005)
- Law on Electronic Communications (no longer in force) (2005)
- Project "One computer per child" and free ICT courses for citizens (2006-2010)
- National Strategy for Development of Electronic Communications and IT (2007)
- Ministry of Information Society and Administration established (MISA) (2008)

2010 - 2015
- PAR Strategy 2010-2015 (2010)
- National Strategy for e-Government 2010-2012 (2010)
- National Strategy for e-Inclusion 2011-2014 (2011)

2015 - 2018
- Law on General Administrative Procedures (2015)
- Macedonian Interoperability Framework 2.0 (2016)
- PAR Strategy 2018-2022 (2018)

2019
- Law on the Central Population Registry
- Law on Electronic Documents, Electronic Identification and Trust Services
- Law on Electronic Management and Electronic Services
- National Operational Broadband Plan
- The updated National e-Services Portal is launched based on current legislation
- The first Single Point for Services is opened in the capital, city of Skopje

2020 - 2022
- Single Point for Services opened in Tetovo (2020)
- Single Points for Services opened in Kumanovo, Bitola, and Ohrid (2021)
- Draft National ICT Strategy 2023-2027 (2022)

2023
- PAR Strategy 2023-2030 and Action Plan

2024
- Ministry of Digital Transformation (MDT) is established
- National Development Strategy 2024-2044
- Single Points for Services in the municipalities of Aerodrom and Jegunovce
- Redesign of the National e-Services Portal and 100 new electronic services

2025
- National Cyber Security Strategy 2025-2028
- Legal amendments in force to ensure electronic documents have equal validity as printed documents obtained at the counter

Source: Own summary of data from MISA National Strategy for e-Government 2010-2012, MISA PAR Strategy documents, MDT documents, the National e-Services Portal, the Assembly and the Government of North Macedonia

As presented in Figure 4, initial activities and measures in the early 2000s were directed towards setting the foundation to advance the development of electronic initiatives in North Macedonia. However, more strategic efforts were made in 2005, with the National Strategy for Information Society Development acting as a key document for the further development of e-content and e-services. This period was marked by the work of expert bodies, national commissions, and a Ministry without portfolio prior to the establishment of the Ministry of Information Science and Administration (MISA) in 2008. Between 2006 and 2010 intensive activities were undertaken to increase public exposure to technology including free ICT courses for citizens, computer vouchers for students, providing laptops for teachers, opening internet clubs, enabling internet access to schools, and implementing the project "One computer per child" (MISA, 2010). The strategic documents adopted in 2010 and 2011 (Figure 4) reflect the commitment to building transparent and modern public administration, established on the good governance principles and providing conditions for equal access and participation of all. In 2015, the Law on General Administrative Procedures was adopted to guarantee that procedural data would be gathered *ex officio* without burdening citizens to repeatedly provide the same information to different institutions. The efforts to enable electronic exchange of data and documents between institutions in a standardised and secure way progressed with the introduction of the Interoperability Platform developed on the basis of the Macedonian Interoperability Framework 2.0 (2016) and aligned with the European Interoperability Framework (EIF 2.0.) (MISA, n.d.). The PAR Strategy 2018-2022 reaffirmed the commitments to providing an optimised digital environment aimed to improving the quality and access to public services (MISA, 2018).

In 2019, several key milestones with concrete deliverables were achieved in the development of electronic services for citizens. The adopted legislative framework (Figure 4) was harmonised with EU legislation to support the operation of electronic platforms, provision and distribution of data and documents. The National e-Services Portal was launched to bring electronic services closer to citizens (MISA, 2019). In the same line, starting from 2019, the Single Points for Services were gradually opened in different cities to enhance the horizontal integration of public administration by providing services for citizens at one physical point of access (MISA, 2019). The National Operational Broadband Plan further contributed to the efforts of reaching European levels of internet stability and reliability aligned with the EU Digital Agenda priorities (MISA, 2019).

Over the past 5 years, strategic efforts to digitalise the public sector continued. The Draft National ICT Strategy 2023-2027 (MISA, 2022) committed to strategically approach digitalization through targeting the four pillars of the EU 2030 Digital Compass, skills, government, infrastructure, and transformation and digitalization of businesses (EC, 2021). The PAR Strategy 2023-2030 (MISA, 2023) provided

concrete steps and measures to create optimal conditions for the provision and access to digital public services. The government's long-term National Development Strategy 2024-2044 also sets digitalization as one of the country's central priorities. These endeavours are aligned with the establishment of the Ministry of Digital Transformation (MDT) in 2024, responsible for overseeing and implementing all digitalization related activities. As per the latest developments, the National Cyber Security Strategy 2025-2028 fosters a safer digital environment while encouraging trust in digital technologies (MDT, 2025). The amendments to the Law on Electronic Documents, Electronic Identification and Trust Services, adopted in late 2024 and effective in 2025, enable electronic documents verified via QR code, to have the same legal validity as printed documents issued at the counter (adopted by the Assembly of North Macedonia, 2024, entered into force in 2025). Both cyber security concerns and document validity are one of the obstacles discouraging widespread use of digital access channels to public services.

Table 2 presents the state-of-the-art developments in 2024, including key digital parameters. This overview balances the policy and legal framework with practical developments in the field, with the parameters framed within the European context.

Table 2: Key digital parameters in North Macedonia and EU contexts

Digital parameter	MK	EU Average	Year
Connectivity (households with internet access)	90.8%	94.2%	2024
Users of the Internet (once a week, including every day)	90.8%	91.7%	2024
Digital skills (at least basic or above basic skills)	34.6%	53.9%	2021
Internet use (website or application of public authorities)	35.3%	70.0%	2024

Source: Eurostat and the State Statistical Office of North Macedonia

Table 2 shows the key parameters of digital access – connectivity, digital skills, and usage, based on the digital access framework of Van Dijk (2005). The data refers to 2024, except in the case of digital skills, where the latest available data for North Macedonia is from 2021. Connectivity refers to the percentage of households

connected to the internet, digital skills is the percentage of individuals with at least basic or above basic skills, and usage refers to the percentage of individuals for both general use of the internet, and use of government websites and applications as relevant to the focus of this dissertation. As shown in Table 2, the country keeps up with physical conditions such as connectivity and general internet use, but it lags behind in digital skills and in using the internet to interact with public authorities when compared to the European context. While the country has made continuous investments in the supply side over the years, the demand side shows slower uptake of digital access channels. In the context of equal access to public services this implies to encourage usage through digital channels among different sociodemographic and socioeconomic groups.

Despite the extensive legal and policy framework, the digitalization of public services in North Macedonia continues to face practical challenges that hinder effective implementation. The main issues identified in the 2024 report of the State Audit Office of North Macedonia (SAO) include the absence of harmonisation of the legal framework with the set of laws on digitalization, the underutilisation of existing digital public services, the inefficient use of resources, and the lack of qualified public employees to support the ICT-related processes in service delivery. The origin of these issues can be traced to insufficient promotion of digital public services and technical shortcomings related to the necessary prerequisites for electronic public service delivery (SAO, 2024).

To be able to access digital public services, citizens need to register at the National e-Services Portal (the Portal). While both the number of registered users and the number of submitted requests for digital public services have been gradually increasing since the Portal was launched in 2019, the overall usage figures remain relatively low. Namely, the total number of registered users displayed on the Portal by the first quarter of 2025 is 159, 680 citizens, accounting for about 13.9% of the population aged 18-64. The total number of submitted requests has reached 132,205, although no additional information is provided regarding the completion or the status of the service requests. The ratio between the number of submitted requests and registered users at the Portal indicates that registration does not necessarily imply routine or regular use, as on average each registered user has submitted less than one service request. Another challenge is that access to digital public services is not fully centralised on the Portal as for some services users are redirected to the respective websites of the public institutions that require an additional login into their systems. Moreover, some services are not fully transactional on the Portal, meaning citizens start the procedure online but are required to collect the document in person or receive it via the post office.

Similar trends are observed with the Single Points for Services, established to deliver public services from several public institutions at a single physical location. In this case, the SAO (2024) report finds that between January 2022 and November 2023, the Single Points for Services outside the capital Skopje, served between 0.2 and 24.33 citizens per month per employee, highlighting the inefficient allocation of resources. In this context, the MISA (2023) acknowledges the technical challenges related to the interoperability features of the Single Points for Services as well as the lack of proper training for the employees for working with the operating systems in place. The underutilised potential of the Interoperability platform in general, coupled with the small number of connected public institutions (53 out of 1,288 institutions in 2024), contributes to the complexity of processes and fragmentation in digital public service delivery. Overall, the process of digitalization is assessed as slow, affecting the quality of the services offered, while the cost of service delivery remains at a relatively high level (SAO, 2024).

Within the European context, the eGovernment Benchmark Report (2024) of the European Commission, which monitors the digitalization of public services and the overall digital transformation of governments, ranks North Macedonia in the second to last position, with an overall score of 36, compared to the EU27 average of 76 (on a scale from 0 to 100). The assessment, which also includes scores for seven EU candidate countries, is based on the biennial average of data from 2022 and 2023. The composite score summarises countries' performance across the four key dimensions: User-centricity, Transparency, Key enablers, and Cross-Border Services (prepared by Capgemini et al., 2024 for the European Commission).

On a global level, the UN E-Government Development Index (UN EGDI) serves as a reference ranking for UN member countries, measuring performance across three key dimensions: provision of online services, telecommunication connectivity, and human capacity (UN, n.d.). In addition, the UN E-Participation Index (UN-EPI) measures e-participation, e-consultation, and e-decision making (UN, n.d.). The goal of the indices is not to present absolute performance of countries, but to provide a comparative assessment of how national governments perform relative to one another (UN, n.d.). In that regard, Table 3 outlines the UN EGDI and UN EPI scores and rankings of North Macedonia for the period 2020-2024.

Table 3: UN EGDI and UN EPI ranking of North Macedonia

Year	UN EGDI score	UN EGDI rank	Rank change	UN EPI score	UN EPI rank	Rank change
2020	0.70830	72/193		0.83330	38/193	
2022	0.70000	80/193	8↓	0.69320	43/193	5↓
2024	0.70704	84/193	4↓	0.57530	76/193	33↓

Source: The UN EGDI and UN EPI Database

The data show that between 2020 and 2024, North Macedonia's ranking declined by 12 positions in the UN EGDI and by 38 positions in the UN EPI. This trend suggests that digital infrastructure and human capacity are experiencing a gradual decline compared to other countries, while citizen engagement is starting to notably lag behind. In other words, maintaining a mid-range position in the UN EGDI over four years may signal stagnation rather than sustained progress. The sharper decline in the UN EPI indicates that the country struggles to keep pace with other countries that are advancing faster in offering interactive and participatory digital tools and platforms for citizens. In regional terms, among EU candidate countries, North Macedonia ranks fourth out of five in the 2024 UN EGDI, ahead only of Bosnia and Herzegovina (107), and third in the 2024 UN EPI, ahead of Bosnia and Herzegovina (78) and Montenegro (85), but behind Albania (49) and Serbia (19).

Finally, the increasing presence of digitalization in public administration and various societal domains has sparked a growing body of scholarly research within the Macedonian discourse. Existing studies cover an array of topics related to financial implications of introducing electronic services (Todevski et al., 2013; Gavrilov et al., 2020), digital skills readiness (Majovski et al., 2018), adoption determinants of electronic public services use (Blagoeva & Mijoska, 2016; Blagoeva et al., 2020), comparative studies on e-government and digitalization (Levkov, 2018; Jordanoski & Meyerhoff Nielsen, 2024), and e-government sophistication and development (Budinoski & Trajkovik, 2012; Gusev et al., 2012). While most of the studies focus on the technical and operational aspects of digital processes or secondary data analysis, primary research involving users of different socioeconomic contexts remains underexplored. Therefore, this dissertation contributes to the existing contextual knowledge by providing primary data that reflect current developments, needs and perceptions of citizens, as instrumental in guiding data-driven policy design. In addition to academic contributions, the progress of digitalization in North Macedonia is monitored and assessed by donor-funded projects, think tanks, and civil society organisations which provide valuable input reflecting implementation dynamics.[2]

1.7 RESEARCH OBJECTIVES

Building on the premise that barriers to access to public services stem from the environment, meaning they result from policies not tailored to citizens' needs, this dissertation aims to identify specific barriers across different socioeconomic contexts and propose appropriate enablers to equal access to public services. The research design follows the twin approach of exploring barriers in both traditional, face-to-face

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[2] See more in the EU ICEDA project, the EU WeBER project, the OECD/EU SIGMA initiative, UNDP country reports, publications of the Centre for Change Management, and the Rural Coalition.

(hereinafter offline access) and digital access to public services. The offline-digital framework is critical in assessing whether groups facing barriers in the offline domain are also being left behind in the digital domain. In addition, this approach facilitates the process of unveiling the exact tools and resources needed for effective transition from offline to digital access to public services. Hence, the research approach consists of the following stages:

1) Bottom-up identification of perceived barriers to access to public services through conducting interviews and a survey with citizens in the role of users
2) Profiling users of public services in relation to barriers they face based on sociodemographic and socioeconomic characteristics
3) Examining the offline-digital access relation of barriers and sociodemographic and socioeconomic profiles of users
4) Identification of potential enablers as outcomes of interviews and survey with users that match their needs accordingly
5) Propose policy recommendations and points for further scholarly research

The focus on barriers aspires to propose solutions that enhance the prospects of digitalization to equalise access opportunities for everyone. Addressing barriers through effective policy measures is expected to yield lasting benefits and prevent the further widening of the access inequality gap. The potential of digitalization to overcome offline barriers and bring public services a click-away from citizens can only be unlocked if the source and type of barriers are properly identified. In this context, the research questions follow the trajectory of the research design approach:

1) What specific barriers hinder offline and digital access to public services for different sociodemographic and socioeconomic groups?
2) What is the sociodemographic and socioeconomic profile of users of digital public services?
3) What is the sociodemographic and socioeconomic profile of non-users of digital public services?
4) To what extent do offline barriers transform into new types of barriers in the digital domain?
5) What adaptation strategies can help overcome the barriers faced by users of different sociodemographic and socioeconomic backgrounds to accessing digital public services?

The first research question aims to identify the specific types of access barriers emerging within different contexts and among individuals of diverse sociodemographic and socioeconomic backgrounds. The second research question explores the profile of a digital public services user or the groups with a potential

advantage to exceed barriers. The third question aims to identify the profile of a non-user and map the groups at risk of exclusion. The fourth research question explores the potential transformation of barriers from the offline to the digital domain and their implications on equal access. The fifth research question refers to identifying enablers and adaptation strategies to effectively address and tackle barriers.

In the same vein, hypothesis development relies on previous research in formulating testable relationships among variables. Prior studies on socio-digital inequalities stress the importance of sociodemographic and socioeconomic variables and their interaction with the environment in generating access disparities (Mubarak et al., 2020; Taipale, 2013). The impact of age, income, education, employment (Helsper & Van Deursen 2017; Pérez-Morote et al., 2020), type of residence (Salemink et al., 2017; Salemink et al., 2025), ethnicity (Rahim et al., 2011), disability (Ragnedda et al., 2022), and gender (Al-Rababah & Abu-Shanab, 2010) has been proven significant in various contexts. Building on this evidence, the first step in this research is exploring the relevance of these relationships in the specific research context. Therefore, the first proposed hypothesis (H1) is:

H1: Sociodemographic and socioeconomic factors influence the incidence of barriers in offline and digital access to public services.

In reference to digital public services use and interaction with digital channels, previous research identifies groups that are more or less likely to be digitally engaged. Hence, prior studies finds that younger individuals with higher education and income levels have greater abilities to evaluate and engage with complex digital content (Helsper & Van Deursen, 2017; Van Deursen & Van Dijk, 2014). Conversely, elderly individuals, ethnic minorities, individuals with disabilities, and individuals of lower education and income backgrounds are at a greater risk of digital exclusion (Ragnedda et al., 2022). Rural areas, especially remote rural areas, are found to lag behind their urban counterparts (Salemink et al., 2017). Gender divides also persist across various contexts (Macaya et al., 2021). Based on these observed patterns, the second hypothesis (H2) investigates the relationship between the specific sociodemographic and socioeconomic factors and digital public services use. Hence, the second proposed hypothesis (H2) is:

H2: Sociodemographic and socioeconomic factors influence the use of digital public services.

Another prominent theme largely discussed in previous research is the interaction between social and digital capital and the spillover of offline inequalities into the digital realm (Helsper, 2012; Ragnedda & Ruiu, 2017). These capital-based frameworks explain the link between offline resources and the type of engagement in

the digital domain (Helsper, 2012; Merisalo & Makkonen, 2022). However, the types of barriers faced by individuals in both offline and digital domains remain an avenue for further exploration. Identifying the potential translation of specific barriers across the two domains could help reveal whether access disparities persist and continue to restrict equal access. Therefore the third proposed hypothesis (H3) is:

H3: The spillover of offline barriers into the digital domain hinders the achievement of equal access to public services.

The hypothesis testing is expected to offer new insights from the specific research context and contribute to the existing body of literature by seeking tailored solutions to achieving equal access. Exploring the sociodemographic and socioeconomic factors alongside barriers to offline and digital access, could help identify groups at risk of exclusion and inform targeted policies and support measures.

2 THEORETICAL FRAMEWORK

This section discusses the theoretical background supporting the dissertation's research approach including the deliberation of the conceptual model. At the beginning, the section offers a conceptual delineation of the main terms and concepts included in the study. When approaching an issue or seeking to deliver a solution, it is very important to clarify any terminological vagueness that may affect the nuanced understanding of concepts under study. In the second part, an overview of technology acceptance theories and models is presented. The constitutive elements of these theories and models are instrumental in the process of understanding enablers and barriers of technology acceptance and technology use in general as a prerequisite of digital access to public services. The section ends with a presentation of the conceptual model that includes all previously elaborated research elements. The conceptual model is the backbone of the research design rooted in previous literature and empirical research and adapted to the approach of seeking solutions to overcoming barriers and enabling equal access opportunities.

2.1 DEFINITION OF MAIN TERMS AND CONCEPTS

The following part presents the definitions and theoretical underpinnings of the main terms and concepts included in the research. This approach supports a better understanding of the multilayered nature of access, helps distinguish between types of barriers and enablers, explains the distinction between public services and digital public services, and clarifies the conceptual nuances of digitisation, digitalization, digital transformation, digital equality, and digital inclusion.

2.1.1 Access

The concept of *access* has been salient in studies explaining the user-service provider relationship yet for long it lacked common conceptual understanding. In response to conceptual ambiguity Penchansky and Thomas (1981) first proposed a specific access framework comprised of five dimensions: availability, accessibility, affordability, accommodation and acceptability (Table 4). This approach consolidated prior fragmented definitions, providing clarity and enabling access to be measured operationally. In this regard, access is not only concerned with mere entry but defined in more qualitative terms as the 'degree of fit between the users and the system' (Penchansky & Thomas, 1981) highlighting the alignment of users' needs with service provision.

Table 4: Access conceptualisation

Authors and dimensions	Definition
Penchansky and Thomas (1981)	
Availability	Relationship between the type and volume of offered services and the type and volume of user's needs
Accessibility	Relationship between the location of service providers and location of users (distance, transportation, travel time)
Affordability	Relationship between services prices and user's ability to pay
Accommodation	Relationship between the manner of service organisation and whether it corresponds to user's demands
Acceptability	The attitudes and perceptions towards personal and practice characteristics developed in the user-service provider relationship
Saurman (2016)	
Awareness	Effective communication and information strategies with both users and service providers, including context considerations

Source: Summary of Penchansky and Thomas (1981) and Saurman (2016)

The continuous interest in improving access resulted in an upgrade of the initial framework. Saurman (2016) spotlighted awareness as potential sixth dimension to influence access. In addition to providing information for the existence of services, awareness is critical in informing users about the overall service characteristics, terms and conditions of service use (Saurman, 2016). Levesque et al. (2013) revisited the concept of access and proposed a framework to express the nuanced aspects of user's experience in contemporary terms. Their dimensions build on previous conceptual frameworks and associate access dimensions with five corresponding user's abilities: approachability with ability to perceive; acceptability with ability to seek; availability and accommodation with ability to reach; affordability

with ability to pay; and appropriateness with the ability to engage (Levesque et al., 2013). Although initially developed in the field of health services provision, these access frameworks attest their applicability in the broader research on access to public services (Logan & Guikema, 2020; Ashik et al., 2020; Wei & Mukherjee, 2024).

In digital terms, the broadly acknowledged framework of Van Dijk (2005, 2020) presents the four subsequent levels of access (Figure 5).

Figure 5: Causal and sequential model of access to digital technologies
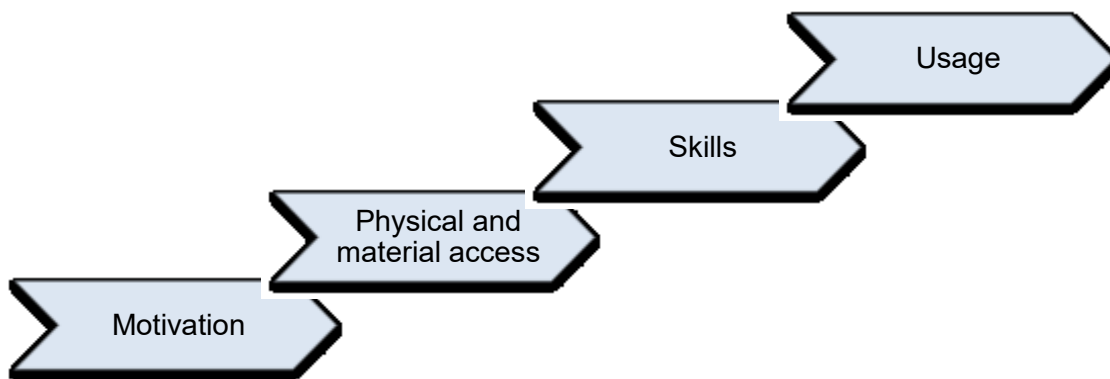
Source: Adapted from Van Dijk, (2005, 2020)

The widely applied framework of Van Dijk (2005, 2020) consists of motivation, physical and material access, skills, and usage. Motivation, as first in the sequence, denotes that people should be first motivated and have positive attitudes towards interacting in the digital domain; physical access means having the necessary digital tools and connectivity, while material access encompasses the qualitative side of speed and stability of internet connection, type of digital devices used, etc.; skills refers to the competences and knowledge needed to engage and produce outcomes from the engagements in the digital domain; and lastly, usage, refers to the actual outcome and the types of outcomes one gets from the digital interactions (Van Dijk, 2005, 2020). Usage is considered as the ultimate purpose of technology appropriation as indicated in prior studies considering utilisation as a proof of access (Donabedian, 1972; Levesque et al., 2013; Saurman, 2016; Van Dijk 2005, 2020). All of the presented frameworks present the multilayered nature of access. Access is not to be perceived in dichotomous terms of 'inside' and 'out', but all access dimensions should be appropriately addressed to enable the ultimate purpose of usage.

2.1.2 Barriers and enablers

The concepts of *barriers* and *enablers* are commonly employed in research of access inequalities, however often without provision of their conceptual definitions. Studies generally consider the etymological meaning of barriers as *limitations* or *obstacles*, and enablers as *facilitators* (Keyworth et al., 2022; Clifton et al., 2020). In addition, Haynes and Loblay (2024) discuss that scholarly approaches on employing barriers and enablers often present a list of inherently "good" or "bad" things as the main finding. However, exceeding this duality requires exploring and understanding the context, experiences, and positions related to barriers and enablers (Haynes & Loblay, 2024). Aiming to contribute to the conceptual refinement and nuanced understanding of the concepts, this dissertation defines barriers as an obstacle that prevents access to public services due to external circumstances; and enabler as the facilitating condition, the action or circumstance that removes/lifts up the barrier – making equal access possible through provision of equitable conditions.

In general, literature distinguishes individual and structural barriers and enablers, observed on a personal and contextual level (Hong et al., 2022; Hailemariam et al., 2023). Individual barriers in the context of access to public services are often shaped by the interaction of individuals' sociodemographic and socioeconomic backgrounds with the environment, resulting in motivational, attitudinal, or cognitive constraints (Hong et al., 2022). Structural barriers on the other hand are linked to institutional frameworks, policies, and broader environmental and infrastructural conditions that shape the extent to which an individual faces barriers (UN, 2017). This distinction is central to the research, grounded in the idea that fostering equal access is achievable through structural interventions and inclusive policies that act as enablers and help reverse the unequal starting positions (UN, 2017). This approach emphasises addressing contextual constraints rather than attributing barriers to personal disadvantage.

In other words, guided by the capabilities framework, individuals' sociodemographic and socioeconomic background should not constitute barriers to access. Instead, institutional enablers, or inclusive policies should adapt environments to individuals' circumstances and realities. In a concrete example of offline access, an elderly individual, living in a remote area should be provided with regular transportation options or offering services at their place of residence. In the case of digital access, promotion of available services, providing digital skills training opportunities, and building trust in digital services could facilitate use among groups at risk of exclusion. While self-motivation and willingness to use act as individual-level enablers, achieving equal access requires first establishing the necessary structural conditions so everyone has the equal opportunities to choose their preferred access channel.

2.1.3 Public services and digital public services

Defining *public services* in their traditional, offline format stands on well-established grounds while the *public electronic services* (*digital public services*) at times enters the field of conceptual ambiguity (Hassan et al., 2011; Lindgren & Jansson, 2013). Traditionally, public services are defined as "an economic activity or general interest defined, created and controlled by the public authorities, subject to varying degrees to a special regime, irrespective of whether is carried out by a public or private body" (European Parliament, 1997); or "services provided by public organisations to citizens, both collectively and individually, either directly or by outsourcing to private providers" (Christensen et al., 2005, cited in Lindgren & Jansson, 2013). Both approaches agree on the service provider – public authorities or public organisations, delivering services to citizens, carried out either directly or through private entities. In qualitative terms, public services are driven by the public ethos and exist to serve the common good and promote social justice (Lindgren & Jansson, 2013).

Digital public services on the other hand, sometimes vary in terminology across studies using *e-service*, *e-government service*, *digital service,* or *digital public services* (Lindgren & Jansson, 2013) depending on contextual understanding and the evolution stages of the concept (Hassan et al., 2011). In the broader sense, digital public services are defined as "electronically mediated services, provided by public organisations, through which users and service providers co-create value through the user's consumption of the service" (Lindgren & Van Veenstra, 2018; Lindgren & Jansson, 2013). In this regard, Lindgren and Jansson (2013) draw specific attention to taking into consideration all three constitutive dimensions of *public, e, and services.* While being mediated through electronic means, the *public* element means that digital public services need to be accessible to everyone, reflecting the values of equity and fairness in the pursuit of achieving equal access (Lindgren and Jansson, 2013). Considering the implications to equal access and the co-creation of public value, this dissertation employs the term digital public services.

In technical terms, the European Commission (EC) set the indicator for measuring the sophistication level of digital public services consisting of the following stages: i) information, (ii) one-way interaction (downloadable forms), (iii) two-way interaction (electronic forms), (iv) transaction (full electronic availability of the service, from service request to service provision), and (v) personalisation (services adjusted to user needs) (Capgemini, 2007). The initial measurements of progress of digital public services across Europe, conducted since 2001, included the first four stages (Capgemini report for the European Commission, 2006), while the fifth stage of personalisation and proactive service delivery was introduced in 2007 to emphasise

the user-centred approach to convenient access to digital public services (Capgemini report for the European Commission, 2007).

2.1.4 Digitisation, digitalization, digital transformation

The processes of *digitisation*, *digitalization*, and *digital transformation* require conceptual delineation as they are often used interchangeably or indistinctively (Legner et al., 2017; Reis et al., 2020; Frenzel et al., 2021). The terminological vagueness risks theoretical misconceptions that can affect the broader application of the concepts or misguide approaches in designing solutions to persistent issues. It is important to note that they are all different concepts with their own specific features.

Figure 6: Definitions of digitisation, digitalization, and digital transformation
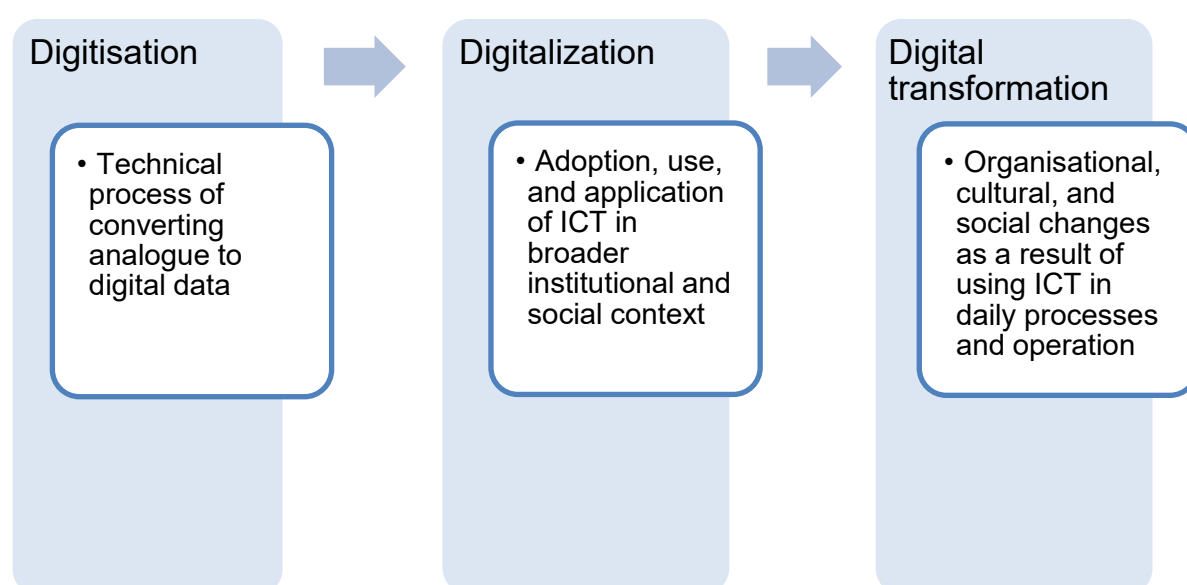
Source: Own, based on definitions of Legner et al. (2017), Mergel et. al. (2019), Frenzel et al. (2021), Baskerville et al. (2020), and Kraus et al. (2021)

Digitisation refers to the technical process of converting analogue to digital data, meaning all of the existing paper documents and forms converted into digital format (Legner et al., 2017; Mergel et al., 2019). However, more recent studies even abandon the analog element in the definition as data and information can now be directly created into digital format (Frenzel et al., 2021; Baskerville et al., 2020). *Digitalization* is the socio-technical process of adoption, use, and application of digital technologies in the broader individual, organisational, and societal contexts (Legner et al., 2017; Frenzel et al., 2021). Finally, the empirical-based approach of Mergel et al. (2019) defines *digital transformation* as a process denoting the cultural, organisational, and relational changes that arise from the use of new technologies in

public administration. In this context, changes are not simple but refer to the continuous transformation process requiring adaptations to meet the demands of users or other external stakeholders (Kraus et al., 2021; Mergel et al., 2019). In summary, the concepts of *digitisation*, *digitalization,* and *digital transformation* depict the technical process of data conversion; use and application of digital technologies; and the holistic aspect of technologies transforming organisations and societies. Within this context, digitisation is not a goal *per se*, but a technical tool to effectuate the application of ICT in government operation as a prerequisite for the transformative moment of encouraging citizen's participation into democratic institutions and processes (Fang, 2002; Mensah et al., 2021).

2.1.5 Digital inclusion and digital equality

Given the transformative role of digitalization in reshaping communication channels and affecting opportunities for public participation, ensuring equal access through digital means has become increasingly essential. In this context, the concepts of *digital inclusion* and *digital equality* are pivotal in the discussions about ensuring the necessary preconditions for access and maximising the potential and beneficial use of technology. The aim is to ensure that everyone has the equal opportunities to access the tools and resources needed for meaningful digital engagement. Although conceptually intertwined, digital inclusion and digital equality are evolving concepts that overlap in their purpose, yet at times appear to differ in scope.

The understanding of digital inclusion evolved alongside the stages of digital access and the emergence of different types of digital divides. In earlier approaches, digital inclusion was primarily associated with ensuring the technical prerequisites for access, e.g. internet connectivity and device ownership (Van Dijk, 2005; Van Deursen & Van Dijk, 2019). Over time, as digital divides progressed to successive levels, digital inclusion expanded to include digital skills (Hargittai, 2002; Van Deursen & Van Dijk, 2014), and more recently the ability to achieve a beneficial outcome from technology use (Helsper, 2021, Rahim et al., 2011). Therefore, digital inclusion goes beyond the mere provision of universal access to the internet and the operational prerequisites, but it also encompasses digital skills and access to adequate support to enable meaningful participation and achieve beneficial outcomes for all individuals (Pérez-Escolar & Canet, 2023; Ragnedda & Mutsvairo, 2018). The type and quality of technical prerequisites matter as well, since quality of internet connection or the varying levels of digital skills can be decisive in determining the purpose of use of the internet for individuals.

Digital equality is driven by the same goal as digital inclusion, emphasising fair participation in the digital domain for all, yet it is often discussed as a broader, overarching concept (Luo & Liu, 2025). Digital equality is associated with the

qualitative aspects of technical prerequisites, such as autonomy and ubiquity of access as well as the broader social implications of technology use (Helpser, 2021). Other perspectives discuss the concept in relation to social inequalities and social power relations (Kuhn et al., 2023; Ragnedda, 2020 in Luo & Liu, 2025). Therefore, digital equality remains an evolving, multilayered concept often interpreted at a more abstract level as the desired outcome of effective digital inclusion (Luo & Liu, 2025).

In summary, digital inclusion and digital equality share a common purpose, as both aim to ensure that fair access leads to beneficial outcomes of use. The two terms are often used interchangeably (Luo & Liu, 2025) and considered central to social inclusion (Luo & Liu, 2025; Reisdorf & Rhinesmith, 2020). Their relationship can be understood as a process – outcome dynamic where digital inclusion addresses the operational aspects necessary to reach the more abstract goal of digital equality.

2.2 OVERVIEW OF TECHNOLOGY ACCEPTANCE THEORIES AND MODELS

While the concept of access in offline terms, as proposed by Penchansky and Thomas (1981) and upgraded by Saurman (2016), is structured around the physical dimensions of achieving the fit between user demand and service delivery, access in digital terms becomes a multifaceted concept encompassing socio-technical and socio-psychological dimensions (Van Dijk, 2005). When transitioning from offline to digital access, discrepancies between groups may arise due to the relative differences in the time and motivation levels needed to accept and adapt to the new forms of interaction. Besides traditional variables, a set of socio-psychological and cognitive factors influences the decision or the ability to interact in the digital domain. In this vein, a number of theories and models have been developed to explain the factors shaping citizens' attitudes in decision-making and learning processes; accepting or rejecting innovations in general; and using or resisting technology as a means mediating the citizen-government interaction. Most of the theories and models originated from sociology, psychology, social psychology, behavioural, and communication studies (Taherdoost, 2018) but they are extensively applied in ICT adoption fields as well. The intention of presenting the salient theories and models in continuation is not to conceptually delve into their distinctive determinants, but to bring forward potential factors that may influence intention and motivation to access public services through digital channels.

Accepting innovations and the effect they have on human psychology needing to adopt new forms of operation in place of conventional methods, has been a compelling subject of study. The Diffusion of Innovations theory (DOI) developed by Rogers (1962, 2003) is considered one of the pioneering studies in the field. DOI

defines diffusion as the process in which an innovation is communicated over time within a social system (Rogers, 2003). Throughout this process, innovation is not accepted at a linear pace, but rather in sequential phases consisting of five adopter categories: innovators, early adopters, early majority, late majority and laggards (Rogers, 1962, 2003). In the context of ICT acceptance, the adoption curve shaping over time indicates that communication between preceding and successive groups could accelerate diffusion and evoke positive sentiments towards the innovation.

In one of the earliest efforts to understand drivers of human volitional behaviour, Fishbein and Ajzen (1975) and Ajzen and Fishbein (1980) proposed the Theory of Reasoned Action (TRA). TRA, rooted in social psychology, departs from the premise that behavioural intention is a result of *attitude*, that is a function of the individual belief one holds toward the behaviour; and *subjective norm*, a function of the normative belief regarding expectations of others towards one's performed behaviour (Ajzen & Fishbein, 1975; Hale et al., 2002). Ajzen (1991) extended TRA into the Theory of Planned Behavior (TPB) by integrating the component of *perceived behavioural control* in addition to attitude and subjective norm. The emphasis on behavioural control pertains to individual's perception in regard to the ease or difficulty of performing certain behaviour (Ajzen, 1991). In a similar vein of research, the Social Cognitive Theory (SCT) developed by Bandura (1986, 1997, 2000, 2001) explores human behaviour in the dynamics of the reciprocal individual-environment interactions. SCT posits that human motivation is driven by intentions, forethoughts, self-regulation, and self-reflection (Bandura, 2001). The key constructs of SCT include *self-efficacy*, meaning the belief of the individual in their skills or abilities to have control over certain behaviour; and *outcome expectancies* related to people's perceptions about the consequences of the undertaken actions (Bandura, 1997; Luszczynska & Schwarzer, 2005).

In terms of digital access, self-efficacy and outcome expectancies relate to individual's confidence in their skills and abilities to navigate digital channels, and the anticipated outcomes of utilising alternative forms of access. SCT intersects with TRA and TPB in the elements of perceived control one needs to have to perform certain behaviour and the influence of the environment or the social system where the behaviour occurs. Another theoretical perspective, the Status Quo Bias (SQB) in decision making proposed by Samuelson and Zeckhauser (1988), posits that individuals tend to perform actions in a familiar manner due to *convenience*, *habit*, or *inertia*, opposite of the sentiments of *risk* and *uncertainty*. This approach could be very beneficial in investigating potential reasons or inhibitors preventing the use of digital access channels (Rey-Moreno et al., 2018).

As technology and internet diffusion advanced, the initial theories did not suffice to explain the intricacies of human behavioural intention. However, the conceptual

foundation of theories underpinned the development of technology acceptance models. The Technology Acceptance Model (TAM) introduced by Davis (1986) is anchored in the main premise of TRA of beliefs determining attitudes that later determine the behavioural intention. TAM asserts *perceived usefulness* and *perceived ease of use* as the two central constructs that shape user's beliefs on technology that in turn determine their attitude towards acceptance (Davis, 1986; Ma & Liu, 2004). The parsimonious yet powerful structure of TAM encouraged its extensive applicability in a number of studies. A more comprehensive approach to understanding the drivers of behavioural intention was proposed by Venkatesh et al. (2003) by formulating the Unified Theory of Acceptance and Use of Technology (UTAUT) based on conceptual and empirical comparison of previous models. The UTAUT consists of four direct determinants of user's acceptance and behaviour: *performance expectancy*, *effort expectancy*, *social influence*, and *facilitating conditions* along with four moderating variables *gender*, *age*, *experience*, and *voluntariness of use* (Venkatesh et al., 2003). The predictive power of the UTAUT has been tested and validated to outperform previous models (Venkatesh et al., 2003). However, in response to conventional constructs of technology acceptance models that could not explain the intricacies of electronic government (hereinafter e-government) adoption, Dwivedi et al. (2017) proposed the Unified Model for Electronic Government Adoption (UMEGA). The UMEGA is based on the UTAUT and theoretical review of previous models and consists of *performance expectancy*, *effort expectancy*, *social influence*, *facilitating conditions* and the e-government specific construct of *perceived risk* (Dwivedi et al., 2017). Adding perceived risk is expected to explain nuances of the attitudes in relation to the behavioural intention.

Table 5: Overview of technology acceptance theories and models

Theory/Model	Author, year	Key dimensions
Diffusion of Innovation theory (DOI)	Rogers, (1962, 2003)	Five adopter categories: innovators, early adopters, early majority, late majority and laggards
Theory of Reasoned Action (TRA)	Fishbein and Ajzen (1975) Ajzen and Fishbein (1980)	Attitude, Subjective norm
Theory of Planned Behavior (TPB)	Ajzen (1991)	Attitude, Subjective norm, Perceived control
Social Cognitive Theory (SCT)	Bandura (1986, 1997, 2000,2001)	Self-efficacy, Expected outcomes
Status Quo Bias (SQB)	Samuelson and Zeckhauser (1988)	Convenience, Habit, Inertia Risk, Uncertainty
Technology Acceptance Model (TAM)	Davis (1986)	Perceived usefulness, Perceived ease of use
Unified Theory of Acceptance and Use of Technology (UTAUT)	Venkatesh et al. (2003)	Performance expectancy, Effort expectancy, Social influence, Facilitating Conditions Moderators: age, gender, experience and voluntariness of use
Unified Model of Electronic Government Adoption (UMEGA)	Dwivedi et al. (2017)	Performance expectancy, Effort expectancy, Social Influence, Facilitating Conditions, Perceived Risk, Attitude

Source: Own summary of the works of referenced authors

Table 5 presents a summary of the evolution of theories and models developed over time to explain the behavioural intention towards accepting technology and innovations in general. The continuous technological advancements required for the theories and models to be extended or modified to correspond to specific contextual circumstances. For instance, the UMEGA has been extended by Verkijika and De Wet (2018) by adding *self-efficacy*, *trust in the internet*, and *trust in government* to the original UMEGA constructs; and by Mensah et al. (2020) by adding *perceived service quality*, *trust in government*, and *intention to recommend* to the original UMEGA constructs. This pattern indicates that socio-psychological and cognitive variables such as trust, confidence, and motivation are also becoming increasingly relevant for digital service adoption. Moreover, the psychological shift from conventional to digital access modes requires studying the perceived reliability, integrity, and security of the services and the broader system, and the internal confidence in one's ability to use the services effectively. Internal motivation and perceived competence are found to be shaped by attitudes towards technology (Van Dijk, 2005; Van Deursen & Andrade, 2018). The concept of trust, as the basis of the relationship between citizens and governments, is one of the most prominent determinants of use as citizens adopt services they trust to benefit them (Bélanger & Carter, 2008).

However, as models studying drivers of use often fail to explain the reasons behind not using, Rey-Moreno et al. (2018) suggest dual models, studying both drivers and inhibitors of intention, or integrating models, studying how intention interacts with habit to initiate behaviour. These developments are in line with the claim that no-one-size-fits-all solution to addressing disparities in digital engagement (Asmar et al., 2022) which may stem from differences in motivation levels to use digital access channels. Therefore, the multifaceted nature of acceptance of technology in the first place and the choice of digital access channels requires customised, context-based approaches that consider socio-psychological constructs. As theories and models show, human behaviour to use alternative access channels is shaped by the sense of control and trust in the process (Bandura, 2000). In the narrower discussion of equal access to public services, this implies that tailored strategies should encourage wider use of digital channels by demonstrating trust and quality, so the groups that lag behind are motivated to confidently engage in the process.

2.3 CONCEPTUAL MODEL

In the endeavour to identify barriers to access to public services across different socioeconomic contexts and propose appropriate enablers, this dissertation developed a conceptual model anchored in the previously presented literature and empirical research. The conceptual approach to the potential solution of the research problem consists of the following components (Figure 7):

Figure 7: Conceptual model of the research
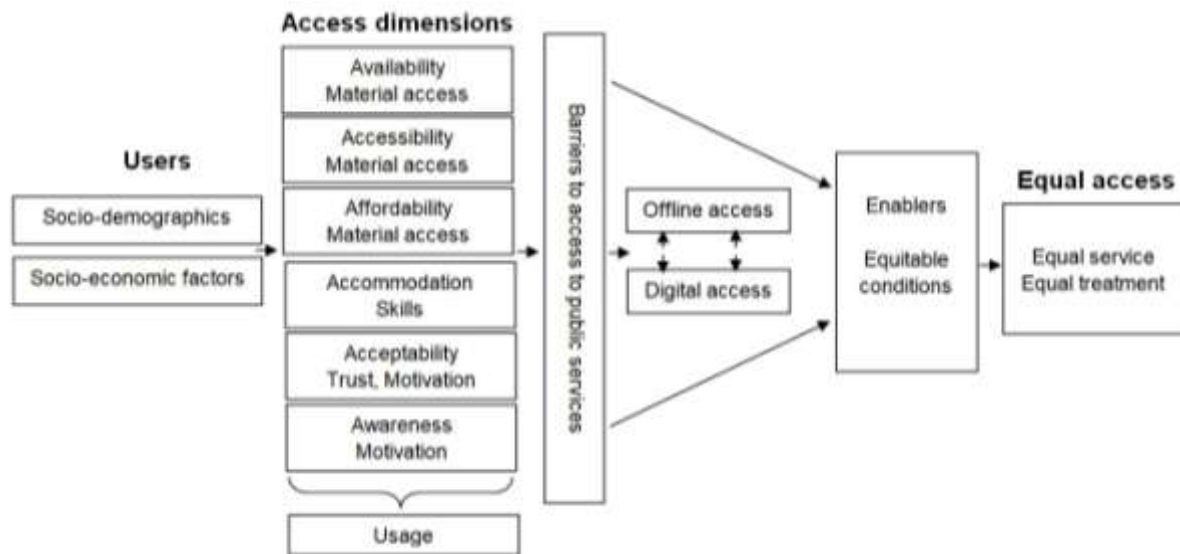
Source: Own, based on previous research of Penchansky and Thomas (1981),
Levesque et al. (2013), Saurman (2016), Van Dijk (2005, 2020)

The model departs from the premise that the profile of a citizen, in the role of user of public services, is shaped by sociodemographics and socioeconomic factors. These factors compose the *compound disadvantage* (Helsper, 2021) or *functional diversity* (Toboso, 2011) denoting the distinctive features of every individual. In regard to sociodemographics, the model includes age, gender, ethnicity, and disability as factors identified in previous research to be potential drivers of access inequality (Ramesh, 2021; Ragnedda, 2022; Taipale, 2013; Eynon & Helsper, 2011). In terms of socioeconomic factors, the model includes income, education and employment, as the most persistent predictors of access (Helsper & Van Deursen, 2017; Mubarak et al., 2020), and residence as the key driver of the urban-rural divide (Cowie et al., 2020; Salemink et al., 2017). The second assumption is that these distinctive features shape citizen's position in facing specific barriers to access to public services across the different access dimensions. The type of public services observed are *life events services* (e.g. birth certificates, marriage certificates, changes in employment status, citizenship certificates, driving licenses, and similar documents) as considered to be the most frequently used and represent the prerequisite for realisation of human rights. The barriers are examined in both offline and digital access to public services to inspect potential spillovers from the offline to the digital domain. Moreover, addressing barriers in offline terms is as equally important as combating digital obstacles, considering the transition period to shift to digital access and the fact that offline access would remain the preferred channel choice for some citizens. The multichannel approach facilitates inclusion and enhances access to the offered services (Rey-Moreno & Medina-Molina, 2016; Verdegem & Hauttekeete, 2008). To reach the solution, identifying potential enablers

as proposed by citizens is expected to remove barriers and release the path to equal access to public services. Addressing barriers is expected to be performed by policymakers through tailored strategies that provide equitable conditions in response to citizen's needs to achieve equal access opportunities.

The model utilises the access dimensions from the original access framework of Penchansky and Thomas (1981) including the awareness component of Saurman (2016) and the considerations of Levesque et al. (2013). Additionally, the levels of digital access (Van Dijk 2005, 2020) are framed within the six offline access dimensions. Availability, accessibility and affordability are connected to material access denoting the physical and material prerequisites to access the service. In offline access this means the service to be offered and available; accessible in terms of proximity to service provider and physical accessibility; and affordable to citizens. In digital context, material access is understood as a broader concept, encompassing both physical access and material access. In other words, that means that material access is not only concerned to the mere provision of physical conditions e.g. internet connection, digital devices, and infrastructure, but with the material aspects as well e.g. the type, quality, and speed of the connection and digital devices (Van Deursen & Van Dijk, 2019). The material dimension of digital access regarding quality of features plays a significant role in creating equal access opportunities. Accommodation both in offline and digital access is related to the manner in which services are organised and whether it corresponds to user's needs. Additionally, in digital access accommodation is connected to service design regarding the skills level needed to be able to utilise the services. Acceptability and awareness in offline terms denote the perceptions, attitudes, and level of information for services. In digital terms, acceptability and awareness also inhibit the cognitive and socio-psychological factors related to motivation as a dimension that further shapes the attitudes of users towards digital access. Motivation in this regard can be impacted by trust, perceived usefulness, perceived easiness of use, social support, social influence, and self-efficacy as proved to be decisive in the technology acceptance theories and models. All access dimensions interact and influence each other in order to reach the ultimate access purpose – usage (Van Dijk, 2005, 2020). Therefore, the concept of access should be considered in its entirety when designing tailored and inclusive strategies. Policy solutions should target all dimensions respectively in aim to achieve effective use as a proxy of access (Van Deursen & Van Dijk, 2015).

In conceptual sense, the model recognises the state of resources as a fact, but considers the capabilities approach towards barriers being a product of the environment – the environment should be adapted to the resources, or to the *functional diversity* of individuals (Toboso, 2011). The state of resources is more constant, and they cannot be changed easily overnight, e.g. one cannot promptly

improve their income or education level or change their age. While some groups are in advantaged positions, digital access can further enlarge the inequalities gap due to the new requirements needed to access the digital domain (Martin & Robinson, 2007). Addressing barriers on the other hand may yield more immediate results by preventing and combatting access inequalities stemming as a result of the start position of unequal resources. After barriers are removed, equal access opportunities are enabled. In this way, the structure of the conceptual model provides the basis for the research design and guides the study accordingly.

3 METHODOLOGY

This dissertation employs an exploratory sequential design, a mixed method approach, to first immerse in concepts as perceived by citizens through qualitative methods and then develop a quantitative measurement instrument accordingly (Creswell & Plano Clark, 2011, 2017). This approach is valuable in studying relatively new phenomena in specific contexts (Cabrera, 2011), such as exploring the impact of digitalization on access to public services and the perceptions of the general population. To provide a well-rounded understanding and examination of the research problem, the dissertation utilises both primary and secondary data sources (Table 6).

Table 6: Primary and secondary sources utilised for research purposes

Data source	Primary sources	
Data type	Qualitative	Quantitative
Data collection method and sample size	Semi-structured interviews (n = 25)	Survey (n = 453)
Participants	Citizens	Citizens
Data collection mode	Face-to-face and online	Face-to-face, online, and phone
Data analysis method	Thematic analysis employing hybrid reasoning	Descriptive statistics, EFA, CFA, Univariate and Multivariate GLM, Binary logistic regression, Chi-square tests
Data source	Secondary sources	
Data type	Qualitative	Quantitative
Data origin	Laws, strategies, reports, and policy documents from national, European, and global level	Eurostat, UN EGDI, UN EPI, ITU, State Statistical Office of North Macedonia
Data analysis method	Qualitative document analysis	Data extraction and descriptive statistics

Purpose	Identifying key concepts, patterns, and chronological developments of access to public services	Identifying trends in basic access indicators within national, regional, European, and global context

The primary sources present the backbone of the research, providing first-hand data collected through procedures best suited to address the research problem (Hox & Boeije, 2005). The secondary data situates the research within a broader comparative perspective, providing additional context and validation based on past and current developments in the field (Hox & Boeije, 2005). The collection of primary sources consisted of a qualitative phase, conducting semi-structured interviews, and a quantitative phase, administering a survey with citizens of North Macedonia. The qualitative sample size comprised of 25 participants ($n = 25$), and the quantitative sample size included 453 participants ($n = 453$). The qualitative data were examined using thematic analysis (Braun & Clarke, 2006, 2019) and applying a hybrid reasoning approach (Fereday & Muir-Cochrane, 2006; Swain, 2018). Quantitative data analysis included Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) (Marsh et al., 2020), univariate Generalised Linear Model (GLM) (De Santis et al., 2021), multivariate GLM (Timm, 2002), binary logistic regression (Harris, 2021), and Chi-square tests of independence (McHugh, 2013). The analysis of secondary sources involved a review of existing legislation and policy documents in the field and reuse of existing data from relevant databases.

3.1 MIXED METHODS RESEARCH DESIGN

The research methodology of this dissertation adopts the phases of exploratory sequential design (Figure 8). Exploratory sequential design is a mixed methods approach where the qualitative phase informs the subsequent quantitative phase (Creswell & Plano Clark, 2011, 2017; Fetters et al., 2013). The qualitative data collection phase has been prepared based on a literature review and adapted to contextual circumstances, while the qualitative data analysis informed the development of the quantitative measurement instrument.

Figure 8: Exploratory sequential design
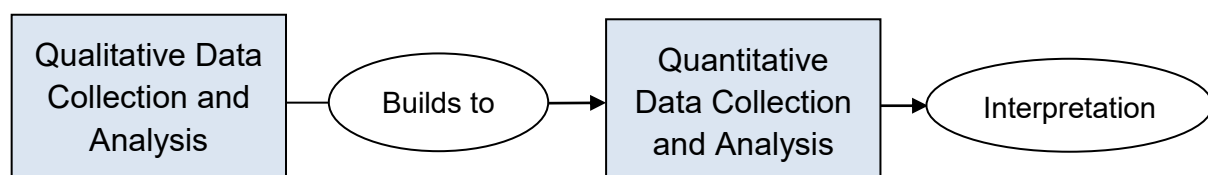
Source: Creswell and Plano Clark (2011, 2017)

The mixed methods approach consolidates the strengths of both qualitative and quantitative strands, providing a more comprehensive insight into the concepts of interest (Almeida, 2018; Berman, 2017). Therefore, the mixed methods approach is preferred when studying concepts that require a nuanced understanding of the context, culture, perceptions, and beliefs, expanding the breadth and depth of the study (Gogo & Musonda, 2022; Dawadi et al., 2021; Shiyanbola et al., 2021). The integration of both qualitative and quantitative methods exceeds the shortcomings of single approaches, by contributing to increased fidelity, reliability, and validity of the developed instruments and the overall study (Onwuegbuzie et al., 2010; Gogo & Musonda, 2022). The sequential design posits that phases occur in a subsequent manner, as in this case, the qualitative phase precedes the quantitative phase, unlike concurrent or convergent design where both phases happen in parallel (Teddlie & Tashakkori, 2006; Fetters et al., 2013). Thus, the exploratory sequential design allows the researcher to first qualitatively delve into the complexities of the concept before proceeding to quantitative validation. While the quantitative strand yields findings based on inference and causality aimed at generalisation, the qualitative strand explains why or how a phenomenon happens and describes the nature of individual experiences (Fetters et al., 2013; Polit & Beck, 2010).

The application of a mixed methods approach requires reflection on the philosophical underpinnings that define the set of beliefs about the nature of reality (Creswell & Plano Clark, 2011, 2017; Shannon-Baker, 2023). In that context, philosophical tenets of knowledge acquisition often challenge the co-existence of ontologically and epistemologically opposing paradigms within a single study (Dawadi et al., 2021). The "paradigm wars" (Doyle et al., 2016) confronts the two major strands positivism/post-positivism and constructivism/interpretivism (Dawadi et al., 2021). Positivism is purely objective, empiricist, and inherently linked to quantitative approaches of knowledge creation (Dawadi et al., 2021; Bryman, 2016). Post-positivism allows space for subjectivity and greater researcher-participant direct interaction, balancing the limitations of purely positivist approaches (Dawadi et al., 2021; Panhwar et al., 2017). On the other hand, fully grasping the complexity of social phenomena and perceptions, which are inherently illative and speculative in nature (Gogo & Musonda, 2022), requires subjective, qualitative approaches that account for the context and lived experiences. This aligns with the interpretivist notion of multiple realities, and interpreting findings from diverse perspectives, while still adhering to established research protocols (Dawadi et al., 2021). Constructivism endorses the diversity of perspectives by asserting that individuals form cognitive constructs of reality based on personal experiences shaped by interactions with the environment (Shannon-Baker, 2023; Dawadi et al., 2021).

While guided by opposing ontological and epistemological frameworks, the integration of quantitative and qualitative methods solidifies the understanding of

complex phenomena by combining their strengths and compensating for the limitations of the two methods respectively (Doyle et al., 2016; Dawadi et al., 2021). Therefore, this dissertation adopts the exploratory sequential mixed methods design. Through interpretivism/constructivism lenses, the research aims to gain in-depth insights into citizens' perceptions of the implications of digitalization on access to public services, ensuring their voices are heard (Doyle et al., 2016). Based on these insights and guided by a positivist/post-positivist approach, a quantitative measurement instrument is developed to collect data that informs policy recommendations from a relevant sample of respondents. The detailed steps of the dissertation's research design are presented in Figure 9.

Figure 9: Dissertation's exploratory sequential research design

Phase 1

QUAL
Semi-structured
interviews
n=25

Builds to

Phase 2

QUAN
Survey
n=453

Interpretation

| Procedure | Product | Procedure | Product |

Development of qualitative data collection instrument → Interview guide

Development of quantitative data collection instrument → Questionnaire

Qualitative data collection → Face-to-face and online semi-structure interviews

Quantitative data collection → Survey responses from a face-to-face, online, and phone survey

Qualitative data analysis → Transcripts, content analysis grid, thematic categories

Quantitative data analysis → Numerical data, factor loadings, model fit indices, regression outputs

Data integration, interpretation, and discussion

Timeline
January - July, 2024

Timeline
August, 2024 - March, 2025

Source: Own, based on Creswell and Plano Clark (2011, 2017), Berman (2017), Shiyanbola et al. (2021), Teddlie & Tashakkori (2006), Onwuegbuzie et al. (2010), Fetters et al. (2013)

Following the phases of exploratory sequential design as proposed by Creswell and Plano Clark (2011, 2017) the dissertation departs from a baseline qualitative phase that informs the development of the questionnaire as a data collection instrument in the quantitative phase (Figure 9). QUAL and QUAN abbreviations are used to indicate qualitative and quantitative phases respectively, while the arrow sign denotes that the quantitative phase occurs once data collection and analysis for the qualitative phase has been completed (Byrne & Humble, 2007). However, the presence of both qualitative and quantitative data collection methods in a single study does not automatically constitute a mixed methods study (Berman, 2017). Rather, it is the integration of qualitative and quantitative strands at multiple levels that distinguishes mixed methods studies, offering novelty in approaches and data versatility (Berman, 2017; Gogo & Musonda, 2022).

Integration in mixed methods studies occurs at three different levels: study design level, methods level, and interpretation and reporting level (Fetters et al., 2013). As discussed by Fetters et al. (2013) integration at study design level includes three basic designs - exploratory sequential, explanatory sequential, and convergent; integration at methods level involves connecting, building, merging, and embedding; and integration at interpretation level occurs through narrative, data transformation, and joint display. Building on these prescribed principles and practices, the dissertation takes the following forms of integration:

Table 7: Integration levels of applied research methods

Integration level	Integration principles applied in dissertation	Definition
Study design	Exploratory sequential Design	Qualitative data collection and analysis is conducted prior to the subsequent quantitative phase
Methods level	Building	The qualitative phase informs and refines the quantitative data collection instrument – the latter building on the former
Interpretation level	Narrative with contiguous approach	Qualitative and quantitative findings are presented in a single report, but in different sections

Source: Adapted from Fetters et al. (2013)

As shown in Table 8, the dissertation's research design involves methods integration at all three levels – study design, methods, and interpretation level. This approach is

aimed at leveraging the strengths of both qualitative and quantitative methods to ensure solid and comprehensive data scrutiny.

The research rationale for choosing a mixed methods design is thoroughly justified by Greene et al. (1989) proposing five key purposes: triangulation, complementarity, development, initiation, and expansion.

Table 8: Rationale for adopting a mixed methods approach

Purpose	Rationale
Triangulation seeks convergence, corroboration or correspondence of results from multiple methods.	To increase the validity of constructs and inquiry references by using different methods to measure the same phenomenon.
Complementarity seeks broader, deeper, and more comprehensive understanding of multifaceted social phenomena.	To elaborate, enhance, deepen, and broaden the overall interpretations and inferences from the study.
Development seeks to use the results from one method to inform the development of the other method, where development is broadly construed to include instrument construction, sampling, and implementation.	To better understand and increase validity of constructs by capitalising on inherent method strengths.
Initiation seeks the discovery of a paradox, contradiction, divergence, and new perspectives of frameworks.	To increase the breadth and depth of inquiry results and interpretation by applying different methods and paradigms with the intended result of divergence or dissonance.
Expansion seeks to expand the breadth and range of study by using different methods to assess different inquiry components.	To expand the scope of inquiry by selecting the most appropriate method for each construct.

Source: Greene et al. (1989) and Greene (2007)

In line with the proposed rationale presented in Table 9, the dissertation employs a mixed methods approach for the purposes of triangulation, complementarity, and development. Triangulation is tied to using different methods to measure the same phenomenon from different perspectives; complementarity refers to providing

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broader and nuanced qualitative understanding of the concepts before proceeding to quantitative examination of the phenomena; and development means applying the results of the first method to inform the development of the subsequent data collection instrument.

3.2 QUALITATIVE METHODS

This dissertation employs semi-structured interviews aiming to acquire a nuanced understanding of citizens' experiences and expectations in offline and digital access to public services. The qualitative phase of the research has been instrumental in unveiling citizens' perceptions of access, which was vital to develop the questionnaire. Interviews are a common method in qualitative research conducted in a reliable, one-on-one setting that enables in-depth and comprehensive discussions (Small & Cook, 2023; Peters & Halcomb, 2015; Gill et al., 2008). The semi-structured character of the interviews allows introducing or delving into themes and concepts not previously anticipated by the interview guide, or strictly set by the interviewer (Gill et al., 2008; Roberts, 2020). This approach is valuable in discovering new knowledge and allows for the researcher to discover concepts of interest for the research. The semi-structured interviews were the preferred method over group discussions to minimise constraints while sharing citizens' expectations and experiences that may arise from differences in socioeconomic backgrounds, personal views, or potential mutual influence among participants.

3.2.1 Casing/sampling

Identifying participants in the semi-structured interviews was targeted to represent diverse profiles, taking into consideration factors that are potential drivers of access inequalities such as age, education, income, ethnicity, and type of residence (Mubarak et al., 2020; Salemink et al., 2017; Ragnedda et al., 2022). The participants were selected by purposive and snowballing, non-probabilistic technique. To reach to potential participants, the information has been spread to community centres, civil society organisations, and contacts from different urban and rural areas. In this regard, the community liaisons played a significant role in setting a trustworthy and open atmosphere which encouraged community members to participate in the research. The interviews were conducted in an environment preferred by the interlocutor, at their home, workplace, or through digital means and platforms. Having a familiar and comfortable setting to conduct the interviews supports a productive and open interview, free of any external constraints (Kvale & Brinkmann, 2009; Gill et al., 2008). The number of the participants has been determined on the grounds of reaching as many diverse profiles of respondents with data collection up to the point of saturation, meaning no new insights or information

are gained with every new respondent (Saunders et al. 2018; Morse, 2015). Interview respondents were of different occupations including employed individuals, unemployed individuals, students, farmers, retirees, and members of marginalised communities (Table 9).

Table 9: Profile of interview respondents

Participant ID	Gender	Age	Ethnicity	Highest level of education	Employment	Type of residence
P1	Woman	46	Macedonian	PhD degree	Yes	Urban
P2	Man	26	Albanian	BA degree	Yes	Urban
P3	Man	36	Bosniak	High school	Yes	Urban
P4	Woman	52	Macedonian	High school	Retired	Urban
P5	Woman	30	Bosniak	BA degree	Yes	Urban
P6	Man	37	Macedonian	BA degree	Yes	Urban
P7	Man	41	Turk	High school	Yes	Urban
P8	Woman	33	Macedonian	BA degree	Yes	Urban
P9	Man	69	Macedonian	High school	Retired	Rural
P10	Man	65	Macedonian	Incomplete primary school	No	Rural
P11	Woman	63	Macedonian	Incomplete primary school	No	Rural
P12	Man	66	Macedonian	High school	Retired	Rural
P13	Man	40	Macedonian	BA degree	Yes	Rural
P14	Woman	63	Macedonian	High School	Retired	Rural
P15	Man	67	Macedonian	Associate degree	Retired	Rural
P16	Woman	67	Macedonian	Primary school	Retired	Rural
P17	Woman	63	Macedonian	Medical Doctor	Yes	Urban
P18	Man	64	Vlach	BA degree	Retired	Urban
P19	Woman	35	Macedonian	MA degree	Yes	Urban
P20	Woman	33	Macedonian	BA degree	Yes	Urban
P21	Man	38	Albanian	MA degree	Yes	Urban
P22	Woman	35	Macedonian	BA degree	Yes	Rural
P23	Man	19	Macedonian	High School	Yes	Urban
P24	Woman	39	Albanian	MA degree	Yes	Rural
P25	Woman	28	Roma	High School	Yes	Urban

Source: Paneva and Bencina (2025)

Table 9 presents the profile of interview respondents based on demographics and socioeconomic variables. The intention was to cover diverse profile of citizens from

proficient users of digital access channels to less digitally savvy citizens. Since the purpose of the qualitative data collection is not statistical generalisation, the employed approach of including diverse profiles supported discovering the multitude of perspectives and perceptions regarding digitalization.

3.2.2 Interview guide development

The interview guide consisted of two parts, offline access (Table 10) and digital access (Table 11) categories. The guide was developed based on previous research and the access dimensions of Penchansky & Thomas (1981) and Saurman (2016). The questions were not necessarily asked in the given order, but the interview followed the pace and topics as developed by respondents (Swain, 2018). Additionally, some of the questions referring to digital access have been adjusted for users or non-users of digital public services. The interviews started with a general question about user experiences and continued with the structured access dimensions, using probes and prompts to encourage respondents to share significant insights or reveal another aspect not envisaged with the interview guide.

Table 10: Offline access interview guide

Offline access interviews	
Availability	How would you describe a recent experience of accessing public service in-person?
Awareness	How did you find the procedure to obtain the public service? Were you familiar with information and steps of getting the public service?
Accessibility	How would you describe getting to and accessing the building of the public institution? How would you describe the experience of locating the exact office or counter you need?
Affordability	Were there any costs related to accessing the public service? How has this affected your budget?
Accommodation	How would you describe the quality of service delivery? Was it according to your needs and expectations?
Acceptability	How would you describe communication and support from service providers?

Source: Paneva and Bencina (2025)

Table 11: Digital access interview guide

Digital access interviews	
Availability	Are you familiar with digital public services? How do you find the current offer of available digital public services?
Accessibility (Physical and material access)	How do you usually access the Internet? Which place, location and digital device?
Affordability (Material access)	What do you think about the monthly Internet prescription fee? How do you find prices of digital devices at the market? Do you possess digital devices personally and/or at your home?
Accommodation (users) (Skills and service design)	How would you describe the overall experience of registering and navigating at the portal? Was there additional support offered?
Accommodation (non-users) (Skills)	How confident are you in using the Internet? What is your opinion, how would you assess your skills to access e-services.
Acceptability (users) (Trust and motivation)	How do you find the overall process of accessing public services online? Any considerations regarding protection of personal data online? What would be some benefits of using digital public services?
Acceptability (non-users) (Trust and motivation)	How do you find the idea of accessing public services online? Any considerations regarding protection of personal data online? What would be some benefits of using digital public services?
Awareness (Motivation)	Are you informed for the possibility to access public services online? Are you informed about where and how you can access electronic public services? What can be improved to better inform you?

Source: Paneva and Bencina (2025)

3.2.3 Qualitative data analysis method

The interviews were audio-recorded and then transcribed verbatim as a common practice to keep respondents' words intact while enabling deeper analysis and

sharing data with other researchers (Bryman, 2016). Prior to the start of the interviews, respondents were familiarised with the research aim and recording consent has been obtained (Alsaawi, 2014). Since originally conducted in the Macedonian language, the transcripts were translated into English, ensuring a faithful word-for-word representation of respondents' intent, without introducing any interpretation bias (McKown et al., 2020).

The data were analysed using reflexive thematic analysis following the steps outlined by Braun and Clarke (2006, 2019). Initially, multiple rounds of reading have been performed to familiarise with the content in detail. To code the data, a content analysis grid was developed (Creswell, 2014) considering the access dimensions as predefined broad themes. As codes were often too detailed and overlapping, they were merged and grouped directly into sub-themes. This approach allowed for a more coherent and meaningful grouping of data, avoiding granularity. Sub-themes were nested under each access dimension, considered a theme in this case, and supported by respondents' statements. In the analysis, the deductive reasoning was employed to nest patterns and sub-themes under predefined themes, and inductive reasoning was used to explore and identify emerging concepts beyond the established framework (Feredey & Muir-Cochrane, 2006; Swain, 2018). Reflexivity was practiced throughout the analysis process with an emphasis on self-awareness of how previous author experiences or positions could influence the process (Creswell, 2014).

3.3 QUANTITATIVE METHODS

The following section presents the procedure for quantitative data collection and the methods used for data analysis. As a first step, subsequent to the interviews, a questionnaire was developed based on relevant literature and interviews insights. The survey sample was designed to mirror the census-based structure of the national population. Appropriate quantitative data analysis and hypothesis testing methods were selected based on the relationships between the variables of interest.

3.3.1 Questionnaire development and structure

The quantitative data were collected through a questionnaire developed on the basis of the original access dimensions of Penchansky and Thomas (1981) – accessibility, affordability, accommodation, and acceptability. Availability of services was not examined as separate dimension in the questionnaire, as it was integrated within the accommodation dimension. In terms of content, the statements development followed the themes as identified from the interviews, nested under each access dimension accordingly. The questionnaire consisted of two main parts, offline access

and digital access, with two tracks of users and non-users for the dimensions of accommodation and acceptability in digital access (Figure 10). The full translated version of the questionnaire can be found in Annex 1.

Figure 10: Questionnaire outline

Sociodemographic and socioeconomic characteristics
Age
Gender
Education level
Employment status
Income
Disability status
Ethnicity
Type of residence

→

Part I **Offline (in-person) access**
Type of service
Frequency
Access dimensions
Accessibility – 5 statements
Affordability – 5 statements
Accommodation – 5 statements
Acceptability – 5 statements

→

Equal access 6 statements

→

Enablers Multiple answers List based on interviews

Basic digital indicators
Internet connection (home or mobile)
Possession of digital devices
Self assessment skills
Social support for Internet use
Purpose of Internet use
Digital public services
Level of information (awareness)
Information medium
Use of digital public services yes/no (divides respondents into users and non-users of digital public services)

→

Part II **Digital access**
Type of service (users)
Frequency (users)
Access dimensions
Accessibility – 5 statements (both groups)
Affordability – 5 statements (both groups)
Accommodation – 5 statements (separate users and non-users)
Acceptability – 5 statements (separate users and non-users)

→

Equal access 7 statements

→

Enablers Multiple answers List based on interviews

End: Preferred future use

Source: Own

The questionnaire (Figure 10) begins by collecting sociodemographic and socioeconomic characteristics that form the profile of a citizen. To examine barriers to offline services, the questionnaire includes five Likert scale statements within the dimensions of accessibility, affordability, accommodation, and acceptability. The Likert scale ranges from 1 (strongly disagree) to 5 (strongly agree). Following barriers, the questionnaire collects information on equal access, focusing on perceived fairness and overall satisfaction with access. The offline access section concludes with a multiple-choice list of enablers, identified from the prior phase of interviews, with the option to add additional responses.

Similarly, the section on digital access opens with basic digital indicators identified as relevant in previous research to assess the basic prerequisites for using digital public services. These prerequisites include internet connectivity, owning devices, and digital skills, and the level of familiarity and information about the existence of digital public services. The bridge question that divides users and non-users of digital public services is a yes/no question asking whether they have used digital public services. The questionnaire then proceeds to identifying barriers in digital access, following the same structure as the offline section, with five Likert scale statements under each access dimension. The dimensions of accessibility and affordability share the same statements for both, users and non-users. On the other hand, the dimensions of accommodation and acceptability are addressed through separate statements – aimed to explore users' experiences with digital access, and to examine the reasons for non-use and expectations held among non-users. Equal access statements also examine perceived fairness and overall satisfaction with digital access, similarly to the offline access approach. The digital access section also includes a list of enablers identified in the interviews, with an option to add additional responses, and concludes with a question on preferred future use.

The offline-digital design of the questionnaire aims to investigate the relationship between offline and digital access barriers, examining whether and how barriers are transferred between the two domains. This approach is expected to identify the common or specific barriers faced by different socioeconomic groups. In terms of public services, the questionnaire included a list of 15 frequently used services (Table 12). These services are fundamental to everyday life, as they cover essential needs to fully function in the society, such as obtaining personal identification documents and accessing life events services such as marriage, change in employment status and similar instances. This set of services forms the basic prerequisite for fulfilling the remaining corpus of human rights.

Table 12: List of public services included in the questionnaire

No.	Type of public service
1	Identification Card (ID)
2	Passport
3	Driving license
4	Birth certificate
5	Marriage certificate
6	Citizenship certificate
7	Criminal record certificate
8	Taxes related services
9	Real Estate Cadastre services
10	Central Registry services
11	Agricultural subsidies
12	Financial compensation for individuals at social risk
13	Employment status certificates
14	Certificates from the Pension and Disability Insurance Fund
15	Certificates from the Health Insurance Fund

Source: Own

In the context of offline access, the public services are provided through the counters or offices of the public institutions. In the context of digital access, public services are provided through the National e-Services Portal or the separate portals of the designated institutions. In the case of ID, passport, and driving license citizens have the opportunity to apply for an appointment, while the rest of the procedure is completed at the counter or office of the designated public institution. All citizens included in the research have accessed services in offline sense, as the conventional access method, while some of them have also utilised digital access channels.

3.3.2 Survey sampling

The questionnaire was designed and available through the open source application 1KA, developed by the Centre of Social Informatics of the Faculty of Social Sciences at the University of Ljubljana. The survey was opened for receiving responses in the period from September to November, 2024.

The survey employed stratified proportionate sampling in order to cover the different sociodemographic and socioeconomic profiles needed for the research. Stratified sampling is a sampling method in which the population is divided into subgroups based on certain characteristics (Nguyen et al., 2021). Stratified proportionate

sampling is common in studies aimed at including respondents from specific groups of interest, while keeping the rigor and ensuring that the sample adequately represents the overall population structure (Iliyasu & Etikan, 2021; Van Haute, 2021). The primary sampling criterion in this research was based on the sociodemographic and socioeconomic characteristics of the population, with urban-rural distribution as a contextual control variable.

To ensure representativeness, the survey sample was designed to mirror the structure of the national population according to census data. The subgroups were defined according to the sociodemographic and socioeconomic variables included in the study – population divided by age groups, gender, education levels, employment status, income levels, disability status, ethnicity, and type of residence - urban or rural. Efforts were made to ensure that the survey sample represented combinations of sociodemographic and socioeconomic characteristics so that all profiles are proportionally covered in accordance with the census structure.

In addition, respondents had the option to share the name of their place of residence for the purpose of tracking geographical distribution across the country. Based on the Nomenclature of Territorial Units for Statistics (NTES), harmonised with the EU classification, North Macedonia consists of 80 administrative units, municipalities at the NTES level 4 (State Statistical Office, 2024). The total of 80 municipalities includes the 10 municipalities comprising the capital city of Skopje which is a separate administrative unit. In reference to their type, 33 municipalities are considered urban, having their seat in a city; 37 municipalities are considered rural, having their seat in a village; and 10 municipalities of the City of Skopje (Law on the Territorial Organisation of the Local Self-Government in the Republic of Macedonia, Official Gazette of the Republic of Macedonia Nos. 55/2004, 12/2005, 98/2008, 106/2008, 149/2014). Both urban and rural municipalities comprise villages within their structure, classified as rural settlements. It is important to note that the sample strived to ensure spatial diversity in the context of presenting different contextual realities, rather than geographic proportions in classical sense, as groups are not evenly distributed across municipalities (e.g. as in the case of ethnic groups, age composition of the population, etc.).

The first phase of data collection consisted of reaching out to respondents via e-mail and in-person visits to ensure coverage of citizens from diverse backgrounds. The e-mail distribution involved sharing the survey across universities, multi-ethnic community centres, and different municipalities via local liaisons. In-person data collection included visits to villages and communities of retired individuals, who would otherwise be harder to reach, thus providing open participation opportunities for different population groups.

The second phase of the data collection process was aimed to targeting underrepresented groups after the first phase. Reaching out to respondents was supported by a public opinion agency working in the field of digitalization,[3] to help ensure that the sample reflects the census structure of the population. Agency representatives were trained on the content and objectives of the questionnaire and conducted only the technical aspects of data collection, without having any access to questionnaire results or sensitive information. The data collection process was performed by reaching out to respondents from panel of phone contacts of the agency. These approaches strived to align with the census sample, although some discrepancies remained as further discussed in the results section (detailed in section 4.2.1).

3.3.3 Exploratory factor analysis (EFA) and Confirmatory factor analysis (CFA)

Following the conceptual model, exploratory factor analysis (EFA) was conducted to explore the underlying structure of the measured items and assess their validity. Although theoretically rooted in previous literature, the conceptual model has not been empirically tested in prior research. Therefore, EFA is instrumental in assessing whether the observed items align with the proposed theoretical dimensions. This analysis supports the refinement of the measurement model by identifying patterns of item loadings and ensuring that each construct is measured by a coherent set of indicators before proceeding to CFA and regression analyses.

EFA is a multivariate statistical method utilised to ensure validation of measurement scales (Watkins, 2018). EFA aims to identify the common factors that explain the order and structure of measured variables, to quantify the relationship between variables and factors, and to understand the nature of the factors based on the observed correlations between variables (Watkins, 2018; Cudeck, 2000). In this regard, EFA is valuable for identifying statistically meaningful items that form a factor, rather than examining scattered and unrelated variables. In line with the research design, three separate models were created through EFA extraction: offline access, digital non-users, and digital users, corresponding to the specific groups defined in the questionnaire.

In factor analysis, the total variance of an observed variable consists of common variance and unique variance (Schreiber, 2021). Common variance ranges from 0 to 1 where values closer to 1 indicate that the extracted factors explain most of the variance of an individual item (Schreiber, 2021). The cut-off value for factor loadings varies across studies, however the minimum acceptable value is 0.30 (Kline, 2014;

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[3] Institute for Development of Electronic Communications (EN: INDECOM – Skopje; MK: INREKOM - Skopje).

Howard, 2016) and all lower values should be excluded from the model (Sarmento & Costa, 2019). In other studies, the cut-off threshold is as low as 0.32 (Tabachnick & Fidell, 2013; Cleare et al., 2018; Samuels, 2016) while other examples recommend 0.40 as the threshold for meaningful factor association (Stevens, 2002). While 0.30 is considered the minimum acceptable factor loading that indicates a moderate correlation between the factor and the item (Tavakol & Wetzel, 2020), loadings above 0.60 or an average common variance of 0.70 are considered indicative of effectively capturing the significance of the variable (MacCallum et al., 1999, 2001). In addition to common variance, uniqueness is also considered to assess the strength of the factors. Uniqueness refers to the proportion of variance in each observed variable that is not explained by common variance (Schreiber, 2021). In contrast to the factor loading threshold, low uniqueness values (closer to 0) indicate that the item is strongly explained by the factor, while high uniqueness (closer to 1) suggests that the variable is less associated with the factor structure. Other authors also consider cross-loadings, the cases when an item loads to primary and alternative factors, where the differences between the primary and alternative factor loadings should be at least 0.20 or more to be acceptable for further factor analysis (Hinkin, 1998 in Howard, 2016).

The EFA process required iterative interventions aimed at improving the reliability and statistical adequacy of the models. Some actions included reviewing and removing item loadings, addressing issues of low common variance, high uniqueness, and cross-loadings, while considering both statistical output and theoretical alignment. This process contributed to a more refined and reliable model by removing weak or cross-loaded items. The factors were then theoretically considered, grouped and named based on their conceptual background. After factor extraction, the sum of the squared loadings (SS loadings), the explained variance (%), and the cumulative variance for each factor were calculated in the statistical software Jamovi (2.6.3). The SS loadings represent the amount of variance explained by each factor, numerically equal to the factor's eigenvalue. According to Kaiser's rule (1960), factors with eigenvalues greater than 1 are retained in the analysis (Williams et al., 2010). The cumulative variance shows how much of total variance is explained collectively by the factors. While there is no specific threshold adopted, in social science, a cumulative explained variance of 50%-60% is generally considered acceptable (Williams et al., 2010). The analysis utilised maximum likelihood extraction method in combination with a varimax rotation.

Assumption tests for the EFA structure included the Kaiser-Meyer-Olkin (KMO) test and Bartlett's Test of Sphericity, used to assess the sampling adequacy and suitability of the data for factor analysis. The minimum acceptable value for the KMO test that allows proceeding with the analysis is 0.50 (Kaiser, 1974). The Bartlett's Test of Sphericity assesses multivariate normality, with $p < .05$ indicating the

rejection of the null hypothesis (Hadi et al., 2016). A significant Bartlett's Test of Sphericity suggests that the variables are sufficiently correlated and potentially measure the same underlying concept, allowing for further grouping through factor analysis. Additionally, Cronbach's alpha was calculated to assess the internal validity of the constructs. In general, in social science research Cronbach's alpha values of 0.70 or above are considered acceptable, while some studies also consider values above 0.60 as reasonable or adequate (Taber, 2018).

Following the EFA, a Confirmatory Factor Analysis (CFA) was conducted to confirm the factor structure and assess the model's fit to the data. The model fit was evaluated through several key indices: root mean square error of approximation (RMSEA), standardised root mean square residual (SRMR), comparative fit index (CFI), Tucker-Lewis index (TLI), Bayesian information criterion (BIC), and the Akaike information criterion (AIC). The RMSEA assesses how far a hypothesised model is from a perfect model (Xia & Yung, 2019). Therefore, RMSEA values closer to 0 are better (Goretzko et al., 2024). Although cut-off values are not absolute, the most frequently cited criteria (Hu & Bentler, 1999; MacCallum et al., 1999; Browne & Cudeck, 1992; Jöreskog & Sörbom, 1993, in Xia & Yung, 2019) for RMSEA are:
- RMSEA ≤ 0.05 good fit
- 0.05 < RMSEA ≤ 0.8 reasonable, acceptable fit
- 0.08 < RMSEA ≤ 0.10 mediocre fit
- RMSEA > 0.10 poor fit

The RMSEA is typically reported with a 90% confidence interval where in ideal cases the lower value is near zero, or below 0.05, and the upper value does not exceed 0.08 (Hooper et al., 2008). The commonly cited cut-off threshold for SRMR is SRMR < 0.08, with values closer to 0 considered ideal (Hu & Bentler, 1999; Cho, 2022). TLI and CFI values above 0.90 are considered a good fit, while values above 0.95 suggest excellent fit (Hu & Bentler, 1998 in Montoya & Edwards, 2021; Xia & Yang, 2019). The BIC and AIC are used for model comparisons and smaller values indicate a better fitting model (Fong & Ho, 2015). The CFA was performed using the statistical software Jamovi (version 2.6.3).

3.3.4 Hypothesis testing methods

The hypothesis testing method applied in this dissertation is regression. Regression is an inferential statistical method used to quantify and express the relationship between one or more independent variables (predictors, x) and one or more dependent variables (outcomes, y). The regression results indicate how changes in the independent variables are associated with changes in the dependent variables. The regression models are based on hypothesis, where the null hypothesis assumes no relationship between the independent and dependent variables, while the

alternative hypothesis suggests the existence of a relationship between the variables (Zaborovskaia et al., 2020). In this dissertation, the three hypotheses, H1, H2, and H3 present the hypothesised relationships between the variables of interest. Depending on the nature of the relationships and the goal of the hypothesis, this dissertation applies three types of regression modeling, H1 utilises a univariate Generalised Linear Model (GLM), H2 employs binary logistic regression, and H3 uses multivariate Generalised Linear Model (GLM). A detailed explanation of the modelling approaches is presented in continuation.

H1: Sociodemographic and socioeconomic factors influence the incidence of barriers in offline and digital access to public services.

The first hypothesis (H1) assumes that sociodemographic and socioeconomic factors shape the barriers individuals face when accessing public services through both offline and digital channels. This hypothesised relationship sets sociodemographic and socioeconomic factors as independent variables and barriers as dependent variables. Sociodemographic factors include age, gender, residence, disability status, and ethnicity, while socioeconomic factors comprise educational attainment, income, and employment status. The proposed independent variables have been identified in previous research as consistent predictors of access disparities with varying effects across different socioeconomic contexts (Ragnedda, 2020; Van Deursen et al., 2017; Mubarak et al., 2020). Barriers to access, the dependent variables, are identified across the access dimensions of accessibility, affordability, accommodation, and acceptability (Penchansky & Thomas, 1981), and operationalised based on the factor structure extracted through the EFA procedure (detailed in section 4.2.3). The relationships between the independent variables and the dependent variable are tested within the three types of access, offline access, digital non-users, and digital users.

Univariate Generalised Linear Model (univariate GLM) was employed to test the hypothesised relationships, allowing for the analysis of the effect of independent variables on the dependent variables. The GLM framework is widely applied in social sciences due to its capacity to model different types of dependent variables (Cao, 2020). The univariate GLM method is applied in the study of Santoso et al. (2018) who investigated the relationship between the use of traditional and eBooks on the final learning outcome in rural settings. Similarly, De Santis et al. (2021) employed linear and binary univariate analyses to examine the influence of sociodemographic factors on the use of digital technologies in healthcare digitisation.

In line with the three groups of interest of the research, offline users (all survey participants), non-users of digital public services, and nusers of digital public

services, the univariate GLM was conducted in three separate settings. The general modelling approach was as follows:

$$Y_j = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \varepsilon$$

Where:
- Y_j is the dependent variable extracted from the EFA structure to denote access barrier (detailed in section 4.2.3).
  - Y_j Offline access: acceptability, affordability, accessibility proximity, accessibility physical, and accommodation
  - Y_j Digital access non-users: accommodation, affordability, accessibility public, accessibility, acceptability
  - Y_j Digital access users: accessibility, acceptability, accommodation, affordability, accessibility public
- $X_1, \cdots, X_8$ are the independent variables, age, gender, residence, disability status, ethnicity, education, employment, and income
- β_0 is the intercept, the expected value of Y when all predictors X are zero
- $\beta_1, \cdots, \beta_8$ represents the effect of the predictor variable X on the dependent variable Y, meaning the change in Y for a one unit change in X
- ε is the error term which capturing the unobserved factors not included in the model

Given the number of dependent variables, the univariate GLM comprised 15 separate models. Assumption tests for homogeneity of residual variance were conducted using the Breusch-Pagan Test and Levene's Test. A non-significant p-value ($p > .05$) indicates that the assumption of homogeneity is met (Garson, 2012). Normality of residuals was assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests. A non-significant p-value ($p > .05$) indicates that the assumption of normality is met (Ghasemi & Zahediasl, 2012). Additionally, multicollinearity was examined through the Variance Inflation Factor (VIF). A VIF value below 5 is the commonly accepted threshold indicating that multicollinearity between variables is not a concern (Daoud, 2017). Recent studies, however, raised concerns that relying solely on the threshold criteria does not completely eliminates the possibility of multicollinearity-induced type 1 errors (Kalnins & Hill, 2025).

The results of the model fit tests included R^2 and adjusted R^2 to express the proportion of the explained variance, along with degrees of freedom (*df*), ANOVA *F*-tests, and *p*-values to determine the significance of each model. H1 is considered supported if, within each access setting – offline access, digital non-users, and digital users, at least one model demonstrates statistical significance. This approach aims to offer deeper insights in how individuals from different sociodemographic and socioeconomic backgrounds experience barriers in both offline and digital access to

public services. The data was analysed in the statistical software Jamovi (version 2.6.3).

H2: Sociodemographic and socioeconomic factors influence the use of digital public services.

The second hypothesis (H2) suggests that sociodemographic and socioeconomic factors determine whether an individual uses or does not use digital public services. This claim involves the relationship between the independent variables, sociodemographic and socioeconomic factors, and the usage of digital public services acting as a binary dependent variable. The independent variables, similarly to H1, include age, gender, education level, income, disability, ethnicity, employment status, and type of residence as identified in previous research to generate inequalities in digital access (Van Deursen et al., 2017). The "yes" response ($Y = 1$) means the respondent uses digital public services and "no" response ($Y = 0$) means the respondent does not use digital public services. Given the dichotomous nature of the dependent variable, H2 is tested using binary logistic regression (Harris, 2021; Nick & Campbell, 2007). The method was employed in similar prior studies related to analysing which variables among demographic factors, health characteristics, and social activities act as predictors of computer use or non-use in the context of the digital divide among urban older citizens (Cresci et al., 2010).

The binary logistic regression method is appropriate to estimate the odds of being a user or a non-user of digital public services based on sociodemographic and socioeconomic predictors. The modelling approach was as follows:

$$\ln\left(\frac{P}{1-P}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8$$

Where:
- $P = Pr(Y = 1)$ is the probability of having the outcome occurring
- $\frac{P}{1-P}$ is the odds of the outcome occurring
- $\ln\left(\frac{P}{1-P}\right)$ is the natural logarithm of the odds (log-odds)
- β_0 is the intercept when all X variables are zero
- $\beta_1, \cdots, \beta_8$ are the regression coefficients
- $X_1, \cdots, X_8$ are the sociodemographic and socioeconomic variables, age, gender, disability, education, employment, income, ethnicity, and residence

This approach directly tests the relationship between sociodemographic and socioeconomic factors and identifies which variables have a statistically significant effect on the use of digital public services. The specific factors associated with non-

use can help identify groups at risk of digital exclusion and to indicate the profiles of non-users. H2 is considered supported if at least one sociodemographic or socioeconomic variable significantly predicts the likelihood of using digital public services as the outcome of the binary logistics model. The analysis was performed in the free statistical software Jamovi (version 2.6.3).

H3: The spillover of offline barriers into the digital domain hinders the achievement of equal access to public services.

The third hypothesis (H3) examines whether offline barriers translate into the digital domain, taking new forms and continuing to create access disparities between users and non-users of digital public services. In other words, this assumption addresses the central question of this dissertation by analysing the spillover of barriers from the offline to the digital domain and having challenges shaped in a new context. This assumption hypothesises equal access comprising of equal service and equal treatment as a dependent variable. The barriers across the access dimensions of accessibility, affordability, accommodation, and affordability, act as independent variables. The hypothesis is tested with multivariate GLM respectively within the three settings, offline access (all survey participants), users of digital public services, and non-users of digital public services. The modelling approach was as follows:

$$\mathrm{Y} = \begin{bmatrix} Y_1 \\ Y_2 \end{bmatrix} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots \beta_k X_k + \varepsilon$$

Where:
- Y is equal access, comprising equal service (Y_1) and equal treatment (Y_2)
- β_0 is the intercept, the expected value of Y when all predictors X are zero
- $\beta_1, \cdots, \beta_k$ measures the effect of the influence of the predictor variable X on the dependent variable
- $X_1, \cdots, X_k$ are the independent variables, in this case the barriers across the access dimensions as extracted with the EFA (detailed in section 4.2.2)
- ε is the error term capturing the unobserved factors not included in the model

The multivariate tests in this context are appropriate to first reveal the statistically significant barriers ($p < .05$) across the different types of access and to then compare their effect size. Bikos et al. (2018) use the multivariate GLM approach in their study on exploring digital divide dimensions and the effects of sociodemographic variables. Other studies that employ multivariate approaches in analysing access discrepancies that generate socio-digital inequalities focus primarily on the relationship between digital inclusion and sociodemographic features (Fuchs, 2008) and the interaction between social and digital capital (Ragnedda et al., 2022). Similarly, in their study, Serrano-Cinca et al. (2018) employed multivariate regression to explain the digital divide by identifying which sociodemographic and

socioeconomic factors influence the use of internet and digital public service, thus mapping the groups that are digitally excluded.

Hence, H3 adopts a methodological approach to explore equality of access, however with the conceptual shift of placing barriers at the core of the analysis. H3 is considered supported if at least one access barrier significantly influences equal service or equal treatment over the three settings, offline access, digital users, digital non-users, in the multivariate model. The analysis was conducted in the statistical software Jamovi (version 2.6.3).

3.3.5 Chi-square tests of independence

In addition to hypothesis testing, Chi-square (χ^2) tests of independence were conducted in for a broader understanding and distinguishing the profiles of users and non-users of digital public services. This differentiation is useful in discussing the impact of barriers between users and non-users in association with their sociodemographic and socioeconomic backgrounds.

The Chi-square (χ^2) test of independence is a non-parametric tool designed to analyse group differences where the dependent variable is measured at a nominal level (McHugh, 2013). The null hypothesis was that there is no relationship between the independent variables and dependent variable. The alternative hypothesis tested the associations between the sociodemographic and socioeconomic factors as independent variables and the use or non-use of digital public services as a dependent variable. Prior to conducting the tests, Variance Inflation Factor (VIF) values were examined to search for potential multicollinearity of independent variables. VIF values below 5 are considered acceptable to rule our multicollinearity among independent variables allowing for the test to be conducted (Kennedy, 2003). The analysis was conducted in the statistical software Jamovi (version 2.6.3).

4   RESULTS

This section presents the research results structured into two sub-sections: qualitative analysis and quantitative analysis. The qualitative analysis outlines the findings from the interviews based on the thematic analysis approach and hybrid reasoning. The identified themes and sub-themes are illustrated with supporting statements from the interviews. The results are displayed for the groups of offline users, non-users of digital public services (hereinafter digital non-users) and users of digital public services (hereinafter digital users). The qualitative findings have been previously published in Paneva and Bencina (2025).

The quantitative analysis presents the results from the administered survey. The quantitative analysis sub-section first displays the figures comparing the demographic and socioeconomic distribution of the national population and the survey sample, focusing on the variables included in the research. Subsequently, the results from the Exploratory Factor Analysis (EFA) and the Confirmatory Factor Analysis (CFA) are presented, including factor loadings and model fit indices. Finally, hypothesis testing results are showcased for offline users, digital non-users, and digital users in line with the groups defined with the questionnaire.

4.1 QUALITATIVE ANALYSIS RESULTS

The qualitative results presents the thematic analysis results across the three access settings, offline access, digital non-users, and digital users. The presentation of results follows the thematic analysis approach with displayed themes, sub-themes and supporting statements for each of the access dimensions.

4.1.1 Offline access thematic analysis results

Table 13 presents the themes and sub-themes identified across offline access dimensions. The examples illustrate encountered barriers, ideas for improvements, as well as positive experiences related to access to offline public services.

Table 13: Offline access thematic analysis results

Access framework/ Themes	Sub-themes	Supporting statements/examples
Availability	Inconsistent service hours	I waited for more than 45 minutes, not because of queues, but because the employee was not there [P1].
	Insufficient service counters	We should have more counters available, so we get the documents in a shorter time without facing crowds [P13].
Accessibility	Proximity and transportation issues	I usually reach the institutions with my own car; otherwise I need to pay for a taxi. There is no other option from our village [P9].
	Uncoordinated physical locations	We do not have a clear picture of where the needed offices are located. It feels like walking through labyrinths [P2].
Affordability	Unexpected Fees	I encountered increased administrative fees on-site without prior information [P3].
	Transportation costs	This is a big city and it costs a lot to reach the institutions. I either need to take the bus or drive and pay for parking [P8].
	Opportunity costs	If I am unable to get the service today due to crowds or queues, I have to return the next day. This means double the expenses and missing out on my daily work obligations [P15].
Accommodation	Complex procedures	We still have to go from counter to counter through complex procedures [P22].
	Delayed service delivery	At first, I could not manage to schedule an appointment. When I finally did, the scheduled time was not respected [P6].
	Queues and crowds	Most of the time, I face crowds and people not respecting the order in the queue [P5].
	Satisfied users	In general, I do not face any issues. So far, it is good [P12].
Acceptability	Inconsistent user support	User support depends on the employee's personality and their willingness to assist [P18].
	Favouritism and connections	People who know someone in the institutions have easier and faster access to services. The others have to wait [P23].

	Satisfied with user support	I was satisfied with the support from public employees and the procedural guidance I received [P25].
Awareness	Lack of procedural information	I needed some help and guidance to fill out the form, as the instructions were not quite clear [P23].
	Additional documents required	Sometimes it happens that I miss some 'hidden' document as part of the procedure without being informed in advance [P20].

Source: Paneva and Bencina, 2025

Accessing public services in-person, or offline access, is the common access channel utilised by all interviewed participants. Participants' statements revealed both common and specific barriers related to one's demographic profile or socioeconomic circumstances.

In terms of availability, some participants noted inconsistency in service hours, meaning encountering empty counters or offices when attempting to access the service during work hours [P1, P24]. Other participants faced queues and long waiting times, especially in periods of high demand for services tied with specific deadlines (e.g. personal documents, open calls for financial aid, agricultural subsidies, etc.) [P3, P7, P9, P13].

When sharing experiences on accessibility, proximity to institutions was pointed out by rural residents as one of the major obstacles to offline access to public services. Reaching institutions requires individuals living in rural areas to arrange their own transportation or pay for other transportation alternatives that sometimes exceed their budget [P10, P11, P14, P16]. On the other hand, their urban counterparts had expenses in reaching out institutions, especially in larger cities where institutions are scattered across multiple locations so there are costs to reach them, parking, and other related costs [P1, P2, P8, P21].

In the context of affordability, in addition to financial costs, some respondents also faced opportunity costs as accessing services in-person often took away time from their daily jobs or obligations [P13]. As potential suggestions to overcome these obstacles, respondents suggested centralised points of access to services at one place [P1, P2, P8] as well as mobile teams or dispersed centres operating in rural areas [P13, P15].

In reference to accommodation, nearly all respondents shared the same impression of long wait times to access the services, crowds and queues in front of counters and offices resulting in failing to meet appointments. Some respondents associated the user experience as "chaotic and disorganised" [P7]; "facing crowds" [P2, P16]; "pretty chaotic and crowds" [P18], or "waiting in queues" [P15, P17, P23]. One of the

most frequent suggestions from respondents was to implement a numbered ticketing system, a good practice from the private sector, as they have experienced in banks.

Regarding acceptability, or perceptions, attitudes, and support from service providers, some respondents experienced fair and professional treatment [P12, P21, P25], while others felt selective treatment based on personal connections or the good will of the public employee to assist [P7, P9, P18, P21]. As a potential enabler, to improve user experience and ensure equality in treatment of citizens, participant [P15] highlighted merits and professionalism over political affiliation in employing public officials:

> *"We need more professional employees in the institutions and fewer political party members. People must be employed based on quality and competences."* [P15]

This approach and suggestion is expected to bring about efficient and impartial relation of public employees resulting in efficient service delivery process.

Lastly, in terms of awareness, respondents shared common occurrence of not being fully informed on the administrative processes to access the service, which often resulted in requiring additional documents on the spot [P1, P20, P25]. To overcome these procedural burdens, respondents suggested transparent manner of spreading information through info-panels or posters at public institutions, and checklists of the required documents explaining step-by-step the procedure to get the service [P20, P25].

Part of the interview participants, shared positive sentiments towards accessing public services offline. They referred to the experience as getting the service in a "timely and efficient manner" [P19, P25], with "no encountered issues" [P12] and "professional support from service providers" [P12]. The positive experiences may stem from the specifics of smaller-size communities, where capacities of public institutions allow serving citizens in an efficient and convenient manner.

Overall, some respondents suggested and mentioned digital access and digital public services as the potential way out of the hardships with offline access [P1, P2, P5, P6]. However, the common concerns they brought up were also related to how and whether elderly generations and other groups of citizens that are not exposed on technology would function in the digital realm and how everyone would keep up with the developments [P1, P2, P4, P13].

4.1.2 Digital non-users thematic analysis results

Table 14 presents the identified sub-themes from the 15 respondents who had not accessed public services through digital access channels. Therefore, this group is named digital non-users. The aim of the interviews with non-users was exploring the reasons for not using digital public services and to explore enablers for potential future use. Similar to the example with offline access, the sub-themes are supported by respondents' statements related to specific access dimension. The identified sub-themes are accompanied by supporting statements to reflect their essence.

Table 14: Digital non-users thematic analysis results

Access framework/ Themes	Sub-themes	Supporting statements/examples
Availability	Unfamiliarity with available services	I am not informed about which public services are available in digital format [P13].
Accessibility	Internet connection	The internet in our village is of low quality. It goes down when you need it [P12].
Affordability	Internet and digital devices	We have internet at home, but I do not know how to use it. Also, I do not have a smart phone [P11].
Accommodation	Perceived complexity of services	I have not used digital public services, and I do not know how to do it. I think it is difficult [P10].
	Need for training and education	We need more training. As adults, we need to start from the very basics, like first-graders [P9].
	Lack of knowledge/skills	We have internet access and digital devices at home, but I do not know how to use them. I only use them with the help of my grandson [P16].
	Support from younger family members	
Acceptability	Perceived benefits	Accessing public services online would save me time and money, and it would be faster [P13].
	Trust and privacy concerns	I feel insecure. I do not use digital public services as I do not trust the process. Personal data can be misused, as we often witness nowadays [P7].
	Involuntary digital exclusion	Getting documents from the comfort of our home is better. I would prefer to do it online, but I do not

		know how to access the services [P11].
Awareness	Self-initiated information seeking	The information about available digital services is not widely public. You need to find it on your own [P24].
	Lack of ubiquitous information	I am not well-informed about electronically available services. I think institutions can do better to inform us through various media, messages, or campaigns [P22].

Source: Paneva and Bencina (2025)

Fifteen out of 25 respondents in the qualitative phase of the research had not accessed public services through digital channels. In terms of sociodemographics, three respondents live in urban areas and twelve in rural areas, their ages range from 41 to 69 years, eight are employed, two are unemployed, and five are retired (Paneva & Bencina, 2025). Education levels range from a few grades of primary school to a university degree (Paneva & Bencina, 2025).

In terms of material and physical aspects, or accessibility and affordability, all respondents shared having internet access and digital devices at home. The quality of internet connection was however reported to be unstable in rural areas [P12, P15, P22] although urban residents also emphasised the need for more stable and quality internet connection [P7, P18]. However, having the basic physical and material prerequisites did not guarantee internet usage. Namely, respondents shared that despite having access to the internet and digital devices, they were unable to use them primarily due to lack of specific skills and knowledge [P9, P10, P11, P16].

Therefore, in terms of accommodation, non-users stressed the need for more training and additional support to be able to utilise digital access channels. In the meantime, they ask help from younger family members or somebody from their surroundings [P12, P16, P17] or do not interact with the internet at all [P9, P10, P11]. In terms of general use, some of the respondents from this group were able to use the internet for simple tasks such as getting information, or reading the news [P7, P12, P17, P23], while others were able to pay bills or work online [P13, P18, P23].

Regarding acceptability and overall perceptions, all of the non-users acknowledged the benefits of accessing public services through digital channels. A present line throughout all interviews was the awareness of saving time, money, and resources and would prefer to access the service from the comfort of their home. However, the lack of skills and knowledge how to use digital access channels, left them no option but using offline services. In that regard, participant [P9] notes:

> *"I think using digital public services is good, but we do not know how to use them. So, our only choice for now is going to the counter in person."* [P9]

While being aware of the benefits, most of the non-users experience involuntary exclusion of using digital access channels, rather than resistance to use [P9, P10, P11, P12, P14, P15]. If they know how, they would use it. Another thing that makes them hesitant is the growing concern of personal data misuse online given the growing example they witness on internet frauds with personal data so need stronger cybersecurity measures [P7, P22, P24]. Still, some would continue at counter due to habit, or convenience. For younger respondents, insufficient information about digital public discourages their intention to use them [P22, P23, P24].

For non-users the dimensions of availability and awareness nearly overlap, as the lack of information limits their awareness of available digital public services. Therefore, they emphasise the need for widespread information, promotion, campaigns, training, and support [P8, P12, P17, P18, P22, P23]. While being aware of the benefits of digital access, involuntary digital exclusion persists due to lack of awareness, knowledge, and digital skills.

4.1.3 Digital users thematic analysis results

Table 15 presents the themes and sub-themes identified across digital access dimensions for users. The examples illustrate encountered barriers, potential enablers for optimising the user experience, as well as positive experiences related to access to digital public services.

Table 15: Digital users thematic analysis results

Access framework/ Themes	Sub-themes	Supporting statements/examples
Availability	Limited offer of available services	The current offer of digital public services is insufficient [P6].
Accessibility		
	Internet access	I can access the internet from a place that is convenient for me, whether at home, work, or anywhere else I go [P8].
	Technical system issues	Sometimes the portal system crashes, preventing me from completing the process and accessing the service [P19].
Affordability		
	Possession of digital devices	We have about ten digital devices at home and I mostly use laptop or a smart phone [P5].

	Internet fees	I have internet access at home and I am satisfied with the fee I pay for the quality and speed I receive [P25].
Accommodation	Complex service design	I spent nearly a day learning how to access digital public services and even asked friends and colleagues for help [P1].
	Positive experiences	The experience of accessing digital public services was quick, easy, and efficient. I got the document within 10 minutes [P20].
Acceptability		
	Perceived benefits	There are some great benefits to digital public services. First, you save time, and second, you save on transportation costs [P3].
	Trust and privacy concerns	I am a bit sceptical about sharing personal data online and unsure about the effectiveness of any specific software protection [P20].
	Recognition of documents	I am not sure whether all institutions will accept electronically issued documents [P21].
Awareness		
	Self-initiated information seeking	I am trying everything, looking for information, exploring available digital public services, and learning on my own. [P3]
	Lack of ubiquitous information	You learn on your own, because there is no official institution or organisation dedicated to sharing information about digital public services [P6].
	Reliance on personal networks	I gather information from institutional websites, colleagues, or friends [P5].

Source: Paneva and Bencina, 2025

Ten out of 25 participants in the qualitative phase of the research had accessed public services through digital channels. In terms of sociodemographics all users live in urban areas, they are employed, with higher education and between the ages of 26 and 46 years old (Paneva & Bencina, 2025).

In reference to physical and material aspects of digital access, related to accessibility and affordability, all respondents from the group of users reported having internet access at home, digital devices they personally own, as well as mobile internet allowing them ubiquitous access to digital public services from a location of their preference.

Regarding accommodation, experiences have been divided. Some users, despite being proficient internet users, assess the navigation at government's services portal as complex and confusing [P1, P8, P5]. However, other respondents found the

process easy, convenient, and expeditious [P3, P19, P20, P20] although some portal system crashes have been occasionally experienced [P19].

When it comes to accessibility, and users' attitudes and perceptions of digital public services, experiences were mainly positive. All users emphasised the time and cost savings as benefits of using digital public services. However, common concerns and scepticism were shared regarding the data safety and online protection, following recent cyber attacks and personal data misuse [P2, P3, P6, P8, P20]. Another administrative obstacle was encountering issues regarding acceptance of electronically issued documents by some institutions, although improvements were noted over time over time [P19, P21]. Addressing validity of documents is key for enhancing trust and the essence of the use of digital public services so they can be practically applied and used.

The access dimensions of availability and awareness often overlap, as limited information disables knowledge about the availability of digital public services. Most of the users emphasised their self-reliance in searching for information through websites, personal networks, or professional connections because information was not widespread and visible for wider public [P1, P4, P5, P8].

Other users, on the other hand, stated information is well spread through both online and traditional media [P25]. While opinions on available information and need for promotion vary, there is a growing emphasised need to support the groups of citizens who require additional assistance to use digital access channels [P1, P2, P20, P3, P5, P6, P21]. In that context, participant [P1] noted:

> "*If I face difficulties accessing public services online, while using the internet daily, I can only imagine how challenging it must feel for non-advanced users. I think customised ICT solutions should make access easier for everyone.*" [P1]

Overall, users perceive the current volume of digital public services as insufficient for effective digital transformation and wider usage [P6, P8]. Other users also feel the process is slow and being delayed on purpose [P2, P6, P18], reflecting a critical approach and higher expectations among respondents who have already accessed digital public services.

4.2. QUANTITATIVE ANALYSIS RESULTS

This section first presents the baseline information from the conducted survey, including the national population and survey sample distribution, descriptive statistics

of the basic digital indicators, followed by the results of the EFA and CFA analysis, hypothesis testing, and the Chi-square tests of independence.

4.2.1 National population and survey sample distribution

The 1KA application where the questionnaire was developed and made available, enables overview into the number of respondents who have entered the introduction of the survey (status 3), entered the first page (status 4), partially completed the survey (status 5), and completed the survey, (status 6). These metrics provide transparency and overview of everyone who interacted with the survey, indicating its overall outreach. For the purposes of this research, only the completed surveys with status (6) were retained for the analysis (Table 16).

Table 16: Survey completion status

Metric	Frequency
Completed (6)	453
Partially completed (5)	32
Total valid	485
Partially empty (5l)	2
Entered first page (4)	37
Entered intro (3)	337
Total invalid	376
Total surveyed	861
All units in database	861

Source: Own, based on 1KA data

A total of 453 participants completed the survey. However, due to privacy considerations, participants were given an option not to disclose any personal information they consider sensitive across any of the categories linked to their sociodemographic and socioeconomic background (Table 17).

Table 17: Descriptive statistics of survey participants

	Age	Gender	Education	Employment	Income	Disability	Ethnicity	Residence
N	452	452	450	439	419	449	452	451
Missing	1	1	3	14	34	4	1	2
Mean	2.79	1.49	2.89	1.75	2.33	1.91	1.54	1.41
Median	3	1	2	1	2	2	1	1
Standard deviation	1.37	0.500	1.23	1.06	1.21	0.285	1.23	0.492
Minimum	1	1	1	1	1	1	1	1
Maximum	5	2	6	4	5	2	7	2

Source: Own, based on 1KA data

The survey sampling approach was designed to closely correspond to the population's demographic and socioeconomic structure at the national level. This approach aims to reflect real-life cases from a small sample to the general population and to ensure the representativeness of different population groups as central to the focus of this dissertation. The sampling strategy included alignment across the key variables included in the research: gender, residence, employment, age, education, income level, ethnicity, and disability. The comparisons of the national and survey sample (Table 18) were made based on last census data provided by the State Statistical Office of North Macedonia (2022). Income level data on salaries and pensions were sourced from the Public Revenue Office (2024) and the Pension and Disability Insurance Fund of North Macedonia (2024), respectively. The shares in the categories employment status income level are reported in the narrative part since they are drawn from different reference groups and do not sum up to 100%.

Table 18: National population and survey sample distribution

Variable	Category	National sample (%)	Survey sample (%)	Survey sample frequency
Gender	Women	50.4%	51.1%	231
	Men	49.6%	48.9%	221
Residence	Urban	61.6%	59.0%	266
	Rural	38.4%	41.0%	185
Age	18-29	18.1%	23.2%	105
(18 or more)	30-39	17.1%	21.9%	99
	40-49	17.4%	21.0%	95
	50-64	25.8%	19.9%	90
	65 and older	21.5%	13.9%	63
Education	Primary education	27.8%	10.4%	47
	Secondary education	44.1%	41.6%	187
	Associate degree	n/a	5.3%	24
	BA degree	17.3%	35.1%	158
	MA degree	1.9%	6.7%	30
	PhD degree	0.4%	0.9%	4
	Other	8.5%	n/a	n/a
Disability	Yes	5.1%	8.9%	40
	No	94.8%	91.1%	409
Ethnicity	Macedonian	58.4%	70.9%	321
	Albanian	24.3%	22.3%	101
	Bosniak	0.9%	0.2%	1
	Roma	2.5%	1.3%	6
	Serb	1.3%	1.5%	7

Turk	3.9%	2.4%	11
Vlach	0.5%	1.1%	5
Other or unknown	7.2%	n/a	n/a

Source: Own survey sample data and State Statistical Office census data (2022)

In terms of gender, 51.1% of survey respondents were women and 48.9% were men. The gender distribution was closely aligned with the national sample where 50.4% are women and 49.6% are men. Regarding type of residence, 59.0% survey respondents were from urban areas and 41.0% from rural areas, closely approximating the national distribution of 61.6% urban and 38.4% rural residents. In terms of geographical distribution, the representativeness on a municipal level is 78.8% (63 out of the total 80 municipalities) aligned with the purpose of matching the urban-rural composition of the national population. The list of municipalities is presented in Annex 2.

The age groups in the survey sample were represented with a general tendency to reflect the national age distribution. However, younger age groups (18-29, 30-39, and 40-49) are somewhat overrepresented with discrepancies ranging between 4% and 5% compared to the national sample. On the other hand, elderly age groups (50-64; and 65 and above) are underrepresented with differences between 6% and 8%, compared to the national distribution in these categories. This occurrence is indicated in the limitations of this research to be considered for future studies.

In terms of highest level of education, individuals with completed primary education are a bit underrepresented in the survey sample (10.4%) compared to the national sample (27.8%), likely due to a higher representation of individuals with BA degree comprising 35.1% of the survey sample contrary to the 17.3% of the national sample. These proportions indicate a slight imbalance in educational levels although the survey design aimed to maintain overall balance across all demographic and socioeconomic variables included in the research.

Regarding employment status, the survey included the categories of employed, not employed, student, and retired. The proportions of employed and unemployed individuals at the national level are considered as economic categories in line with official statistics. The figures of students and retirees on the other hand, are presented as general demographic indicators, calculated as a percentage of the total population aged 18 and over to avoid overlap with the labour force categories as some students and retirees may also be working or actively looking for a job. According to official statistics of the State Statistical Office North Macedonia, the total working-age population in 2024 was 1,515,306 with an economic activity rate of 52.3%. The national employment rate was 45.8% while employed individuals

account for 62% of the survey sample. The unemployment rate at national level was 12.4%, somewhat underrepresented in the survey sample (9.7%). The group of students were somewhat overrepresented in the survey, comprising 11.2% of the sample, compared to the 3.6% at national level. Finally, there is also a slight discrepancy between the proportion of retirees in the survey sample (16.9%) compared to the national figure of 23.3%. The gaps in these categories may stem from the imbalance in the distribution of age groups, where younger age groups were overrepresented on the account of the older age groups.

The income level categories in the survey were divided into five ranges, including no regular monthly income, below minimum wage, between minimum and average wage, and above average wage to depict different circumstances. The survey sample took into account both salaries and pensions within the defined income ranges, whereas at the national level these data are reported separately. According to data provided by the Public Revenue Office to media outlets (2024), about 7% of employed individuals receive below minimum or minimum wage, about 60%-70% receives between minimum and average wage, and about 20%-30% receives above average wage. In terms of pensions, based on the Pension and Insurance Fund Data (2024), about 66% of retired individuals receive pension in the amount of below or equal to minimum wage, about 22% receive a pension between minimum and average wage, and about 12% receive pension in the amount above the average wage. As these data fluctuate on a monthly basis, the presented figures are provided only for comparison and orientation with the survey sample. Overall, the general pattern suggests that the largest proportion of employed individuals earns between the minimum and average wage, while among retired individuals the biggest proportion receives pensions at below minimum or equal to minimum wage. The survey sample covered 22.9% respondents with less than minimum wage, 48.4% receiving between minimum and average wage, 16.2% receiving above average wage, and 12.4% with no regular income to reflect possible economic disadvantage.

In terms of disability, 5.1% of citizens at the national level are registered as having some form of disability compared to the 8.8% in the survey sample. The distribution of ethnicities strived to closely reflect national proportions and resulted in overall balanced representation of different ethnicities with slight overrepresentation of the Macedonian population. Overall, the survey intended to mirror the national population sample as close as possible, however some acknowledged discrepancies remained.

4.2.2 Descriptive statistics of basic digital indicators

Based on the digital access model, comprising motivation, material access, digital skills, and use (Van Dijk, 2005), the questionnaire included section for gathering

insights of basic digital indicators. The gathered information referred to connection to the internet, possession of digital devices, self-assessment of digital skills, purpose of use of the internet, reasons for not using digital public services, available support, and preferred future use of public services. This approach provides an overview of respondents' available resources and capacities as prerequisites for digital access and highlights potential gaps or areas for improvement.

The first questions referred to access to the internet, as the technical prerequisite of use. The results (Figure 11) are disaggregated by urban and rural residence due to the disparities in digital infrastructure commonly observed between the two areas (Duanmu et al., 2025; Fu et al., 2024).

Figure 11: Home and mobile data internet connection in urban and rural areas
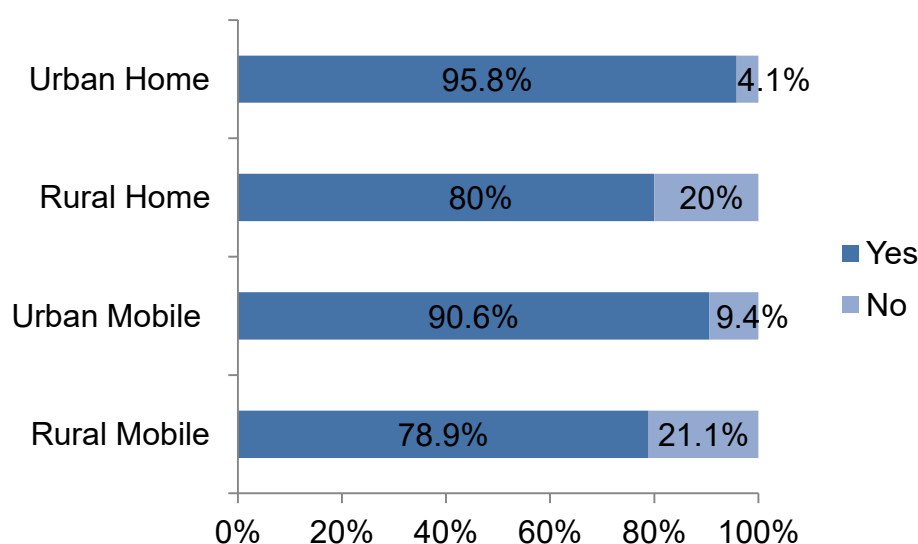

Source: Own

The survey responses revealed somewhat similar levels of internet connection in both urban and rural areas. Rural residents however lag behind their urban counterparts for both home (80% in rural areas compared to 95.8% in urban areas) and mobile data internet connection (78.9% in rural areas and 90.6% in urban areas). The proportions of residents not having internet connection is also greater in rural areas, 20% of rural residents reported not having an internet connection at home and 21.1% of rural residents do not have mobile data internet connection. The gap within urban areas is somewhat narrower, with 4.1% of respondents reporting not having internet connection at home and 9.4% not having mobile data internet connection. This indicates that residents in rural areas are at higher risk of being left behind, as internet access gaps are greater compared to those within urban areas. However, internet connection as a mere technical resource is not sufficient. The qualitative aspects of internet connection and its performance features are as equally important to achieve effective use of the internet. Therefore, the existing differences

in bandwidth capacity, the generation of internet technology (e.g. 4G, 5G, or emerging next-generation technologies) and the quality and stability of internet connection also impact the user experience and the extent of internet use (Helsper, 2021). These nuances of quality of internet connection are explored through the interviews within this research.

Alongside internet connection, the possession of digital devices represents a basic technical prerequisites to access the internet. The survey offered multiple options for respondents to select the types of digital devices they own or have at their home.

**Figure 12: Possession of digital devices**

Source: Own
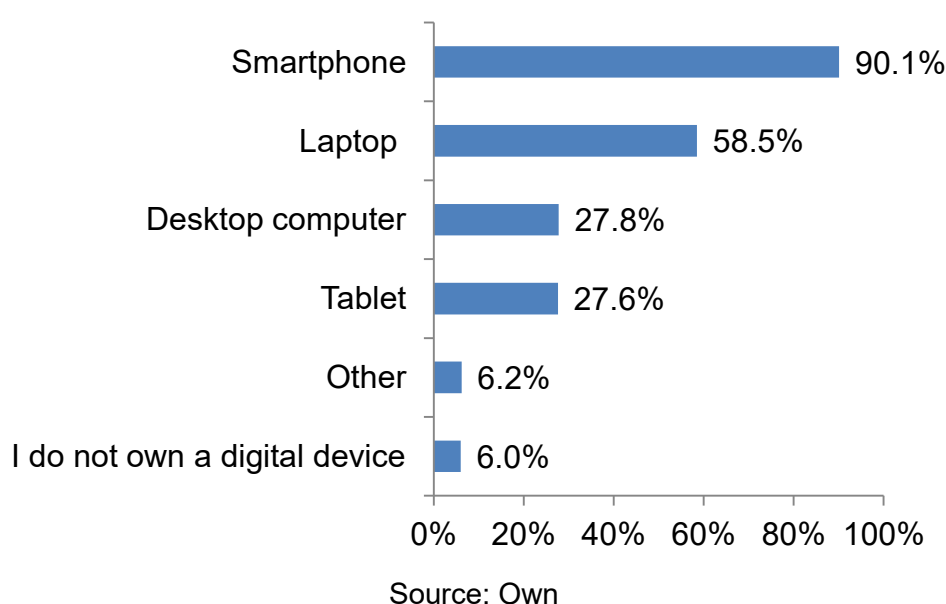
The survey results (Figure 12) show that about 90% of respondents have a smartphone, followed by laptop (58.5%), desktop computer (27.8%) and tablet (27.6%). Similar to the internet connection, the type of device, its performances, and regular maintenance influence the opportunities to be able to use the internet for public participation, including access to public services. Overall, the technical prerequisites, being connected to the internet and having a digital device are at a satisfactory level among survey participants, with about 80-90% being connected to the internet and 90% having at least one digital device.

After securing material connection, the successive stage in digital access is having a specific level of digital skills to be able to achieve meaningful use of the internet (Hargittai, 2002; Van Dijk, 2005). The survey included digital skills self-assessment question, offering the options of independent user; mostly independent user who needs support for complex content; basic user who primarily relies on support of others to be able to use the internet; and not using the internet.

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The results (Figure 13) show that 56.7% respondents self-assessed their skills as being independent users; 19.9% of them are mostly independent with support needed for complex content; 16.1% mostly rely on others to be able to use the internet, and 7.3% do not use the internet at all. When needing assistance, most respondents rely on family members as the primary source of support, followed by friends, neighbors, and work colleagues in the respective order. The role of civil society organsations and public institutions is not recognised or utilised by respondents as potential sources of support. A few respondents do not have anyone to turn to when needing support to use the internet.

Figure 13: Digital skills self-assessment
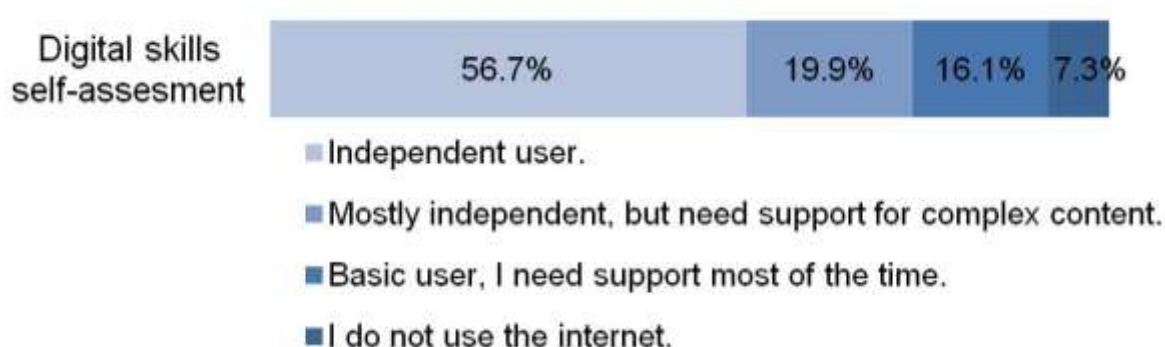
Source: Own

Self-assessment of skills is the most commonly used method to investigate levels of digital skills; however, to avoid underrating or overrating of the possessed skills, performance tests in controlled environments may yield more precise results for tailoring specific policies accordingly (Van Deursen & Van Dijk, 2014).

The purpose of internet use is another indicator of the practical application of digital skills. The results (Figure 14) show that most of the survey participants use the internet for the purposes of networking through social media (83.9%), communication (80.8%), or entertainment and leisure time activities (72.4%). The internet use for more functional purposes is notably lower and drops roughly by half, ranging from 38.4% to 45.0% for the purposes of paying bills online, employment opportunities, e-shopping, e-banking, and studying opportunities, in descending order. Using the internet to interact with public institutions is at the bottom of the list, with only 17.2% of respondents using digital channels for this purpose.

Figure 14: Purpose of internet use

Purpose	Percentage
Social media	83.9%
Internet video or voice calls	80.8%
Leisure time activities	72.4%
Online bills payment	45.0%
Employment opportunities	43.9%
e-shopping	43.5%
e-banking	39.3%
Studying opportunities	38.4%
Interacting with institutions	17.2%
I do not use the internet	8.6%
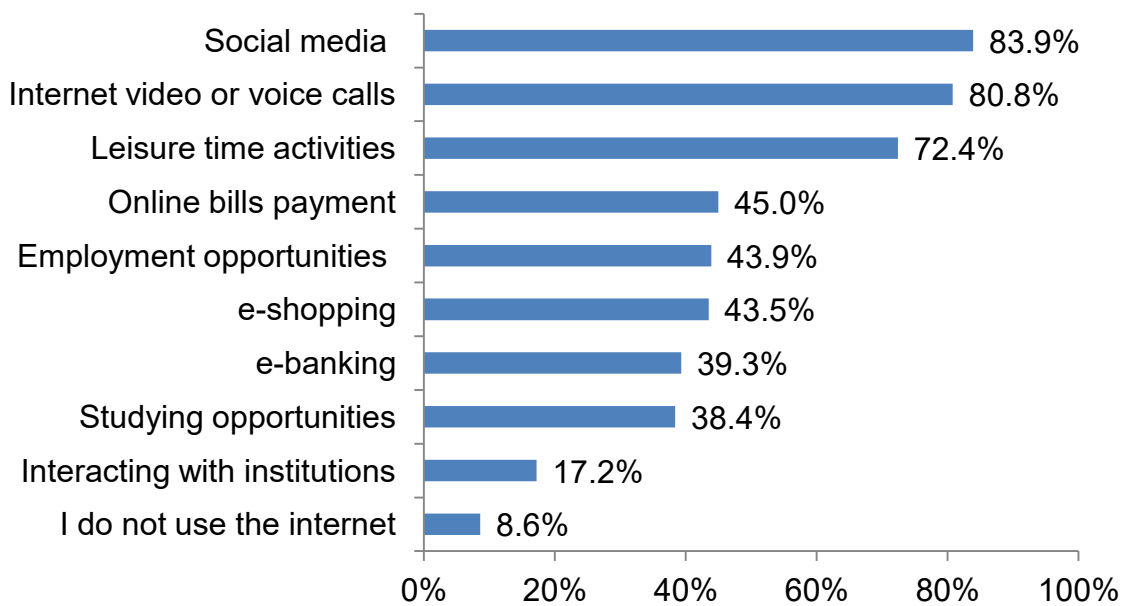
Source: Own

The purpose of internet use is very meaningful to assess what the individual is able to do on the internet once the material and skills prerequisites have been obtained (Helsper, 2021; Van Dijk, 2020). The results (Figure 14) show that while the internet is largely used for the purposes of networking, communication, and entertainment, using the internet for more functional purposes and especially for interaction with public institutions significantly lags behind. This trend also indicates that using internet applications is not unknown for most of the respondents; however, using the internet for public participation purposes needs to be encouraged or made as accessible as the applications they use for day-to-day communication.

To find more about digital public services use, the respondents were asked whether they have utilised the National e-Services Portal or any of the public institutions' portals to submit a request or obtain a document through digital channels.

Figure 15: Digital public services use
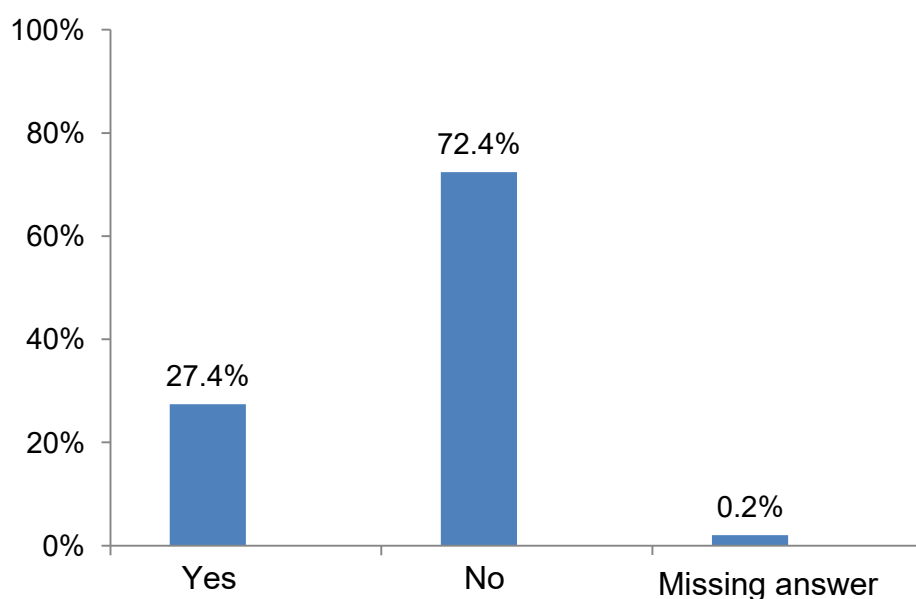
The results (Figure 15) show that almost three quarters (72.4%) of respondents have not used digital public services, while 27.4% have utilised this option. To better understand the causes behind this occurrence, Figure 16 presents the most common reasons for not using digital public services as expressed by survey respondents.

Figure 16: Reasons for not using digital public services
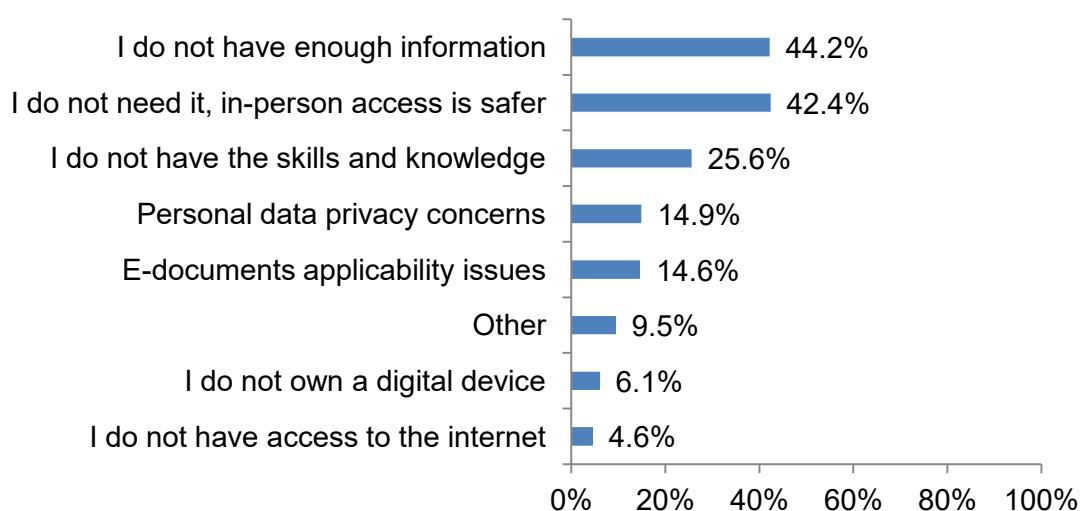
Nearly half of the respondents pointed out to not having enough information as the main reason for not using digital public services (44.2%), followed closely by the perception that in-person access is safer and digital public services are not needed

(42.4%). Hence, the ambiguity and the absence of information may contribute to lower awareness and result in lack of motivation to use digital public services. About one-fourth of the respondents (25.6%) shared they do not have the skills and knowledge needed to use digital public services. Personal data privacy concerns and issues with practical application of the electronically issued documents were reported at similar levels, accounting for 14.9% and 14.6% of respondents respectively. The lack of technical prerequisites was the least common reason for not using digital public services, with 6.1% not owning a digital device and 4.6% not having access to the internet.

Other reasons, as indicated by respondents, included lack of trust in digital access channels, low availability of digital public services, complex registration and navigation at digital services portals, and the habit to go in-person at the counter along with the perception that in-person processes are faster.

The question about preferred access channel for future use yielded interesting results, as no single option was strongly preferred by respondents. The answers were almost evenly spread across the three options (Figure 17), with about one-third of respondents preferring in-person access, another third choosing digital access, and the remaining third indicating that it depends on the type of service. Respondents prefer in-person access primarily due to habit, while digital access is recognised as an opportunity to save time, money, and resources.

Figure 17: Preferred access channel for future use
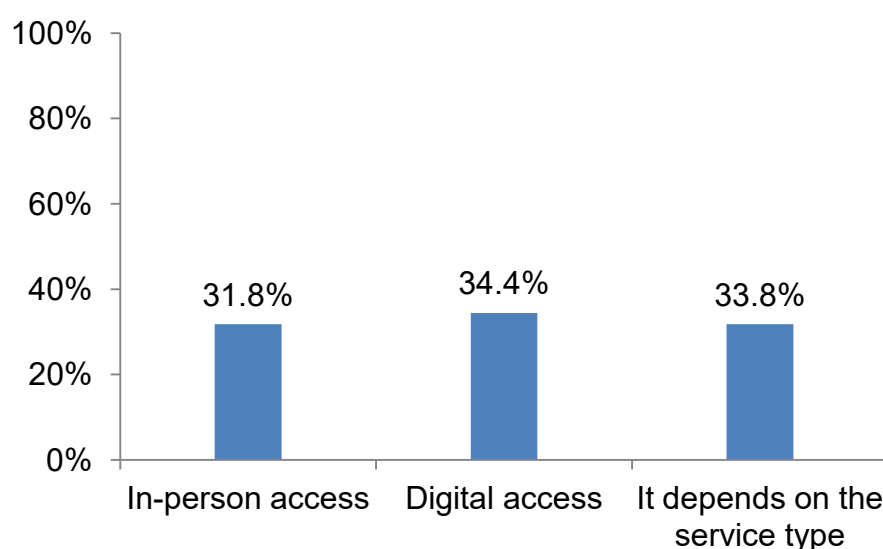
Source: Own

In addition, most of the general comments at the end of the survey also referred to the aspects of digital trust and the shared concerns regarding potential frauds on the

internet that makes respondents reluctant to use digital public services. The need of further promotion was also emphasised, by suggesting promotion channels similar to those used by private entities to advertise their services which could increase the visibility of digital public services. Sharing good practices is also necessary, as some respondents tried to use these services but the functionality features and the overall experience did not meet their expectations. Considering that the effective use of services is the actual proof of access, some additional measures and activities are needed to encourage use given the low level of utilisation of digital public services.

4.2.3 Exploratory factor analysis (EFA) and Confirmatory Factor Analysis (CFA) results

The tables in continuation present the results from the Exploratory Factor Analysis (EFA) and the Confirmatory Factor Analysis (CFA). The presentation of the results is organised according to the conceptual model comprising barriers to access within the dimensions of accessibility, affordability, accommodation, and acceptability; and equal access defined through the dimensions of equal treatment and equal service (detailed in Figure 7, section 2.3). The results are presented according to the three settings of public services access: offline access, referring to experiences of users accessing public services in person, digital access non-users (hereinafter digital non-users), and digital access users (hereinafter digital users). In each setting, the first part presents the EFA procedures, including assumption tests for factor analysis, factor statistics, and factor loadings; while the final part presents the CFA results corresponding to the respective EFA procedures for both barriers and equal access.

Table 19: Offline access barriers factor model – assumption tests

Test	Overall score	Purpose
Cronbach's alpha	0.752	Internal consistency
KMO	0.724	Sample adequacy
Bartlett's Test of Sphericity	χ^2 = 1935, df = 66, p < .001	Collinearity of variables

Source: Own

Table 19 presents the results of Cronbach's alpha (α = 0.752) indicating acceptable internal consistency of the offline model. The KMO test yielded an overall value of 0.724, suggesting good sampling adequacy for conducting factor analysis (Hair et al., 2006). The significant value of Bartlett's Test of Sphericity (p < .001) and the Chi-square test result (χ^2 = 1935) demonstrate the sufficient correlation among the variables, further supporting the suitability for performing factor analysis. The extracted factors were assessed based on the amount of variance explained by each factor (Table 20).

Table 20: Offline access barriers factor model - factor statistics

Factor	SS Loadings	% of Variance	Cumulative %
1	1.76	14.70	14.7
2	1.65	13.78	28.5
3	1.62	13.51	42
4	1.46	12.15	54.1
5	1.06	8.80	62.9

Source: Own

The factor extraction followed the criteria of eigenvalue and cumulative percentage of variance (Williams et al., 2010). The SS loadings (column 2) show that factors' eigenvalues are greater than 1, hence retained in the analysis (Williams et al., 2010). The percentage of variance (column 3) presents the overall contribution of each factor to the explained variance. The cumulative percentage (column 4) shows the total variance after each factor is included, accounting for 62.9% which is within the commonly accepted threshold of 50%-60% in social sciences (Williams et al., 2010).

Table 21: Offline access barriers factor model – factor loadings

| | Factor | | | | | Uniqueness |
	1	2	3	4	5	
Access_4b	0.775					0.30953
Access_4c	0.657					0.46561
Access_4a	0.644					0.54811
Access_2e_r		0.930				0.11538
Access_2d_r		0.597				0.61960
Access_2b_r		0.545				0.68397
Access_b			0.994			0.00500
Access_a			0.780			0.36548
Access_d				0.973		0.00500
Access_e				0.612		0.53001
Access_3e	0.333				0.681	0.36637
Access_3b	0.337				0.622	0.43393

Source: Own

Note. 'Maximum likelihood' extraction method was used in combination with a 'varimax' rotation

As shown in Table 21 the EFA for the offline access barriers model extracted five factors. The first factor measures Acceptability (Access_4b, Access_4c, Access_4a). The second factor measures Affordability Proximity (Access_2e_r, Access_2d_r, Access_2b_r). The third factor measures Accessibility Proximity (Access_b,

Access_a). The fourth factor measures Accessibility Physical, (Access_d, Access_e). The fifth factor measures Accommodation (Access_3e, Access_3b). The grouping and naming of the factors was made in line with the EFA implementation steps (Taderhoost et al., 2014). The items Access_c, Access_2c_r, Access_3a, Access_3c, Access_3d, Access_4d, and Access_4e, were omitted due to loading below 0.30 or crossloadings (detailed in Annex 3). Confirmatory Factor Analysis (CFA) was conducted to test the adequacy and model fit of the extracted factor structure (Table 22).

Table 22: Offline access barriers factor model - CFA model fit measures

				RMSEA 90% CI			
CFI	TLI	SRMR	RMSEA	Lower	Upper	AIC	BIC
0.982	0.973	0.0376	0.0413	0.0258	0.0561	14923	15112

Source: Own

In the case of the offline access barriers model (Table 22), the CFI (0.982), TLI (0.973), SRMR (0.0376), and RMSEA (0.0413) values indicate good model fit and fall within the acceptable thresholds, confirming the factor structure exctracted from the EFA.

Table 23: Offline equal access factor model - assumption tests

Test	Overall score	Purpose
Cronbach's alpha	0.850	Internal consistency
KMO	0.750	Sample adequacy
Bartlett's Test of Sphericity	χ^2 = 1269, df = 10, p < .001	Collinearity of variables

Source: Own

Table 23 presents the assumption test results for the equal access offline model. The Cronbach's alpha (α = 0.850) confirms solid reliability and good internal consistency of the model. The KMO value of 0.750 indicates good sampling adequacy for performing factor analysis. The Bartlett's Test of Sphericity is significant (p < .001) indicates the matrix is not identity matrix and the EFA can proceed. Table 24 presents the factor statistics for the offline equal access model.

Table 24: Offline equal access factor model – factor statistics

Factor	SS Loadings	% of Variance	Cumulative %
1	2.08	41.6	41.6
2	1.53	30.6	72.3

Source: Own

The SS loadings, eigenvalues are greater than 1, meaning they can be kept in the analysis. The cumulative variance explained by the factors is 72.3% which is considered sufficient and exceeds the commonly accepted threshold of 50%-60% in social science research (Williams et al., 2010). Table 25 presents the factor loadings for the equal access offline model.

Table 25: Offline equal access factor model – factor loadings

	Factor		
	1	**2**	**Uniqueness**
Q3f	0.901		0.125
Q3e	0.884		0.162
Q3d	0.580	0.379	0.520
Q3a		0.892	0.170
Q3b	0.343	0.687	0.411

Source: Own

Note. 'Maximum likelihood' extraction method was used in combination with a 'varimax' rotation

The EFA for the equal access offline model extracted two factors. The first factor measures Equal Service (Q3f, Q3e, and Q3d) and the second factor measures Equal Treatment (Q3a and 3b). The item Q3c was removed due to crossloading between the two factors with a difference less than 0.20. The CFA results are presented in Table 26.

Table 26: Offline equal access factor model - CFA Model Fit Measures

				RMSEA 90% CI			
CFI	TLI	SRMR	RMSEA	Lower	Upper	AIC	BIC
0.979	0.948	0.0433	0.1210	0.0827	0.1620	5345	5411

Source: Own

In the case of the equal access offline model, the CFI (0.979), TLI (0.948), and SRMR (0.0433) values fall within the commonly accepted thresholds and indicate a

good model fit. The RMSEA value (0.1210) however, exceeds the recommended cut-off values (< 0.10) suggesting space for model refinement. The decision to retain the model is based on the combined values of the CFI, TLI, and SRMR indices, which demonstrate a good model fit, while considering the sensitivity of RMSEA to model complexity and sample size (Kenny et al., 2015; Shi et al., 2019).

The EFA and CFA results for digital non-users are presented in continuation. The first part presents the process of factors extraction for the access barriers model, followed by equal access.

Table 27: Digital non-users barriers factor model - assumption tests

Test	Overall score	Purpose
Cronbach's alpha	0.848	Internal consistency
KMO	0.802	Sample adequacy
Bartlett's Test of Sphericity	$\chi^2 = 2012$, $df = 120$, $p < .001$	Collinearity of variables

Source: Own

Table 27 presents the results of Cronbach's alpha for the digital non-users model (α = 0.848) indicating solid internal consistency of the model. The KMO test yielded an overall value of 0.802, suggesting good sampling adequacy for conducting factor analysis (Hair et al., 2006). The significant value of Bartlett's Test of Sphericity (p < .001) demonstrates sufficient correlation among the variables, further supporting the suitability for performing factor analysis.

Table 28: Digital non-users barriers factor model - factor statistics

Factor	SS Loadings	% of Variance	Cumulative %
1	2.57	16.08	16.1
2	2.42	15.13	31.2
3	1.72	10.76	42.0
4	1.70	10.60	52.6
5	1.27	7.92	60.5

Source: Own

Table 28 shows that the eigenvalues are greater than 1 (column 2) meaning they can be kept in the analysis. The cumulative variance explained by the factors is 60.5% (column 4) which is acceptable in reference to the commonly accepted threshold of 50%-60% in social science research (Williams et al., 2010). Table 31 presents the factor loadings for the digital non-users model.

Table 29: Digital non-users barriers factor model - factor loadings

| | Factor | | | | | |
	1	2	3	4	5	Uniqueness
Accomm_d	0.903					0.13461
Accomm_e	0.745					0.40212
Accomm_c	0.704					0.44896
Accomm_a	0.616					0.43846
Afford_d		0.790				0.32562
Afford_e		0.670				0.41685
Afford_b		0.640				0.47670
Afford_a		0.623				0.50550
Afford_c		0.528				0.71729
Accessibil_e			0.981			0.00500
Accessibil_d			0.756			0.33810
Accessibil_b				0.965		0.00500
Accessibil_c				0.583		0.55510
Accessibil_a				0.424		0.67742
Acceptabil_b					0.726	0.36960
Acceptabil_c					0.634	0.50708

Source: Own

Note. 'Maximum likelihood' extraction method was used in combination with a 'varimax' rotation

The EFA for the digital non-users model extracted five factors. The first factor measures Accommodation (Accomm_d, Accomm_e, Accomm). The second factor measures Affordability (Afford_d, Afford_e, Afford_b, Afford_a, Afford_c). The third factor measures Accessibility Public (Accessibil_e, Accessibil_d). The fourth factor measures Accessibility (Accessibil_b, Accessibil_c, Accessibil_a). The fifth factor measures Acceptability (Acceptabil_b, Acceptabil_c). The grouping and naming of the factors was made in line with the EFA implementation steps (Taderhoost et al., 2014). The items Accomm_b, Acceptabil_a, Acceptabil_d, and Acceptabil_e, were omitted from the analysis due to loading below the threshold of 0.3 or crossloadings between factors (detailed in Annex 3).

Table 30: Digital non-users barriers factor model - CFA model fit measures

| | | | | RMSEA 90% CI | | | |
CFI	TLI	SRMR	RMSEA	Lower	Upper	AIC	BIC
0.918	0.895	0.0704	0.062	0.0525	0.0717	12031	12265

Source: Own

Table 30 shows the CFA parameters for the digital non-users barriers model. The CFI (0.918), SRMR (0.0376), and RMSEA (0.0413) values fall within the acceptable thresholds, while the TLI value (0.895) falls slightly below the conventional cut-off of 0.90. The combined values of the CFI, SRMR, and RMSEA indicate an overall good model fit, taking into account that the TLI is sensitive to model complexity (Fan & Sivo, 2007).

Table 31: Digital non-users equal access factor model – assumption tests

Test	Overall score	Purpose
Cronbach's alpha	0.858	Internal consistency
KMO	0.700	Sample adequacy
Bartlett's Test of Sphericity	$\chi^2 = 847$, $df = 10$, $p < .001$	Collinearity of variables

Source: Own

Table 31 presents the assumption tests results for the equal access digital non-users model. The Cronbach's alpha ($\alpha = 0.858$) indicates solid internal consistency of the model. The KMO test yielded an overall value of 0.685, suggesting good sampling adequacy for conducting factor analysis (Hair et al., 2006). The significant value of Bartlett's Test of Sphericity ($p < .001$) demonstrate sufficient correlation among the variables, further supporting the suitability for performing factor analysis.

Table 32: Digital non-users equal access factor model - factor statistics

Factor	SS Loadings	% of Variance	Cumulative %
1	1.92	38.4	38.4
2	1.80	36.0	74.4

Source: Own

The eigenvalues (Table 32, column 2) are greater than 1 meaning they can be kept in the analysis. The cumulative variance explained by the factors is 74.84% which is acceptable considering the commonly accepted threshold of 50%-60% in social science research (Williams et al., 2010). Table 33 presents the factor loadings for the equal access digital non-users model.

Table 33: Digital non-users equal access factor model - factor loadings

	Factor 1	Factor 2	Uniqueness
Equalacces_2b	0.970		0.00849
Equalacces_2a	0.732		0.41336
Equalacces_2d	0.524	0.349	0.60362
Equalacces_2f		0.968	0.00500
Equalacces_2g	0.330	0.801	0.25012

Source: Own

Note. 'Maximum likelihood' extraction method was used in combination with a 'varimax' rotation

The EFA extracted two factors. The first factor measures Equal Service (Equalacces_2b, Equalacces_2a, and Equalacces_2d). The items Equalacces_2c and Equalacces_2e were omitted due to loading below 0.30 or crossloadings higher than 0.20 between two factors (detailed in Annex 3). The item Equalacces_2d, that crossloads between the two factors with a difference less than 0.20 was retained in the model due to the conceptual meaning of the item. Table 34 presents the CFA results for the equal access digital users model.

Table 34: Digital non-users equal access factor model - CFA model fit measures

CFI	TLI	SRMR	RMSEA	RMSEA 90% CI Lower	RMSEA 90% CI Upper	AIC	BIC
0.976	0.940	0.043	0.133	0.085	0.186	2960	3019

Source: Own

The CFI (0.976), TLI (0.940), and SRMR (0.043) values indicate an overall good model fit. The RMSEA value (0.133) however exceeds the conventional thresholds of RMSEA < 0.10 that may be a result of the RMSEA sensitivity to sample size (Kenny et al., 2015; Shi et al., 2019). The decision to keep the model was made based on the combined acceptable values of the CFI, TLI, and SRMR indices.

The presentation of results for the digital users follows the structure of the previous offline access and digital users models. The results present defining of barriers and equal access for the digital users users model.

Table 35: Digital users barriers factor model – assumption tests

Test	Overall score	Purpose
Cronbach's alpha	0.837	Internal consistency
KMO	0.737	Sample adequacy
Bartlett's Test of Sphericity	$\chi^2 = 777$, $df = 120$, $p < .001$	Collinearity of variables

Source: Own

The Cronbach's alpha for the digital non-users model ($\alpha = 0.837$) confirms solid reliability and good internal consistency of the model. The KMO value of 0.737 indicates good sampling adequacy for performing factor analysis. The Bartlett's Test of Sphericity is significant ($p < .001$) indicating the matrix is not identity matrix and the EFA can be conducted further. Table 36 presents the factor statistics for the model.

Table 36: Digital users barriers factor model – factor statistics

Factor	SS Loadings	% of Variance	Cumulative %
1	2.01	12.57	12.6
2	1.93	12.08	24.6
3	1.91	11.96	36.6
4	1.84	11.53	48.1
5	1.59	9.96	58.1

Source: Own

The SS loadings, eigenvalues are greater than 1 (column 2), meaning they can be kept in the analysis. The cumulative variance (column 4) explained by the factors is 58.1% which is within the acceptable range for social science research (Williams et al., 2010). Table 37 presents the factor loadings for the digital users model.

Table 37: Digital users barriers factor model – factor loadings

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Uniqueness
Accessibil_b	0.982					0.00499
Accessibil_c	0.736					0.43756
Accessibil_a	0.618					0.51609
Acceptab_b		0.832				0.23617
Acceptab_c		0.794				0.26009
Acceptab_a		0.543				0.6396
Accommod_a			0.772			0.36435
Accommod_b			0.619			0.51433
Accommod_d			0.601			0.60184
Accommod_c			0.518			0.59235
Afford_d				0.816		0.30188
Afford_e				0.641		0.48863
Afford_c				0.622		0.59182
Afford_b				0.436		0.63736
Accessibil_d					0.935	0.05015
Accessibil_e					0.686	0.46897

Source: Own

Note. 'Maximum likelihood' extraction method was used in combination with a 'varimax' rotation

The EFA for the digital users model extracted five factors (Table 39). The first factor measures Accessibility (Accessibil_b, Accessibil_c, Accessibil_a). The second factor measures Acceptability (Acceptab_b, Acceptab_c, Acceptab_a). The third factor measures Accommodation (Accommod_a, Accommod_b, Accommod_d, Accommod_c). The fourth factor measures Affordability (Afford_d, Afford_e, Afford_c, Afford_b). The fifth factor measures Accessibility Public (Accessibil_d, Accessibil_e). The items Afford_a, Accommod_e, Acceptab_d, and Acceptab_e, were omitted from the analysis as they all loaded below the threshold of 0.3 (detailed in Annex 3). Table 38 presents the CFA results for the digital users barriers model.

Table 38: Digital users barriers factor model - CFA model fit measures

CFI	TLI	SRMR	RMSEA	RMSEA 90% CI Lower	RMSEA 90% CI Upper	AIC	BIC
0.938	0.921	0.0663	0.0511	0.0409	0.0612	11359	11592

Source: Own

The CFI (0.938), TLI (0.921), SRMR (0.0663), and RMSEA (0.0511) values for the digital users model (Table 38) fall within the acceptable thresholds and indicate an overall good model fit. These results suggest that the CFA provides support for the factor structure extracted from the EFA.

Table 39: Digital users equal access factor model - assumption tests

Test	Overall score	Purpose
Cronbach's alpha	0.765	Internal consistency
KMO	0.622	Sample adequacy
Bartlett's Test of Sphericity	$\chi^2 = 199$, $df = 10$, $p < .001$	Collinearity of variables

Source: Own

The Cronbach's alpha ($\alpha = 0.845$) confirms solid reliability and good internal consistency of the equal access digital non-users model (Table 39). The KMO value of 0.622 indicates borderline acceptable sampling adequacy for performing factor analysis. The Bartlett's Test of Sphericity is significant ($p < .001$) suggesting the matrix is not identity matrix and the EFA can be conducted further.

Table 40: Digital users equal access factor model - factor statistics

Factor	SS Loadings	% of Variance	Cumulative %
1	1.67	33.3	33.3
2	1.50	30.0	63.3

Source: Own

Table 40 presents the factor statistics where the eigenvalues are greater than 1 (column 2), meaning they can be kept in the analysis. The cumulative variance explained by the factors is 63.3%, somewhat above the commonly accepted threshold of 50%-60% in social sciences (Williams et al., 2010).

Table 41: Digital users equal access factor model - factor loadings

	Factor		
	1	2	Uniqueness
Q7e	0.940		0.11201
Q7d	0.678		0.47435
Q7a	0.490		0.68917
Q7f		0.985	0.00500
Q7g		0.623	0.55290

Source: Own

Table 41 presents the factors structure of the equal access digital users model. The EFA extracted two factors. The first factor (Q7e, Q7d, Q7a) measures Equal Service, and the second factor (Q7f, Q7g) measures Equal Treatment. The items Q7b and Q7c were omitted from the analysis as they loaded below 0.30 or crossloaded between factors (detailed in Annex 3). Table 42 presents the CFA results for the equal access digital non-users model.

Table 42: Digital users equal access factor model – CFA model fit measures

				RMSEA 90% CI			
CFI	TLI	SRMR	RMSEA	Lower	Upper	AIC	BIC
0.941	0.852	0.0422	0.156	0.0813	0.238	1457	1502

Source: Own

The CFI (0.941) and SRMR (0.0422) values for the equal access digital users model (Table 44) fall within the acceptable ranges, indicating a good overall model fit. The TLI (0.852) and RMSEA (0.156) values do not fall within the conventionally acceptable ranges, indicating space for model refinements. The decision to retain the model was based on the CFI and SRMR values, while considering the sensitivity of the TLI and RMSEA indices to sample sizes and model complexity (Fan & Sivo, 2007; Kenny et al., 2015).

4.3 HYPOTHESIS TESTING RESULTS

The next section presents the hypothesis testing results of the three hypotheses included in the research. Hypothesis testing procedures comprise of assumption tests, calculating overall model fit, followed by presentation of regression results and outlining the contextual meaning of the results. The first hypothesis (H1) is tested with univariate GLM, the second hypothesis (H2) is tested with binary logistic regression, and the third hypothesis (H3) is tested with multivariate GLM.

4.3.1 First hypothesis (H1): univariate GLM regression results

H1*: Sociodemographic and socioeconomic factors influence the incidence of barriers in offline and digital access to public services.*

The first hypothesis (H1) tests the relationship of sociodemographic and socioeconomic factors on the formation of access barriers. The hypothesis is tested across the three access settings, offline access, digital non-users, and digital users, and the dependent variables correspond to the dimensions of the barriers extracted by EFA modelling: five dependent variables for offline access, five dependent

variables for digital non-users, and five dependent variables for the digital users (detailed in section 4.2.3). For each setting, assumptions for homogeneity and normality of residuals are tested along with multicollinearity diagnostics using VIF. The hypothesis is considered supported if, within each setting at least one independent variable displays a statistically significant influence on the dependent variable.

Assumption checks for homogeneity were conducted using the Breusch-Pagan Test and Levene's Test. Normality of residuals was assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests. The tests for the five dimensions of offline access showed the following results:

- Acceptability – Assumption tests were non-significant ($p > 0.05$), except in the case of the Shapiro–Wilk test ($p = .016$) pointing to potential deviation from normality.
- Affordability – All assumption tests were non-significant ($p > .05$) except in the case of the Shapiro–Wilk test ($p = .011$) indicating a potential non-normal distribution of data.
- Accessibility Proximity – Assumption tests were non-significant ($p > .05$), except in the case of the Levene's test ($p = .001$) which suggests potential deviation from the assumption of homogeneity of variance; and in the case of the Shapiro-Wilk test ($p < .001$) indicating deviation from normality.
- Accessibility Physical – Assumption tests were significant indicating potential violations of normality and homogeneity of variances.
- Accommodation – Assumption tests were non-significant ($p > .05$), except in the case of the Levene's test ($p = .034$) suggesting potential heteroscedasticity.

Some deviations were expected due to the sensitivity of assumption tests to sample sizes and considering that the conceptual model is being tested for the first time in a specific local context, as in the case of this research. Q-Q plots showed that the data is approximately normally distributed, with some minor data points scattered near the line. The VIF collinearity diagnostics resulted in values below 5 for all variables, indicating multicollinearity is not an issue (Annex 4). The results of the overall model fit are presented in Table 43.

Table 43: Offline access – model fit

	R²	Adj. R²	*df*	*df* (res)	*F*	*p*
Acceptability	0.189	0.138	24	380	3.70	<.001
Affordability	0.172	0.120	24	380	3.30	<.001
Accessibility Proximity	0.477	0.444	24	380	14.40	<.001
Accessibility Physical	0.081	0.022	24	380	1.39	0.108
Accommodation	0.089	0.032	24	380	1.55	0.049

Source: Own

As shown in Table 43, four of five regression models of offline access are statistically significant. Acceptability (F = 3.70, p < .001), Affordability (F = 3.30, p < .001), Accessibility Proximity (F = 14.40, p < .001), and Accommodation (F = 1.55, p = .049) models are statistically significant meaning that the independent variables are moderate to strong determinants of dependent variables. The Acceptability model explains 18.9% of variance (R^2 = 0.189, adjusted R^2 = 0.138); Affordability model explains 17.2% of the variance (R^2 = 0.172, adjusted R^2 = 0.120); Accessibility Proximity model explains 47.7% of the variance (R^2 = 0.477, adjusted R^2 = 0.444); and the Accommodation model explains 8.9% of the variance (R^2 = 0.089, adjusted R^2 = 0.032). Accessibility Physical (F = 1.39, p = .108) is non-significant, meaning that independent variables do not explain the dependent variables. The formation of barriers in this case may not be fully explained by sociodemographic and socioeconomic factors, but it suggests the potential presence of institutional, environmental, or infrastructural conditions, pointing to structural barriers.

The four significant models support H1 and confirm that sociodemographic and socioeconomic variables influence the incidence of barriers to access to public services in the offline setting.

In addition, Table 44 presents the coefficients as supplementary information, providing additional detail on the relationships between the variables. For the purposes of clarity, the table only displays the statistically significant effects (p < .05).

Table 44: Offline access – regression coefficients

	Names and Effect	Estimate	SE	β	df	t	p
Acceptability_Off	Age	0.111	0.047	0.126	380	2.346	0.019
	Ethnicity_31 (2-1)	0.977	0.413	0.8	380	2.364	0.019
	Gender1 (Man-Woman)∗ Residence1 (Rural-Urban)	1.473	0.607	1.206	380	2.426	0.016
	Gender1 (Man-Woman)∗ Ethnicity_32 (3-1) ∗ Residence1 (Rural-Urban)	2.798	1.117	2.291	380	2.506	0.013
Affordability_Off	Age	-0.123	0.043	-0.157	380	-2.895	0.004
	Disability1 (Yes-No)	-0.837	0.336	-0.772	380	-2.495	0.013
	Gender1 ∗ (Man – Woman) Residence1 (Rural-Urban)	-1.269	0.544	-1.171	380	-2.331	0.02
Access_Proxi_ Off	Residence1 (Rural-Urban)	-1.598	0.27	-1.609	380	-5.923	<.001
	Gender1 (Man-Woman) ∗ Residence1 (Rural-Urban)	1.011	0.396	1.019	380	2.552	0.011
	Ethnicity_31 (2-1) ∗ Residence1 (Rural-Urban)	-1.275	0.521	-1.284	380	-2.449	0.015
	Disability1 ∗ (Yes-No) Ethnicity_31 (2-1) ∗ Residence1 (Rural-Urban)	-2.037	1.03	-2.052	380	-1.978	0.049
Access_Physi_ Off	Gender1 (Man-Woman)	0.704	0.325	0.693	380	2.167	0.031

	Gender1 (Man-Woman) ✻ Disability1 (Yes-No)	1.181	0.582	1.163	380	2.03	0.043
	Gender1 (Man-Woman) ✻ Ethnicity_31 (2-1)	1.623	0.793	1.598	380	2.046	0.041
Accommodation_Off	Income_ordinal	-0.195	0.092	-0.136	380	-2.119	0.035
	Gender1 (Man-Woman) ✻ Ethnicity_31 (2-1) ✻ Residence1 (Rural-Urban)	1.548	0.7	1.163	380	2.21	0.028

Source: Own

The coefficients (Table 44) are interpreted in terms that higher score corresponds to lower perceived barriers, whereas lower score corresponds to higher perceived barriers. In that regard, the results show that older individuals report fewer acceptability barriers (B = 0.111, p = .019), as well as individuals of Albanian ethnicity (B = 0.977, p = .019). In terms of affordability, as age increases, the perceived affordability barrier score decreases (B = -0.123, p = .004), suggesting that older individuals are less likely to perceive higher affordability barriers to access. Individuals with reported disabilities face higher affordability barriers compared to individuals without reported disabilities (B = -0.837, p = .013). Furthermore, rural residents face higher proximity barriers than their urban counterparts (B = -1.598, p < .001) and women experience more physical accessibility barriers than man (B = .704, p = .031). Finally, the accommodation barriers score decreases as income increases (B = -0.195, p = .035) suggesting that higher income levels are related to higher expectations to services tailored to users' needs thus experiencing more accommodation barriers. The coefficients also captured interaction effects between variables, allowing for intersectional analysis that shows the combined influence of variables, which signals the intersectionality of sociodemographic and socioeconomic factors in inducing barriers to access to public services.

The hypothesis testing for digital non-users was conducted following the same procedure as in the case of offline access. The assumption tests for homogeneity and normality of residuals for the digital non-users model showed the following results:

- Affordability – Assumption tests for normality were non-significant (p > .05). Assumptions for homogeneity were significant indicating lack of homogeneity.

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- Accessibility Public – Assumption tests were non-significant ($p > .05$), except in the case of the Levene's test ($p = .037$) indicating deviation from normality.
- Accessibility – Assumption tests were non-significant ($p > .05$), except in the case of the Shapiro – Wilk test ($p < .001$) indicating deviation from normality.
- Acceptability – Assumption tests for homogeneity were non-significant ($p > .05$) indicating the homogeneity assumption is met. Assumption tests for normality of residuals were significant indicating deviation of data from normal distribution.
- Accommodation – Assumption tests were significant ($p < 0.05$), indicating deviation from normality and homogeneity, except in the case of the Kolmogorov – Smirnov test ($p = .290$).

The Q-Q plots showed that the data is approximately normally distributed, with some minor data points scattered near the line. The VIF collinearity diagnostics resulted in values below 5 for all variables, indicating multicollinearity is not an issue (Annex 4). The results of the model fit for the digital users setting are presented in Table 45.

Table 45: Digital non-users – model fit

	R²	Adj. R²	df	df (res)	F	P
Acceptability	0.167	0.084	23	231	2.01	.005
Affordability	0.213	0.135	23	231	2.72	<.001
Accessibility Public	0.302	0.233	23	231	4.36	<.001
Accessibility	0.162	0.079	23	231	1.94	.008
Accomodation	0.274	0.202	23	231	3.8	<.001

Source: Own

Table 45 shows that all five models are statistically significant. The Acceptability model explains 16.7% of the variance ($R^2 = 0.167$, adjusted $R^2 = 0.084$) The Affordability model explains 21.3% of the variance ($R^2 = 0.213$, adjusted $R^2 = 0.135$); the Accessibility Public model explains 30.2% of the variance ($R^2 = 0.302$, adjusted $R^2 = 0.233$); the Accessibility model explains 16.2% of the variance ($R^2 = 0.162$, adjusted $R^2 = 0.079$); and the Accommodation model explains 27.4% of the variance ($R^2 = 0.274$, adjusted $R^2 = 0.202$). The statistical significance of the models support H1, indicating that sociodemographic and socioeconomic factors influence the formation of barriers for non-users of digital public services.

Table 46 shows the results of the regression coefficients for the digital non-users setting. For the purposes of clarity, the table only displays the statistically significant effects ($p < .05$).

Table 46: Digital non-users – regression coefficients

	Names and Effect	Estimate (B)	SE	β	df	T	p
Affordability_	Age	-0.121	0.056	-0.141	231	-2.152	0.032
	Income_ordinal	0.412	0.098	0.331	231	4.225	<.001
Accessibility Public	Gender1 (Man-Woman)	0.829	0.301	0.821	231	2.753	0.006
	Education	0.134	0.064	0.149	231	2.075	0.039
	Gender1(Man-Woman) ✳ Disability1 (Yes-No)	1.783	0.527	1.766	231	3.383	<.001
Accessibility	Age	-0.178	0.052	-0.231	231	-3.417	<.001
	Income_ordinal	0.220	0.09	0.198	231	2.448	0.015
	Disability1 (Yes-No) ✳ Residence1 (Rural-Urban)	1.295	0.629	1.28	231	2.057	0.041
Acceptability	Ethnicity_31 (2-1)	1.018	0.492	0.828	231	2.07	0.040
Accomodation	Education	0.150	0.07	0.158	231	2.158	0.032
	Disability1 (Yes-No)	-0.854	0.343	-0.799	231	-2.492	0.013
	Disability1 (Yes-No) ✳ Residence1 (Rural-Urban)	-1.595	0.619	-1.492	231	-2.577	0.011
	Gender1 (Man-Woman)✳ Disability1 (Yes-No) ✳ Ethnicity_31 (2-1)	3.561	1.581	3.331	231	2.253	0.025
	Gender1(Man-Woman) ✳ Ethnicity_31 (2-1) ✳ Residence1 (Rural-Urban)	3.068	0.653	2.87	231	4.695	<.001
	Gender1 (Man-Woman) ✳ Ethnicity_32 (2-1) ✳ Residence1 (Rural-Urban)	2.318	1.015	2.168	231	2.283	0.023

Source: Own

The results show that with every additional year of age, the affordability barrier increases (*B* = -0.121, *p* = .032), while higher levels of income decrease the effect of the affordability barrier (*B* = .412, *p* <.001). In terms of public internet access, men have reported fewer barriers than women (*B* = 0.829, *p* = .006). Individuals of higher education levels also experienced fewer barriers to public internet access (*B* = 0.134, *p* = .039). In terms of perceived accessibility among non-users, older individuals perceive higher barriers (*B* = -0.178, *p* < .001), while higher income levels decrease the barrier (*B* = .220, *p* = .015). The perceptions of individuals of minority ethnic

groups suggest they expect to face lower acceptability barriers when accessing digital public services (B = 1.018, p = .040). Positive expectations and accommodation perceptions increase with the increase of education levels (B = 0.150, p = .032), while individuals with reported disability have lower expectations regarding accommodation of access to digital public services, meaning they expect to face higher accommodation barriers (B = -0.853, p = .013). The analysis also detected a few interactions among variables that significantly influence how individuals of certain backgrounds experience barriers.

The same hypothesis testing procedure, as in the cases of offline access and digital non-users, was applied for digital users. The assumption checks for homogeneity and normality of data for digital users yielded the following results:

- Affordability – Assumption tests were non-significant (p > .05), except in the case of the Shapiro-Wilk test (p = .013) indicating potential deviation from normality.
- Accessibility Public – All assumption tests were non-significant (p > 0.05) indicating the assumptions of normality and homogeneity have been met.
- Accessibility – The homogeneity assumption tests were non-significant. The normality assumption tests were significant indicating potential deviation from normality.
- Acceptability – Assumption tests were non-significant (p > 0.05), except in the case of the Shapiro – Wilk test (p = .023) indicating deviation from normality.
- Accommodation – Assumption tests were non-significant (p > 0.05), except in the case of the Shapiro – Wilk test (p = .008) suggesting potential violation of normality of data.

Most of the models met the basic assumptions of homogeneity of variance and normality, however, with acknowledging the exceptions and the potential limitations. The Q-Q plots showed that the data is approximately normally distributed, with some minor data points scattered near the line. The VIF collinearity diagnostics resulted in values below 5 for all variables, indicating multicollinearity is not an issue (Annex 4).

Table 47: Digital users – model fit

	R²	Adj. R²	*df*	df (res)	F	p
Acceptability	0.434	0.337	16	93	4.46	<.001
Affordability	0.312	0.194	16	93	2.64	0.002
Accessibility Public	0.251	0.122	16	93	1.95	0.025
Accessibility	0.135	0	16	93	0.904	0.567
Accommodation	0.228	0.095	16	93	1.72	0.057

Source: Own

The digital users model fit results (Table 47) show that three models Acceptability (F = 4.46, $p < .001$), Affordability (F = 2.64, p = .002), and Accessibility Public (F = 1.95, p = .025) are statistically significant. Accommodation is borderline significant (p = .057), while Accessibility is non-significant (p = .567). The Acceptability model explains about 43.4% of the variance (R^2 = 0.434, adjusted R^2 = 33.7%; Affordability model explains 31.2% of the variance (R^2 = 0.312, adjusted R^2 = 19.4%; and the Accessibility Public model explains 25.1% of the variance (R^2 = 0.251, adjusted R^2 = 12.2%). The three significant models support H1 and confirm that sociodemographic and socioeconomic factors influence the incidence in barriers for users of digital access to public services.

Table 48 shows the results of the regression coefficients for digital users. For the purposes of clarity, the table displays the statistically significant effects ($p < .05$).

Table 48: Digital users – regression coefficients

	Names and Effect	Estimate	SE	β	df	t	p
Acceptability	Age	0.218	0.085	0.233	93	2.562	0.012
	Gender1	1.382	0.523	1.239	93	2.643	0.010
	Education	-0.283	0.097	-0.278	93	-2.922	0.004
	Gender1 (Man-Woman ✶ Ethnicity (2-1)_31	-1.534	0.644	-1.375	93	-2.383	0.019
	Gender1 (Man-Woman) ✶ Ethnicity_32 (3-1)	2.545	1.152	2.282	93	2.209	0.03
	Disability1 (Yes-No) ✶ Ethnicity_31	-3.159	1.424	-2.832	93	-2.219	0.029
	Gender1 (Man-Woman) ✶ Residence1 (Rural – Urban)	1.506	0.769	1.35	93	1.959	0.053
Accommodation	Employment_2	1.618	0.551	0.3	93	2.937	0.004
	Income_ordinal	-0.289	0.134	-0.249	93	-2.166	0.033
	Disability1 (Yes – No)	-2.107	0.827	-1.864	93	-2.548	0.012

Source:Own

The results (Table 48) show that individuals of older age groups experience less acceptability barriers (B = 0.218, p = .012) suggesting they may use digital public services with assistance. On the contrary, individuals with higher education

backgrounds experience higher acceptability barriers (B = -0.283, p = .004), potentially reflecting higher expectations or criticism of the available digital public services. Women face higher acceptability barriers compared to men (B = 1.382, p = .010). Regarding accommodation, unemployed individuals among users of digital public services, face higher barriers than those who are employed (B = 1.618, p = .004). The effect of income shows that as income level increases, accommodation barrier is higher (B = -0.299, p = .031) potentially reflecting higher expectations for a better fit between user needs and service design. The disability status also has a significant effect on the accommodation barrier, with individuals with reported disability facing higher accommodation barriers (B = -2.107, p = .012) indicating a misfit between service design and the needs of individuals with reported disability. Several statistically significant interactions among variables were detected, suggesting the combined influence of sociodemographic and socioeconomic variables on inducing barriers to access.

The statistically significant models in offline access, digital non-users, and digital users, supported H1 and confirmed the influence of sociodemographic and socioeconomic factors in inducing barriers to access to public services.

4.3.2 Second hypothesis (H2): binary logistic regression results

H2: Sociodemographic and socioeconomic factors influence the use of digital public services

The second hypothesis (H2) examines the role of sociodemographic and socioeconomic factors as predictors of digital public services use among different individuals. Given the dichotomous nature of the response variable, the hypothesis testing approach employs binary logistic regression to assess the relationship between the predictors and the outcome. The collinearity diagnostics using VIF yielded values below 5 for all variables, indicating no multicollinearity issues and allowing the analysis to proceed (Akinwande et al., 2015).

Table 49: Binary logistic regression model fit measures

				Overall Model Test		
Model	Deviance	AIC	R^2_{McF}	χ^2	*df*	*P*
1	369	389	0.216	102	9	<.001

Source: Own

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Table 49 presents the binary logistic regression model fit measures, including deviance values, the Akaike Information Criterion (AIC), and McFadden's R^2. Lower deviance and AIC values suggest a better-fitting model, or a model that is closer to the ideal compared to a null model (Zhu & Carlin, 2000). The model explains 21.6% of the variance (McFadden's R^2 = 0.216), which represents a reasonable fit considering that values above 0.2 are generally considered satisfactory (McFadden, 1974; Ugba & Gertheiss, 2023; Zhu & Carlin, 2000). Overall, the model is statistically significant ($\chi^2(9)$ = 102, $p < .001$) supporting H2 that sociodemographic and socioeconomic factors influence the use of digital public services.

In addition, the regression coefficients, display the influence of the independent variables, sociodemographic and socioeconomic factors on the dependent variable, digital public services use (Table 50).

Table 50: Binary logistic regression coefficients table

Predictor	Estimate	SE	Z	P	Odds ratio
Intercept	-5.650	1.340	-4.216	<.001	0.004
Age	-0.323	0.113	-2.864	0.004	0.724
Residence:					
Urban environment – Rural environment	1.383	0.338	4.085	<.001	3.986
Employment:					
1 – 0	0.559	0.607	0.922	0.356	1.750
Education	0.588	0.133	4.419	<.001	1.801
Income	-0.022	0.170	-0.132	0.895	0.978
Disability:					
No – Yes	2.112	1.085	1.947	0.052	8.264
Ethnicity:					
Albanian – Macedonian	0.624	0.333	1.872	0.061	1.866
Other – Macedonian	-0.693	0.608	-1.140	0.254	0.500
Gender:					
Man – Woman	0.162	0.267	0.606	0.544	1.176

Source: Own

Note. Estimates represent the log odds of "Use = Yes" vs. "Use = No"

The results show that age (p = .004), residence (p < .001), and education (p < .001) are significant predictors. Disability (p = .052) and ethnicity (p = .061) can be considered borderline significant however still not statistically significant at the 0.05 level. Employment (p = .356), income (p =.895), and gender (p = .544) are non-significant predictors of the use of digital public services in this model. The displayed results reject the null hypothesis, as several predictors, age, residence, and education, are statistically significant confirming H2 and the influence of sociodemographic and socioeconomic factors on the use of digital public services.

Regarding the significant predictors, the negative coefficient for age (-0.323) and the odds ratio (0.72) indicate that older individuals are less likely to use digital public services. The odds of using digital public services decrease by 28% with each additional year of age. In terms of residence, the coefficient (1.383) and odds ratio (3.99) suggest that urban residents are nearly four times more likely to use digital public services compared to their rural counterparts. In the case of education, the coefficient (0.589) and odds ratio (1.80) indicate that higher education levels increase the likelihood of using digital public services, with each additional level of education increasing the odds of use by 80%. Finally, the borderline significance of disability and ethnicity indicates that further research involving larger samples or qualitative follow-up studies are needed to explore these trends thoroughly.

4.3.3 Third hypothesis (H3): multivariate GLM regression results

H3: The spillover of offline barriers into the digital domain hinders the achievement of equal access to public services.

The third hypothesis (H3) explores the potential spillover of access barriers from the offline to the digital domain. The goal is to examine how the translation effect of barriers from the offline to the digital domain affects equal access to public services. The hypothesis is tested with multivariate GLM. Multivariate tests are performed across offline access, digital access users, and digital access non-users, followed by comparisons of the effect of barriers across the three settings. The hypothesis is supported if at least one independent variable (barrier) shows a statistically significant effect on at least one dependent variable (equal service or equal treatment) within each setting, offline access, digital non-users, and digital users.

The models were checked for the assumptions of normality of residuals and homoscedasticity, with any deviations reported. The Shapiro–Wilk tests were significant for digital users (p = .028) in the equal service dimension and for offline access (p = .002) in the equal treatment dimension suggesting a potential deviation from normality. The Q-Q plots indicated that the data followed a normal distribution with data points located near the reference line (Annex 5). The Breusch-

Pagan/Cook-Weisberg and White tests confirmed heteroskedasticity for equal treatment in the offline model ($p < .001$; $p = .0001$); the White test indicated heteroskedasticity for digital non-users in both equal service ($p = .03$) and equal treatment ($p = .043$). Heteroskedasticity was also detected for digital users ($p = .024$; $p = .041$) in the equal service dimension. Deviations from normality and homogeneity were expected, given that this is the first empirical testing of the measurement model in a research setting. However, the GLM is expected to mitigate these effects by accommodating non-normal and heteroscedastic distributions (Parker et al., 2010). The multicollinearity diagnostics employed the VIF, which showed values below 5 for all independent variables, indicating that multicollinearity is not an issue (Annex 5). The testing procedure included model fit statistics to examine how well the model explaince the variance in the dependent variable.

Table 51: Offline access – model fit test

Variable	Number of obs.	F (5, 447)	Prob > F	R-squared (R^2)	Root MSE
Equal service	453	57.30	< .001	0.391	0.829
Equal treatment	453	20.21	< .001	0.184	0.997

Source: Own

The offline regression model included 453 observations (Table 51) equal to the sample size of the study. The F-statistic was statistically significant for both Equal service ($F (5,447) = 57.30$, $p < .001$) and Equal treatment ($F (5,447) = 20.21$, $p < .001$). The regression models explained a moderate proportion of variance in equal service ($R^2 = .391$) and a moderate proportion in equal treatment ($R^2 = .184$). The statistical significance of the model fit confirms the presence of barriers that hinder equal access in the offline setting.

Table 52: Digital non-users - model fit test

Variable	Number of obs.	F (5, 278)	Prob > F	R-squared	Root MSE
Equal service	284	24.84	< .001	0.309	0.841
Equal treatment	284	7.77	< .001	0.123	0.949

Source: Own

The digital non-users model included 284 observations (Table 52), considering the complete survey responses of non-users of digital public services across the access dimensions. The F-statistic was statistically significant for both Equal service (F (5, 278) = 28.84, p < .001) and Equal treatment (F (5,278) = 7.77, p < .001). The regression models explained moderate proportion of variance in equal service (R^2 = 0.309) and equal treatment (R^2 = 0.123). The statistical significance of the model fit supports the claim that offline barriers transform and persist in the digital domain, continuing to hinder equal access to public services.

Table 53: Digital users – model fit test

Variable	Number of obs.	F (5, 515)	Prob > F	R-squared	Root MSE
Equal service	121	13.57	< .001	0.371	0.854
Equal treatment	121	8.44	< .001	0.269	0.880

Source:Own

The digital users model included 121 observations (Table 53), considering complete survey responses from users of digital public services across all access dimensions (Table 42). The F-statistic was statistically significant for both equal service (F (5, 515) = 13.56, p < .001) and equal treatment (F (5,515) = 8.44, p < .001). The regression models explained moderate proportion of variance in Equal service (R^2 = .371) and Equal treatment (R^2 = .269). The statistical significance of the model fit supports the claim that offline barriers transform and persist in the digital domain, continuing to hinder equal access to public services. The VIF yielded values below 5 for all variables indicating that multicollinearity is not an issue (Annex 5).

The significant models in offline access, digital users, and digital non-users confirm the model fit test and confirm the hypothesised relationship between the variables. Table 54 presents the specific effects of the independent variables on the dependent variables across the three settings, offline access, digital users, and digital non-users. The types of barriers and the effect size are presented side-by-side for a better overview and comparison between the different types of barriers that hinder the achievement of equal access to public services.

Table 54: Spillover of access barriers from offline to the digital domain

Predictor	Offline: Equal service (B, p)	Digital non-users: Equal service (B, p)	Digital users: Equal service (B, p)	Offline: Equal treatment (B, p)	Digital non-users: Equal Treatment (B, p)	Digital users: Equal treatment (B, p)
Accommodation	0.469, $p < .001$	0.369, $p < .001$	0.299, $p < .001$	0.234, $p < .001$	0.226, $p < .001$	0.500, $p < .001$
Acceptability	0.475, $p < .001$	0.288, $p < .001$	0.406, $p < .001$	0.218, $p < .001$	0.176, $p = .002$	0.177, $p = .029$
Accessibility/ Physical/Proximity/Public	0.084, $p = .023$ 0.185, $p < .001$	0.119, $p = .018$ 0.272, $p < .001$	0.262, $p = .001$ 0.223, $p = .003$	0.035, $p = .419$ 0.170, $p < .001$	0.157, $p = .005$ -0.006, $p = .918$	0.056, $p = .483$ 0.026, p = .744
Affordability	0.095, $p = .011$	0.192, $p < .001$	0.200, $p = .008$	0.289, $p < .001$	0.164, $p = .004$	0.058, $p = .473$

Source: Own

Table 54 presents the overview of the effects of independent variables on equal service and equal treatment across the three settings. The statistically significant effect of barriers across the three settings support H3 and confirms that offline access barriers transform into new forms into the digital domain and continue to affect equal access to public services. In the case of equal service there is a complete spillover of all barriers across the three settings, while in equal treatment accommodation and acceptability exhibit complete spillover, Affordability spills over at least across two settings, while accessibility is only significant for a single setting and does not translate across offline and digital domains.

The positive coefficient values among all relationships indicate that lower barriers improve equal access. Equal service comprise the ability to access high-quality public services independently at any time, while equal treatment encompasses the users' perceptions on fairness and how individuals are treated and supported when accessing public services.

Accommodation is a consistent predictor of equal service and has a statistically significant effect across the three settings. This indicates that perceptions of equal service depend on service responsiveness to user needs. Acceptability is significant across the three settings of equal service with the largest effect in offline access, suggesting that the treatment of public employees contributes to the perceptions of equal service . Accessibility/Physical/Proximity/Public is significant across the three settings of equal service , with varying affects of the specific sub-dimensions, indicating that accessible physical and technical prerequisites contribute for the overall perceptions of equal service . Affordability is also a consistent predictor of equal service across the three settings, suggesting the continued need to provide affordable access to both offline and digital public services. The statistical significance of all models across the three settings confirms that barriers spill over across the three domains, affecting perceptions of equal service.

In reference to equal treatment, accommodation is consistently significant across the three settings, meaning that meeting user expectations contribute to better equal treatment perceptions. Acceptability is as well significant across the three settings of equal treatment highlighting the importance of continued professional assistance and support in offline and digital access to public services and building trust in the processes. Accessibility/Physical/Proximity/Public is a borderline significant predictor for non-users of digital public services, and significant in the offline setting. However, the barrier does not translate across domain meaning that physical and technical prerequisites may not be the main barriers impeding access to public services. Affordability is significant across offline access and digital non-users, while non-significant for the digital users indicating that once individuals become users, affordability does not influence the equal treatment perceptions. The largest effect of

affordability is observed for offline access, suggesting that citizens of lower income backgrounds feel they do not have equal access opportunities due to potential economic constraints.

Overall, accommodation and acceptability are consistent predictors of equal access with a statistically significant effect across the three settings of both equal service and equal treatment. The equal service component comprises full spillover of barriers across the three settings, while for Equal treatment Accommodation and Acceptability supports the complete barriers spillover. This signals that equal service is more critical to achieving equal access, meaning that appropriate access conditions should be created for everyone, through enabling environments that ensure independent access to public services by any citizen regardless of the individual user characteristics. The overall effect of barriers across the three settings reduces quality of access in offline and digital users settings, while it completely prevents access for digital non-users highlighting areas for policy interventions.

4.3.4 Chi-square test results

In addition to hypotheses, Chi-square (χ^2) tests of independence were conducted to reveal the differences between users and non-users of digital public services in relation to the identified barriers and their sociodemographic and socioeconomic backgrounds. The profiling aimed to identify differences across key sociodemographic and socioeconomic factors including age, gender, education, employment, income, disability, ethnicity, and residence. This analysis was instrumental in defining the distinct user and non-user profiles, needed to understand the effect of barriers within different contexts. Table 55 summarises the Chi-square (χ^2) test results, followed by a narrative explanation of the associations between digital service use and each variable. The detailed Chi-square (χ^2) contingency tables are available in Annex 6.

Table 55: Chi-square (χ^2) test results

Variable	χ^2 Test Result	df	p	N
Age	25.3	5	< .001	452
Gender	1.48	1	= .224	451
Education	65.6	5	< .001	449
Employment	30.4	3	< .001	438
Income	23.5	4	< .001	418
Disability	11.0	1	< .001	448
Ethnicity	2.92	2	= .233	452
Residence	32.6	1	< .001	450

Source: Own

The results show that age, education, employment, income, disability, and residence have a significant association with digital public service use. On the other hand, gender and ethnicity did not display a significant association with digital public service use.

The contingency tables present the following trends for each sociodemographic and socioeconomic variable. In terms of Age, the use of digital public services declines as age increases. Additionally, the discrepancies in use grow as age increases, indicating that older age groups, 50-64 and 65 or more, are less likely to use digital public services. Conversely, the higher rate of use is distributed within the age groups 18-29 and 30-39, followed by the age group 40-49 in a slightly lower trend.

Regarding gender, there is a relatively proportional share of users between women (69) and men (55) with a slight tendency toward women. However, within each gender group non-use is prevalent with more than half of women (161 out of 230) and more than half men (166 out of 221) not using digital public services. The association of Gender is non-significant in the χ^2 test.

The observations for education reveal a growing trend in usage with higher levels of education. For instance, the usage rate among individuals with completed only primary education is very low (1 out of 47 respondents). In contrast, higher use rates are observed among individuals with BA degree, MA degree, or PhD degree. Moreover, the within-group usage gap is narrowing among individuals with BA degree (65 out of 157 respondents) and MA degree (19 out of 30 respondents).

Regarding employment status, more than half of the employed individuals in the sample do not use digital public services. The highest usage rate is observed among students, with a narrower user - non-user gap compared to the other groups. The lowest level of use is recorded among retired individuals where the vast majority are non-users. A high number of non-users is also present among the unemployed (38 out of 44), in a relatively higher proportion than among the employed (183 out of 271). However, although employed individuals are more likely to use digital public services, it is not the main determining factor, as non-use among employed individuals also persists.

In terms of income, individuals with higher income are more likely to use digital public services. The rate of use increases with income level, narrowing the within-group gap between users and non-users. The lowest usage levels are observed among individuals in the lowest income category and among individuals without regular monthly income. The middle-income group shows an increase in use compared to the lowest income group. This trend suggests that even a moderate increase in income can improve the likelihood of digital public service use.

The observations for disability suggest that individuals without disabilities are more likely to use digital public services than individuals with disabilities. The notable disparity between the two groups indicates that individuals with disabilities are more likely to face barriers, resulting in almost all respondents with reported disability being non-users.

Regarding ethnicity, the results show that respondents of Albanian ethnicity exhibit slightly higher use of digital public services than Macedonians. Other ethnic groups display a relatively lower rate of digital public service use (5 out of 31). However, the Chi-square (χ^2) test result is non-significant (p = .233) suggesting that the observed trends are not consistent across the sample to confirm a reliable association between ethnicity and digital public service use.

In terms of different types of residence, the observations show that individuals living in urban areas are more likely to be users (99 out of 166) than individuals living in rural areas (24 out of 161). However, non-use remains at a relatively high level in both groups, suggesting that barriers of use still persist among both urban and rural residents.

5   DISCUSSION

This section discusses the results and frames the findings within existing literature. This approach pinpoints the theoretical contribution of the dissertation and positions its conceptual framework within the broader scholarly discourse. The dissertation aimed to identify existing barriers in both offline and digital access to public services across different sociodemographic and socioeconomic groups, and to propose potential enablers to overcome these barriers. To achieve this aim, qualitative and quantitative approaches were employed to answer the research questions and test the hypotheses.

The interviews allowed for a bottom-up approach in gathering perspectives of citizens on access barriers, while exploring the prospects of digitalization in enabling equal access to public services. The qualitative findings identified existing offline barriers tied to specific socioeconomic contexts and provided a more nuanced understanding of risks, uncertainties, and sentiments with digitalization as a relatively new phenomenon. Moreover, the interviews highlighted perspectives that could not be fully captured with the survey when it comes to understanding concepts related to risks, motivation, and perceptions related to the process of shifting from offline to digital access.

The quantitative results, on the other hand, statistically confirmed the influence of certain sociodemographic and socioeconomic factors on the incidence of access barriers, as well as their role in shaping the profile of a user or a non-user of digital public services. Furthermore, the quantitative approach was instrumental in highlighting how offline barriers translate and transform in the digital domain, revealing the complexity and multiple layers of barriers when transitioning from offline to digital access.

Overall, the findings suggest that tailoring inclusive access solutions should begin by addressing offline barriers, rather than focusing solely on digital remedies, with the aim of preventing a further widening of the access inequality gap.

The discussion begins by revisiting the research questions followed by an elaboration of the hypotheses. The inclusion of relevant literature from the field supports the interpretation of the findings in the context of previous research, while allowing space to introduce new insights derived from the dissertation's approach. The discussion integrates both qualitative and quantitative findings in line with the exploratory sequential research design.

5.1 DISCUSSION OF RESEARCH QUESTIONS

RQ1: *What specific barriers hinder offline and digital access to public services for different sociodemographic and socioeconomic groups?*

The first research question referred to identifying the types of access barriers encountered across different sociodemographic and socioeconomic groups. For this purpose, both qualitative and quantitative approaches were engaged. In the first step, qualitative approach was employed to explore the emergence of specific barriers across the access dimensions. Subsequently, hypothesis testing helped determine which sociodemographic and socioeconomic factors influence the incidence of encountering these barriers. In other words, the quantitative approach contributed to closer identification of sociodemographic and socioeconomic profiles that are more likely to face barriers in offline or digital access to public services.

The conducted interviews revealed that offline access barriers persist across different socioeconomic settings. Findings show that some of the common barriers include issues related to proximity, transportation costs, service delays, long wait hours, complex procedures, favouritism and personal connections, and lack of service provider support. Issues related to proximity and transportation costs are frequently identified in studies on access disparities. Studies by Saunders et al. (2014), Wiewiora et al. (2015), and Lo Storto (2016) confirm the role of geographical locations, infrastructure, and service-related expenses in generating barriers to access. However, contrary to the expectation that proximity and transportation issues would be only linked to the urban-rural divide (Cowie et al., 2020), the interviews found that these barriers are also encountered by urban residents who find service locations dispersed around the city instead of being centralised at one convenient location. In terms of providing a professional service and optimise user experience, Lajante et al. (2023) and Bove (2019) found that empathy training for service employees can reduce perceptions of favouritism and enhance service quality through personalised and professional interactions with users.

While offline access barriers remain pervasive, some citizens transition to digital access as an offered alternative. However, certain barriers still add layers of complexity when accessing digital public services. As a first point, users have reported facing complex service design even for experienced internet users. Recent approaches propose the "design for experience" concept (Trischler & Trischler, 2021) that calls for a multi-level approaches in service design starting by integrating user practices on a micro-level in aim to co-create services and produce a value for users (Trischler et al., 2018). In other instances, users experienced downtime of service portals, thus preventing the completion of the service. These technical inconveniences contributed to lowering the perception of reliability of digital access

among users, initially promoted as easily accessible and convenient at all times. Similar challenges are noted in the studies of Nikiforova and McBride (2021), Kumar et al. (2018), and Faisal et al. (2016), highlighting that technical issues may decrease portal usability.

On the other hand, despite persistent offline barriers, some citizens are left with offline access as their only choice as they do not meet the technical and skills prerequisites for digital access. The first and most evident digital access barrier among non-users is the lack of skills and knowledge. The need for additional and continuous training was consistently highlighted throughout all interviews with non-users. While being aware of the benefits of digital access, the lack of skills prevented digital access resulting in involuntary digital exclusion. This occurrence risks further marginalisation and impacts the willingness to participate in the digital domain as addressed by Park and Humphry (2019). Improving digital skills is one of the most prominent themes in literature studying predictors for use of digital public services (Hargittai et al., 2019; Van Deursen & Van Dijk, 2014; Eynon & Geniets, 2016).

A common concern shared by both users and non-users is data privacy and placing personal information in online systems. These concerns stem from recent cyber attacks and data breaches which flagged the need for strengthened cyber security systems in place that uphold ethical standards in handling personal data online. Recent studies noted the growing privacy concerns that may result in scepticism and diminished trust in digital public systems overall (Mircea, 2024; Quach et al., 2022).

Another shared perception between users and non-users is the lack of widespread information for the available digital public services and any news related to these processes in general. Citizens do not recognise an entitled medium that provides ubiquitous information, but rather information is scattered and one should search for it on their own or rely on personal and professional networks. To improve accessibility of information, studies suggest targeted marketing and collaboration with communities (Zubir & Abdul Latip, 2024) to identify the best mean for informing citizens, through traditional or modern media. Other perspectives include sharing peer-to-peer best practices through community forums and promoting favorable attitudes for digital public services among community members (Dwivedi et al., 2017; Apolinário-Hagen et al., 2020).

The unequal starting positions between the ones relying solely on offline access and digital users generate disparities in access. While offline access is burdened with barriers, digital users are able to move forward. Although digital users may also encounter challenges in digital access, once they successfully overcome them, they benefit from faster and more convenient service delivery. This advantage contributes to the widening of the access inequality gap, while leaving digitally excluded further

behind. Therefore, inclusive policies should start with targeting offline access barriers while simultaneously equipping citizens with the knowledge and skills needed for an effective transition to digital access.

RQ2: *What is the sociodemographic and socioeconomic profile of user of digital public services?*
RQ3: *What is the sociodemographic and socioeconomic profile of non-user of digital public services?*

The second and third research questions referred to mapping the sociodemographic and socioeconomic profile of a user and non-user of digital public services. The regression results showed that age, residence, and education are significant predictors that determine whether an individual is more or less likely to use digital public services. In that regard, individuals of younger age, living in urban areas, and having higher education levels are more likely to use digital public services. Conversely, the profile of a non-user is associated with individuals of older age, living in rural areas, and having lower education levels. These results are in line with previous digital divide studies that explain the effect of traditional variables including age, education, and residence, on digital public services usage levels (Elena-Bucea et al., 2021; Friemel, 2016; Cruz-Jesus et al., 2016).

In addition, within groups differences were also explored by performing Chi-square tests of independence, aimed to identify potential factors that contribute to intersectional and compounded exclusions (Fang et al., 2019; Van Deursen et al., 2017). In that context, age, education, residence, income, employment, and disability were found to be significant determinants of digital public service use, while gender and ethnicity were non-significant.

The results for age showed a consistent pattern – usage decreases as age increases. The highest usage rates were observed within the age groups 18-29 years old, followed by 30-39 years old, while the lowest rates persist among individuals of over 65 years old. This finding is common in studies confirming that advancing age is closely linked to digital exclusion (Mubarak & Suomi, 2022; Wilson-Menzfeld & Brittain, 2023). Education is also a consistent predictor of use with higher education levels corresponding to higher usage rates. This trend is consistent with findings from studies on the acceptance and use of digital access channels, where higher education levels are often related to better access to information and increased digital engagement (Ramesh, 2021; Mubarak, 2020).

The example of residence, however, reveals that although urban residents exhibit higher usage rates in absolute terms compared to their rural counterparts, disparities within urban areas also persist. This trend indicates that despite the traditional

urban-rural divide, growing disparities among urban residents are evident as well. This finding suggests that other factors, despite residence, may also be decisive in determining the likelihood of digital public services use. These patterns align with recent studies examining the increasing levels of digital inequalities within urban areas (Reddick et al., 2024; Yang & Ma, 2024).

In terms of income, usage increases alongside increasing income levels, with more balanced usage rates observed among individuals within similar income groups. Regarding employment status, employed individuals were found to be more likely to use digital public services compared to non-employed individuals. Additionally, the highest usage rates were observed among students, while the lowest rates were identified among retired people. These findings align with the study of Martin and Robinson (2007) indicating that higher income levels increase the likelihood of access to the internet, but contrast with the findings of Wong et al. (2015) that show the income gap, concerning digital exclusion, is getting smaller or even closing on the account of the urban-rural divide. The higher usage rate among students and employees of certain occupations may be explained by their greater daily exposure to digital technologies (Haleem et al., 2022; Reljic et al., 2021; Henderson et al., 2015). The low usage rates among retired individuals call for additional measures to encourage and active use within this group.

Individuals without reported disability were more likely to be users, while almost all of the respondents with reported disabilities were found to be non-users. However, the discrepancies between users and non-users within these groups suggest that disability status alone may not be determining factor of use. These findings may reflect the actual situation or require a targeted study with a larger sample for a thorough investigation of the issue. Similar studies in the field acknowledge the difficulties faced by individuals with reported disabilities and recommend further digital divide research focused on specific disabilities sub-groups (Johansson et al., 2021).

Gender and ethnicity were non-significant determinants of use in this research; however, this finding is likely context-specific. In general, some studies find that the digital gender gap narrows with widespread internet diffusion (Yang, 2017), whereas the ITU (2025) reports that although the gap has narrowed globally since 2021, it has been widening in the least developed countries (Poll, 2025). The intersectional influence of ethnicity and other factors influencing the digital divide is also discussed by Wang et al. (2024) which calls upon considering intersections of marginalised social identities when tailoring targeted strategies.

The overall findings suggest the profile of a user is associated with younger individuals, students, living in urban areas, and individuals with higher incomes and

education levels. On the other hand, individuals of older age, residents of rural areas, retirees, and individuals of lower income and education levels are more likely to be non-users of digital public services. However, this division is not definitive. Namely, the within-group discrepancies suggest that these patterns should be observed through the lenses of intersectional influence, which calls for customised approaches rather than one-size-fits all solutions (Helsper, 2021; Zheng & Walsham, 2021; Wang et al., 2024).

RQ4: "*To what extent do offline barriers transform into new types of barriers in the digital domain?*"

The qualitative results showed that offline access barriers persist to some extent for almost all respondents in the study, as previously discussed in the first research question. However, when transitioning from offline to digital access, instead of overcoming the existing offline challenges, some barriers permeate into the digital domain, transforming into new types and continuing to impede equal access for all. Although digital access promises easier and more convenient service delivery, the spillover of the barriers makes it challenging to achieve this overarching goal.

Some respondents reported to have managed to overcome offline barriers on their own by seeking information independently or through personal networks, and seeking solutions to leverage digital alternatives. Some of the successful examples include overcoming the offline accommodation barrier of long wait times and queues by using digital access that provided immediate access to the needed service. Other examples included cases where respondents were able to successfully enter the digital access channels, but then encountered complex service design. In other instances, respondents faced no barriers in either offline or digital access.

On the other hand, other citizens continued to face obstacles and remained unable to transition to digital public services, placing them in a disadvantaged position and leaving them further behind. In some of these cases, the proximity barrier of living in a rural area transformed into accessibility, affordability, and accommodation barriers in digital terms due to lack of required skills and the need of additional support, resulting in involuntary digital exclusion. For these citizens, both offline and digital access remain burdened.

These examples indicate the varying extent of the barriers spillover effect for different individuals. For some, barriers lower the quality of service, while for others the spillover completely hinders digital access and excludes individuals from the digital domain. These insights were further investigated through a quantitative approach within this study, which also confirmed the existence of barriers spillover. Mixed-method studies of this type are needed to first identify the exact types of

barriers faced by individuals, and then to connect the effects of barriers to specific sociodemographic and socioeconomic backgrounds. Connecting barriers to user profiles and their contextual realities may be a good first step in tailoring customised solutions that tackle barriers effectively (Taylor & Packham, 2016; Raihan et al., 2025).

RQ 5: "*What adaptation strategies can help overcome the barriers faced by users of different sociodemographic and socioeconomic backgrounds to accessing offline and digital public services?*"

Addressing the fifth research question integrates citizens' insights gathered through the qualitative and quantitative phases of the research. The respondents acknowledged the open space for suggesting ideas for improvements, recognising this method as effective to potentially facilitate effective communication between users and service providers. Table 56 and Table 57 present the suggested enablers.

Table 56: Offline access enablers

Access dimension	Enabler	Expected outcome
Availability	Open more counters or offices in times of high service demands.	Reduced queues and crowds.
Accessibility	More public transportation options available.	Accessible transportation alternatives.
	Establish a service point in one village to serve nearby communities.	Reduced need for long-distance travel.
Affordability	Keep administrative fees consistent.	Enhanced trust in transparency of administrative processes.
	Provide transparent information about administrative fees.	No 'hidden' costs encountered.
Accommodation	Implement a queue management system with numbered tickets, modeled on the example of private sector institutions such as banks.	Established an organised queuing system, resulting in no crowds.
Acceptability	More professional, knowledgeable, and supportive	Improved trust and satisfaction with the overall

	service provider employees.	service delivery process.
Awareness	Provide transparent information on the procedures to obtain public services.	Enhanced trust and certainty in administrative processes.

Source: Paneva and Bencina, 2025

Table 57: Digital access enablers

Access dimension	Enabler	Expected outcome
Availability	Communicate with citizens to identify the services needed to be offered.	Aligned service supply with citizen demand.
Accessibility	Ensure quality and stable internet connection. Ensure stable and reliable service portals.	Consistently accessible internet for all. Preventing downtime of service portals.
Affordability	Subsidies for digital devices or internet fees.	Affordable material digital access prerequisites for all.
Accommodation	Simplified design of digital public services. Training to enhance citizens' digital skills.	Service design matching citizen skills. Combat involuntary digital exclusion.
Acceptability	Hybrid centres and virtual user support offered at service portals. Effective cyber security strategies.	Enhanced individual confidence in using digital public services. Enhanced trust in digital public systems.
Awareness	Digital service promotion across various media platforms.	Increased citizen awareness and engagement with digital public services.

Source: Paneva and Bencina, 2025

The suggested enablers for offline access (Table 56) highlight the need to uphold quality standards to prevent growing disparities for those continuing to rely on offline

services as digital adoption increases. In this context, the challenges include proximity, limited public transportation options, the lack of trust and transparency, and the issue of crowds and queues as common barriers faced by citizens. The suggested enablers for digital access (Table 57) aim to create favourable conditions and encourage greater usage of digital public services. For users, the enablers optimise the user experience by extending the offer of available services and providing simple, reliable, and secure service portals. For non-users, enablers encourage usage by widespread promotion, easing access to digital devices and the internet, providing digital skills training, and enhancing trust in digital processes as paramount to combat involuntary digital exclusion. All of the proposed enablers result from user needs and practical requirements. The strength of this approach lies in addressing past critiques that digital solutions often follow top-down approaches that overlook user needs (Van Winkle et al., 2017). This direct feedback loop is pivotal for driving meaningful change and ensuring digital solutions meet real-world requirements.

5.2 DISCUSSION OF HYPOTHESES

H1: *Sociodemographic and socioeconomic factors influence the incidence of barriers in offline and digital access to public services*

The first hypothesis (H1) aimed to statistically test the relationship between the sociodemographic and socioeconomic factors and the incidence of barriers in offline and digital access to public services. This approach is beneficial for tailoring inclusive policies, as it helps map and identify the needs across different sociodemographic and socioeconomic groups.

The effect of the sociodemographic and socioeconomic factors on the formation of barriers was found to be statistically significant and the assumptions of the first hypothesis were supported. The findings showed that different factor induce barriers to access across the access dimensions accessibility, affordability, accommodation, and accessibility. Age, residence, gender, ethnicity, and their mutual interactions were found to induce barriers to offline access. The interaction between gender and disability status was also found significant for the dimension of accessibility.

Demographic differences in utilisation of offline services, especially among older age and socially vulnerable groups, are also evident in prior studies (Tomlinson et al., 2023; Govier et al., 2022). Age is a common predictor of barriers to offline access, considering the need of older adults to physically visit the premises that sometimes requires additional mobility support. In this research, older age groups were found to face higher affordability barriers, while the effect of acceptability barriers decreased with each additional year of age. This indicates that the costs of obtaining public

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services take up a larger share of their budget, while they acknowledge the social aspect of receiving public services in person along with the willingness of service providers to help them. Residence is another factor often found to generate disparities in offline access, especially in relation to proximity as part of the urban-rural divide, and the manifold infrastructural challenges of rural areas (Cowie et al., 2020). This finding calls for the existence of mobile centres or service provider teams visiting rural and remote areas that would decrease the disadvantage and balance the unequal starting points between rural residents and their urban counterparts. The influence of ethnicity suggests that individuals may experience offline services differently, especially in connotation to acceptability, including the language in which services are offered, calling for an overall alignment of service delivery with cultural norms and expectations. The effects of gender are contextually tied to cultural expectations that have traditionally influenced the starting points of different genders. In this research, women reported higher accessibility barriers than man, highlighting the need for optimised accessibility solutions to address gender- specific challenges which may relate not only to physical accessibility, but also to mobility opportunities of women from different areas to reach public services in person (Giuffrida et al., 2025). The interaction between gender and disability status emphasises how overlapping factors can amplify barriers by producing a compounded disadvantage (Matin et al., 2021; Van Deursen et al., 2017). This intersectional approach to understanding barriers is a present theme in the research of Wang et al. (2024), Ramesh (2021), Zheng and Walsham (2021), confirming that the intersection of specific sociodemographic and socioeconomic variables impacts equality of access to public services.

Among non-users of digital public services, age, income, education, ethnicity, gender, and disability were found to be significant in influencing the formation of barriers to digital access. Since they are non-users, the dimensions of accessibility and affordability were explored in the context of technical and material readiness to access; while accommodation and acceptability were examined in terms of perceptions and expectations regarding the potential outcomes of using digital public services. Age is traditionally related to digital exclusion and inducing digital access disparities gaps, due to lack of skills or the fast-paced nature of digital developments (Mubarak & Suomi, 2022). Although this is one of the most common findings in literature, in practice individuals of older age groups are still lagging behind, demanding more systematic tailored policy approaches to this matter. Higher income and education levels are consistent enablers of digital access as often found across studies (DiMaggio et al., 2004; Martin & Robinson, 2007; Van Deursen et al., 2021). The results of this research align with this claim showing that individuals of higher income and education levels expect to face lower barriers or feel capable to overcome them in order to access digital public services. Ethnicity shows a weaker effect on acceptability barriers, suggesting that individuals across ethnic

backgrounds tend to trust digital public services and expect to benefit from them. Gender and disability are also found to be tied to lower digital accessibility opportunities, requiring targeted further studies to examine the specific needs of individuals within these groups. This research finds that women face more digital accessibility barriers than man. Individuals with reported disabilities also expressed expectations to face higher accommodation barriers, reflecting their lower confidence that digital public services portals would meet their needs. This highlights the importance of integrating accommodation and support features into the portals ensuring they are adapted to diverse needs. Similar to the offline setting, the interactions between the identified factors also influence the incidence of barriers, since individual's identity consists of multiple overlapping factors. The interaction between two or more sociodemographic and socioeconomic factors highlights their intersectional character which requires further inter-group examinations.

In the case of users of digital public services, employment, income, education, age, and disability were found to induce barriers to access across the dimensions of acceptability and accommodation. This suggests that digital public services may not be appropriately tailored to respond to specific user needs. The link to employment reflects two possible perspectives: first, the practical need for employed people using digital public services more for work-related purposes compared to unemployed individuals; and second, the relationship between employment and income, suggesting that unemployed individuals may face a greater economic burden in affording digital devices or internet subscription fees. As previously discussed, higher income and education levels are found to be consistent enablers of digital access (Helsper & Van Deursen, 2017; Mubarak et al., 2020). However, the findings of this research move in contrast to the traditionally expected results. Namely, contrary to non-users, users of digital public services with higher income and higher education levels report higher accommodation barriers to access while individuals of older groups perceive lower barriers. Nonetheless, a possible explanation to this occurrence is that users with higher income and education levels have higher expectations and approach the digital public services more critically by assessing their service design and functionality. Individuals of older age groups may be using digital public services with additional support and assistance, or using simpler services, reflecting their opinion of facing lower accommodation barriers. Similar to the findings of non-users, individuals with reported disability experience higher barriers to digital access. This fact indicates that individuals with disabilities in general perceive or experience higher barriers to access, both in the role of users and non-users to digital public services. Therefore, in-depth approaches are needed to investigate the specific source of these barriers and propose solutions accordingly.

Overall, an important note in terms of digital access is that the influence of sociodemographic and socioeconomic factors completely prevents access for non-users, while it diminishes service quality for users as they already managed to enter the digital domain. Therefore, the effect on barriers of the same factor may vary depending if the individual is user on non-user of digital public services.

H2: *Sociodemographic and socioeconomic factors influence the use of digital public services*

The second hypothesis assumed that sociodemographic and socioeconomic factors influence the use of digital public services. The hypothesised relationship was statistically significant and supported the assumption. The findings indicated that age, residence, and education significantly predict the use of digital public services. In the case of age, older individuals are less like to be users, with a decreasing trend in use with each additional year of age. The exclusion of older adults from the digital world is a prominent theme in discussions of digital access (Wang et al., 2024; Lu et al., 2022). However, despite the theoretical acknowledgment of the issue, the age disparity gap persists in practice, emphasising the need for targeted strategies to engage older populations (Lee et al., 2020).

Residence is another significant predictor of digital public service use. When comparing between groups, urban residents are four time more likely to use digital public services than their rural counterparts. The urban-rural divide is another persistent issue in studies on digital access inequalities (Salemink et al., 2017; Cowie et al., 2020). These disparities typically stem from infrastructure that favours urban areas, economic disparities, and challenges in spreading information to rural areas. While urban residents are generally more likely to use digital public services, there is also a growing disparity within urban areas. Recent studies point to the urban access inequalities gap, calling for cross-context studies that identify disadvantaged groups even within local urban settings (Reddick et al., 2024).

Education is another constant predictor of digital public service use, with the likelihood of use increasing with each additional level of education. While the formal level of individual's education cannot be promptly changed, progress can be made by providing digital skills training as a key enabler to digital public service use (Wilson-Menzfeld et al., 2023). However, these initiatives should not be limited to basic training, but to strive to a holistic approach tailored to the evolving needs required to operate and participate in the digital world (Imran, 2023).

H3: *The spillover of offline barriers into the digital domain hinders the achievement of equal access to public services*

The third hypothesis investigated the potential spillover of barriers from the offline to the digital domain. The hypothesised relationship assumed that offline barriers translate into the digital domain, take new forms, and continue to hinder equal access to public services. This hypothesis addresses the core premise of the research, examining whether digital access removes barriers and facilitates equal access or, whether it is adding new layers of complexity that amplify existing disparities.

Barriers to access were presented through the access dimensions accessibility, affordability, accommodation, and acceptability. Accessibility refers to physical, material, and technical prerequisites to access public services; affordability is related to all costs incurred in the process of accessing public services; accommodation is connected to service design adapted to user needs; and acceptability denotes the perceived support from service providers and trust in the processes. Equal access referred to the dimensions of equal service, encompassing autonomy and ubiquity, the ability to access public services independently at any time needed (Helsper, 2021); and equal treatment, referring to the perceived fairness of how individuals are treated and respected when accessing public services, and whether the established procedural rules apply equally to everyone (Norman-Major, 2023). The barriers spillover was tested across offline access, digital non-users, and digital users models. The results supported the hypothesis assumption that at least one barrier has a statistically significant effect on equal service or equal treatment over the three access models.

All of the access barriers showed statistically significant spillover effect over the three models for equal service. This suggests that individuals prioritise having conditions in place that ensure accessing high-quality, affordable public services, that are responsive to user needs, accompanied by provided professional support by service providers (Rhee & Rha, 2009; Mestrum & Menon 2021; Suzuki & Demircioglu, 2021). For equal treatment, accommodation and acceptability were consistent across all access settings, affordability barriers persisted across at least two settings, while the dimension of accessibility was significant for a single setting, but did not achieve spillover across the offline and digital domains.

Overall, the consistent presence of accommodation and acceptability across both equal service and equal treatment in both offline and digital access, signals that lowering accommodation and acceptability barriers would support the achievement of equal access. Responsive, user-centred service design, professional and impartial support by service providers, and building trust in the processes remain important for

both offline and digital access to public services (Strokosch & Osborne, 2023; Suzuki & Demircioglu, 2021). Accessibility barriers were present across the three models in equal treatment, however it showed that public points of internet access are non-significant for the equal treatment perceptions among non-users. The affordability barrier persists in the offline model and among digital non-users, suggesting that the costs incurred in offline access are burdening users. The costs-related concerns associated to providing material and technical prerequisites for digital access remain present among non-users. This indicates that some of the offline users may not be able to transit to digital access due to affordability issues, highlighting the need for supportive policy measures.

The approach of identifying the persistence and spillover of barriers across the offline, digital users, and digital non-users models aligns with the capabilities line of thought of removing structural and systemic barriers so equal access can be achieved. Identifying the exact barriers could support the development of customised solutions that address the specific barriers across all access models. The benefits would be manifold: addressing offline barriers helps prevent the widening of the offline-digital access gap by enabling quality access conditions and supporting individuals who have offline access as their only option; removing barriers for non-users would encourage their participation in digital domain and help combat the involuntary digital exclusion; and addressing barriers for digital users would optimise their experience and encourage continued use of digital public services. This approach is also a good starting point to facilitate communication and encourage cooperation between public institutions and citizens, by mapping the specific user needs through barriers identification and developing solutions accordingly.

5.3 NOVELTY AND IMPLICATIONS FOR THEORY

This dissertation focuses on identifying immediate barriers to access to public services and proposing potential solutions. In addition to existing studies in the field that depart from inequalities of resources and their replication in the digital domain (Helsper, 2012, 2021; Van Deursen et al., 2017; Ragnedda & Ruiu, 2017; Ragnedda et al., 2022), this research expands that focus and investigates the barriers encountered within different socioeconomic contexts. While the state of resources is more constant and it takes more time for an effective change, addressing barriers, or accommodating the environment to users' circumstances, is expected to prevent the widening of the access inequalities gap while resources gradually improve.

Instead of concentrating solely on digital access (Higgins et al., 2023; Allmann & Radu, 2023), this dissertation adopts a two-track approach – studying both offline and digital access to public services. This approach stems from the understanding that, for some citizens offline access is, and may remain, their only available access

channel. While digital access offers more convenient and efficient ways to access to public services, it risks leaving further behind the ones who continue to rely on offline access channels. This unequal starting position widens the gap between offline users and early adopters of digital access. Therefore, effective approaches in tailoring inclusive solutions involve addressing simultaneously both offline and digital access, making sure that while different groups transition to digital access, existing access disparities are not further aggravated.

Although the user-centred research approach is frequently found in studies on access inequality, it is often disregarded in the process of policy design and practical implementation (Hutchinson & Stilinovic, 2021; Gulliksen et al., 2003; Kotamraju & Van Der Geest, 2012). In that context, one of the methodological contributions of this dissertation would be the field research and collecting data through direct contact with end users. This approach was acknowledged by some of the citizens as the right way for understanding their needs and design policies accordingly. By grounding the research in real-life experiences, the dissertation contributes to integrating user perspectives in facilitating inclusive transition to digital access for everyone.

In practical terms, this dissertation contributes to understanding the challenges of access for users in the local context under study across different sociodemographic and socioeconomic groups. Recognising how structural and systemic barriers shape the user experience while accounting for the intersectionality of individuals' identity is essential for designing responsive public service delivery. This research approach may be applicable in similar environments undergoing the early stages of digital transition.

5.4 POLICY AND PRACTICE RECOMMENDATIONS

The findings offer insights into several key aspects that could support user-centred, tailored policy solutions to achieve the full potential of digitalization, while at the same time addressing users' offline access needs and demands. The approach of gathering first-hand data was acknowledged by citizens as an effective way to address their needs and requests. Since this research encourages the cooperation between users and service providers, the following points provide user insights for bottom-up service design to exceed offline barriers, boost digital services adoption rates, and make digitalization an enabler of equal access to public services. Some of the points include best practices examples from European countries to inspire and motivate approaches to digital inclusion policies.

- **Enhance offline and hybrid service quality and efficiency**

While digitalization of public services is the goal, the transition period risks widening the access inequality gap, especially for individuals with fewer resources as they remain dependent on offline access. Therefore, while groups in a better socioeconomic position advance more rapidly, others are left behind. Mitigating this risk requires optimising the offline access user experience along with efficient public service delivery. The findings of this research indicate that offline access barriers are primarily associated with accommodation and acceptability, meaning the direct relation between service providers and users. Addressing these barriers requires professional public administration and mechanisms to reduce long wait times, eliminate personal favouritism, and foster equal treatment and equal service for everyone irrespective of their sociodemographic and socioeconomic background.

Additionally, as part of the transition to digital public services, establishing hybrid centres can provide ongoing assistance for citizens and encourage their confidence in using digital public services. The hybrid centres could gradually encourage the use of digital public services among groups at risk of digital exclusion. This research identified potential groups at risk of digital exclusion particularly among elderly and retired citizens, combined with lower education, lower income, and rural residence.

- **Data-driven policy design**

The second point highlights the practical need for better mapping of citizens' needs by gathering ICT indicators data across different socioeconomic contexts. Identifying citizens' needs within diverse contextual realities is critical in designing tailored policies and detecting groups at risk of digital exclusion. While national-level official surveys of the State Statistical Office provide a general overview of ICT indicators, a complementary approach of qualitative data collection, involving direct engagement with citizens is needed to understand contextual realities, social nuances, and the reasons behind the numbers and statistics, in order to design policy solutions accordingly.

In addition, development of a standardised national measurement instrument or index, aligned with the EU, ITU, UN or other relevant digital indices methodologies, could help track the evolving trends across different stages of digital access. This instrument should provide national-level statistics disaggregated by key sociodemographic and socioeconomic factors found to contribute to disparities in access, as well as cross-sectional data. To reflect the needs accurately, the instrument needs to be updated regularly updated and designed to capture context-sensitive information as a point of reference for policy design.

– **Promote, motivate, and build trust in digital public services**

Besides sociodemographic and socioeconomic factors, the socio-psychological and cognitive factors including motivation, trust, and self-confidence should be considered in the process of digital adoption. Motivation is the first stage of digital access as citizens should first be willing to use the offered digital public services (Van Dijk, 2005). Even in cases when there is simple service design citizens might be reluctant to use due to internal perceptions and constraints related to the shift of conventional ways of doing things, habit, and risks (Samuelson & Zeckhauser, 1988; Xiao et al., 2021).

The initial approach to building motivation would be promoting digital public services and make them more visible. One common point shared by some of the respondents in this research was the insufficient information about digital public services. Some practical proposals include promotion through traditional or digital media, targeted campaigns, telephone messages, mobile applications, or other service communication channels. At the moment, informing primarily relies on self-initiated information seeking, so more activities are needed for digital public services to become omnipresent. Another important aspect of building trust is offering quality and reliable digital public services. Sharing best practices of quality services in close-knit communities is an effective promotion strategy as good examples tend to spread fast among constituents. On the contrary, when services are announced but fail to function properly it diminishes overall trust.

– **Strengthen technical readiness and digital skills to ensure effective use**

Following the stages of digital access, effective use requires motivation, technical prerequisites, and a sufficient level of digital skills and competences (Van Dijk, 2005). While findings show that almost all respondents have access to the internet and digital devices, as the basic technical prerequisites, the quality of connectivity varies across contexts. Moreover, the required level of digital skills to access digital public services significantly lags behind. One of the main reasons behind the involuntary digital exclusion among non-users in this research was the lack of digital skills and the expressed need for digital skills training.

Therefore, to ensure equality of access opportunities and beneficial outcomes, continuous policy support is needed across all stages of digital access. Furthermore, this support should be sustained rather than sporadic, and adaptive to ongoing technological advancements. In terms of technical prerequisites this includes providing the conditions for benefiting from next-generation digital infrastructure, for example enabling the 4G to 5G transition at even pace across both urban and rural areas and ensuring high-speed broadband connection to support ubiquitous access.

In addition to self-assessment, digital skills should also be evaluated through practical tests to accurately assess individual competences (Van Deursen et al., 2014). These tests can help identify varying levels of digital skills proficiency and map individuals or groups who may require additional support to independently navigate across digital service platforms. Efforts should focus on enabling individuals to reach a level of digital competence that allows them to critically assess and work with information online, including the effective use of digital public services and use of the internet for the purpose of public participation.

In this regard, establishing digital hubs in the form of public centres would play an instrumental role by offering training, assistance, and free access to the internet and digital devices for citizens. While this idea is not entirely new, as internet clubs of this type existed before, it is important to re-establish and redesign these centres to reflect current technological developments. Consistent operation of these centres can build citizens' trust so they recognize this initiative as their partner in digital participation. A good practice of this kind is the "Innovation Lab and Digital Gyms" project of the Veneto Region in Italy. The innovation labs represent a collaborative venue for citizens, researchers, enterprises, and public administration with the goal to reduce the digital divide, advance digital skills, and promote e-government use (Innovation Lab del Veneto, n.d.). The "Training people for digital" strategy of Portugal is also focused to lifelong learning and digital inclusion, including training for unemployed youth and helping adults in taking first steps on the internet (ePortugal, n.d.). Estonia showcases a set of good practices through its initial Tiger Leap project aimed at developing digital skills among the population, the ProgeTiger programme that supports keeping up with digital developments, and the digital focus on lifelong learning that positioned the country among the most developed digital societies globally (e-Estonia, n.d.). These examples could inspire similar initiatives aimed at increasing digital levels skills and fostering long-term interest in technology.

– **User feedback at the heart of service design**

Most of the digital initiatives and platforms often remain underutilised or unrecognised as they do not respond to users' needs and expectations. In the case of North Macedonia, utilisation can be encouraged by delivering high-quality services, promoting good practices, and applying user-centred approaches in service design. Including user feedback before initiatives go live, through surveys and focus groups in the pilot phase, and establishing feedback mechanisms during implementation contributes to more effective and organic change (OECD, 2020, 2022). Feedback should be gathered from both, experienced users to learn how to optimise the user experience, and novice users, to better understand and address any challenges they encounter. A good practice example in this area is the ePortugal, One-stop digital portal that has established a feedback mechanism at

every page and an electronic option for complaints or suggestions (OECD, 2022). Another example is the e-Citizens portal of the Republic of Croatia that displays user feedback section on the homepage, encouraging user participation. The National e-Services Portal of North Macedonia also displays a designated section for user feedback, however, greater transparency is needed regarding how user feedback is integrated into policy or service design solutions, as this process often remains unclear. Besides feedback mechanisms, offering real-time support through virtual assistants or telephone lines, along with accessibility features tailored to users' needs could leverage the user experience.

− **Improve technical conditions and interoperability across public institutions**

One of the key advantages of digital access is the centralisation of services into a single point of access, enabling the convenient, easy, and efficient delivery of public services. However, the effective operation of these features necessitates reliable and interoperable systems in place that provide integrated front-end and back-end service components and enable seamless data exchange between institutions (Scholta et al., 2019; Wimmer, 2002). Therefore, ensuring optimal user experience requires offering quality digital public services at one point of access, exceeding fragmentation, and addressing technical inconveniences as the reported downtime of digital public service portals that discourages use. On the other hand, service providers also need to operate under favourable conditions including adequate training and supportive infrastructure and operating systems that are regularly maintained. The socio-technical nature of digital public service delivery process relies on the synergy between human capital and technological components to achieve optimal results.

5.5 LIMITATIONS AND FURTHER RESEARCH

This dissertation adopted a comprehensive approach to achieving the research objectives, including theoretical conceptualisation, methodological thoroughness, and contextual data interpretation. However, as common in real-life research, several limitations and further research areas have been identified.

While the findings of this research can serve as a starting point for inclusive policy design, further research could enrich this perspective by conducting more case-specific targeted studies. The research design of this dissertation could be complemented by including focus groups to explore how barriers are experienced by specific population sub-groups. This methodological approach would contribute to a more nuanced understanding of the needs within different group settings. In the same line, in case of no time or financial constraints, conducting the data collection process in the native language of the different ethnicities included in the study, would be an added value of the research by displaying consideration for the diverse social and cultural backgrounds and minimising the risk of or misinterpretation of the questions.

Considering that this was the first operationalisation of the measurement model in a real-life setting, some limitations in the statistical models have been expected and anticipated. Further testing and empirical application could help refine the models through adjustments based on additional data, or different analytical approaches. In terms of the survey sample, since respondents of younger age with higher education levels were somewhat overrepresented compared to the national population, further research could take this into account and design the survey sample accordingly.

This research identified specific barriers to access, while further longitudinal studies could examine whether addressing the immediate barriers improves the state of resources over time. In other words, further research could reveal whether equal access to public services and the beneficial outcomes of public services use could balance the unequal distribution of resources and contribute to improving social equality in the long run.

While this dissertation presented the user-centred, citizens' perspective, a complementary study could investigate the needs, conditions, and requirements of service providers to enable ongoing and effective digital public service delivery. Including service providers in the research would indeed contribute to a more holistic and systematic understanding of the challenges and perspectives related to digitalization. This approach could help unlock the full potential of digitalization in enhancing equal access to public services.

6   CONCLUSION

Current approaches to enabling equal access to public services often look into resources of individuals as the primary source of inequalities. This dissertation expanded this perspective by identifying the specific barriers encountered by individuals of different sociodemographic and socioeconomic backgrounds on the way to accessing public services. In response to existing barriers in the offline domain, governments worldwide relied on ICT as a potential remedy to persistent issues. However, the introduction of ICT in the public sector and the growing reliance on digital tools, in many cases further aggravated these barriers for certain groups of citizens. Instead of providing potential solutions, digitalization has often introduced barriers of a new kind leaving the groups at risk further behind. As digital access promises more convenient and faster access to services, at the same time it poses a risk to groups currently facing offline barriers while not yet being ready to transition to digital access. Therefore, devising a holistic solution that tackles both access channels is essential in the pursuit of ensuring equal access to public services for all.

Conceptually, this dissertation built on the dimensions of the traditional and digital access framework. The interaction of offline and digital inequalities and the potential spillover of access barriers from the offline to the digital domain were another important aspect of the research. One of the core principles of this dissertation was that the source of barriers lies in the environment, not within the individual. This stance follows the *capabilities* line of thought, expanding the perspective beyond the purely *resources-based approach* that inequality stems from the unequal distribution of resources. In other words, it is not only about what kind of resources one has, but also about the opportunities available to turn those resources into functional outcomes. This theme is framed within the wider context of the UN's efforts to tackle inequalities and achieve the SDGs while leaving no one behind. Translated in terms of access to public services, the dissertation sought to explore how policymakers can adapt environments to the specific realities of individuals, shaping public service delivery in line with good governance principles and the creation of public value.

The research context is set in North Macedonia, following the timeline and developments of introducing digitalization in the public sector. However, besides the extensive legal and policy framework along with the continuous efforts over the last 25 years, practical implementation lags behind. The uptake of digital public services is at a relatively low level, so digitalization does not have the opportunity to reach its full potential in enabling fast, convenient, and easy access to public services to everyone.

The research approach employed exploratory sequential design consisting of an initial qualitative, exploratory phase, followed by a development of a quantitative measurement instrument and a subsequent data collection. The qualitative phase was instrumental in understanding individuals' perceptions and sentiments towards the relatively new phenomenon of digitalization within the given research context. The qualitative phase involved 25 citizens and was not intended to produce statistically generalisable findings, but rather to present a diverse range of citizen profiles and understand the nuances of their experiences. The insights from the qualitative phase, combined with existing literature, informed the development of the quantitative measurement instrument - a questionnaire that was administered for broader data collection. The questionnaire data collection involved 453 citizens, with a sample structure designed to reflect the national population across different sociodemographic and socioeconomic characteristics. The research focused on administrative public services, as being the most frequently used and in some cases mandatory to claim or enjoy basic human rights. Besides primary sources, the study design also incorporated secondary sources and databases to support the presentation and interpretation of collected data as well as the state-of-the-art in the local context set in a wider perspective.

To achieve the research objectives of identifying specific access barriers and suggesting potential enablers, the dissertation posed five research questions and three hypotheses. The analysis involved both descriptive and inferential approaches. The qualitative analysis was conducted using thematic analysis and hybrid reasoning that combined inductive and deductive approaches. General survey sample information was presented using descriptive statistics and Chi-square tests of independence were employed to explore the differences between users and non-users across the variables included in the study. The quantitative analysis employed univariate GLM, multivariate GLM, and binary logistic regression. Through addressing the research questions and testing the hypotheses, the dissertation aimed to investigate potential spillover effects of barriers between offline and digital access domains and to propose enablers accordingly.

Findings showed that while citizens face barriers in both offline and online access to public services some are in better position to overcome these barriers. In offline access, there are some common and unique barriers across different sociodemographic and socioeconomic groups. Issues related to proximity, transportation costs, complex procedures, personal connections and favouritism continue to burden offline access, prompting some of the citizens to turn to digital access instead. However, citizens who cannot meet digital access prerequisites are left with offline access as their only available access channel. Therefore, targeting simultaneously offline and digital access barriers mitigates the risk of further widening of the access inequalities gap.

To optimise user experience, digital users emphasised the importance of improving the technical aspects of providing the services through stable and reliable portals. Expanding the range of available digital public services, simplifying service design, and establishing a legal framework for recognition of electronically issued documents were other key aspects from user perspective.

On the other hand, as involuntary digital exclusion persists, non-users expressed the need for more digital skills training and support to be provided. Data privacy and widespread promotion remain common concerns. Encouraging motivation to use, fostering positive attitudes, and building trust by demonstrated continuous quality and application of the available digital public services could facilitate use alongside technical improvements.

Besides identifying the barriers, the findings revealed the profile of a typical user and non-user of digital public services. This approach is instrumental in pointing the sociodemographic and socioeconomic predictors inducing access barriers. Policy design that takes into consideration the potential factors carrying risk of digital exclusion could enhance the prospects of digitalization in fostering equal access to public services. Although focused on a specific research context in North Macedonia, the approach can be applied in a wider perspective within societies in early stages of digitalization. Some key points identified through the research include:

- Offline access barriers continue to persist.
- As some citizens transition to digital access, others are left with offline access as the only option, potentially widening the access inequalities gap.
- Offline barriers take new forms and translate into the digital domain.
- There is a statistically significant proof that specific sociodemographic and socioeconomic factors influence the incidence of barriers in offline and digital access to public services.
- Involuntary digital exclusion among non-users emerges due to a lack of digital skills training and applicable knowledge of the procedures.
- Users are discouraged by the limited offer of digital public services and the limited practical recognition and validation of electronically issued documents.
- Technical issues including experiencing system downtime or portals crashing, as well as complex service design remain valid concerns for digital users.
- Both users and non-users miss ubiquitous information on digital service related processes.
- Privacy and personal data protection emerged as a shared concern for both users and non-users of digital public services.
- Older age groups, individuals with lower education levels, and individuals living in rural areas are less likely to be users of digital public services.

- Traditional divides persist, but intersectional and compounded exclusion is also present.
- Accommodation and acceptability are the most consistent predictor of barriers across offline and digital access to public services.

In addition, several recommendations that could inform inclusive policy design and offer solutions to barriers in both offline and digital access channels are presented:

- Offline access barriers should not be disregarded while seeking remedies to digital access.
- Barriers to both channels should be targeted simultaneously to prevent widening the gap between citizens that continue the offline use and the citizens transitioning to digital use.
- Addressing barriers across all access dimensions contributes to a comprehensive approach that targets physical and technical prerequisites, but also the user needs and expectations as integral to the overall user experience.
- A customised approach to service design and service delivery contributes to diminishing the intersectional and compounded exclusion effects of sociodemographic and socioeconomic factors.
- Establishing user feedback mechanisms and transparent integration of user input would encourage the active participation of citizens in offline and digital service related processes.
- Digital inclusion policies require needs assessment within different communities to identify specific users' needs and requests.
- Offering assistance online and through hybrid service centres, along with digital skills training could combat involuntary digital exclusion.
- Making digital public services omnipresent through widespread promotion and campaigns would enhance awareness about the existence of these services.
- Offering high-quality digital public services and sharing best practices enhance motivation and willingness to use these services.
- Offering fully transactional digital public services and ensuring their legal validity would encourage higher usage rates.
- Implementing reliable cyber security systems would build trust in digital access related processes.
- Improving technical and interoperability features and centralising digital public services in one point of access would optimise the overall user experience.

This dissertation presented a user-centred approach to proposing solutions that unlock the potential of digitalization in fostering equal access opportunities for everyone. On the same note, this research provided the ground for cooperation

between users and service providers as the two key actors in the process. The growing reliance on digital technologies, requires designing tailored policies that ensure equal access opportunities for all. The potential of digitalization to exceed offline barriers and enable fair, convenient, and efficient access to public services becomes immanent to the overall societal advancement.

DALJŠI POVZETEK

OBETI DIGITALIZACIJE ZA IZBOLJŠANJE ENAKOSTI PRI DOSTOPANJU DO JAVNIH STORITEV V RAZLIČNIH SOCIALNO-EKONOMSKIH KONTEKSTIH V SEVERNI MAKEDONIJI

Disertacija obravnava ovire pri dostopu do javnih storitev, s katerimi se soočajo posamezniki z različnim sociodemografskim in socioekonomskim ozadjem, ter raziskuje možnosti digitalizacije pri spodbujanju enakopravnega dostopa. Dostop do javnih storitev je neločljivo povezan z ohranjanjem in izboljšanjem blaginje posameznikov ter splošnim razvojem družbe. V skladu z načeli dobrega upravljanja je dostop do javnih storitev ključnega pomena za zagotavljanje pravičnih, poštenih in enakih možnosti za sodelovanje javnosti. Dostop do javnih storitev prav tako opredeljuje zaupanje državljanov v javne institucije in predstavlja minimalni pogoj za zagotavljanje dostojnega in uspešnega življenja državljanov. Glede na njegov pomen je enakopraven dostop do javnih storitev priznan kot temeljna človekova pravica, ki je zakonsko zagotovljena na nacionalni, evropski in mednarodni ravni. Pomembni strateški dokumenti, vključno s cilji Združenih narodov za trajnostni razvoj (UN SDGs), postavljajo enakopraven dostop do javnih storitev v središče svojega zavezanosti k doseganju splošnih ciljev zmanjševanja neenakosti in spodbujanja socialne pravičnosti.

Kljub zavezam o zagotavljanju optimalnih pogojev pa različne okoliščine ovirajo enake možnosti dostopa. Osebni dostop do javnih storitev je obremenjen s težavami, kot so oddaljenost, stroški, čakalne vrste in zapleteni postopki. V prizadevanjih za premagovanje ovir pri osebnem dostopu do javnih storitev se vlade po vsem svetu obračajo k uporabi informacijsko-komunikacijske tehnologije (IKT). Omogočanje javnih storitev „z enim klikom" je postalo ena najpogostejših fraz, ki se danes uporablja v strategijah reforme javne uprave, namenjenih premagovanju ovir pri osebnem dostopu do storitev. Kljub pričakovanju, da bo dostop do javnih storitev lažji in udobnejši za vse, digitalni dostop še naprej ustvarja razlike v dostopu. Kot je bilo ugotovljeno v prejšnjih raziskavah, namesto da bi premagale obstoječe ovire v realnem svetu, splošne digitalne rešitve, ki niso uravnane na potrebe uporabnikov, razlike v dostopu med državljani z različnim sociodemografskim in socioekonomskim ozadjem še povečujejo.

Zato se ta disertacija osredotoča na perspektivo uporabnikov pri opredeljevanju ovir za dostop do javnih storitev in predlaganju ukrepov za izboljšanje, ob upoštevanju specifičnega lokalnega konteksta Severne Makedonije. Cilj raziskave je bil preučiti

možnosti digitalizacije za premagovanje obstoječih neenakosti in izboljšanje enakopravnosti pri dostopu do javnih storitev. Pet raziskovalnih vprašanj je preučevalo vlogo sociodemografskih in socioekonomskih dejavnikov, to so starost, spol, raven izobrazbe, zaposlitveni status, raven dohodka, oviranost, etnična pripadnost in prebivališče, pri ustvarjanju razlik v dostopu; preučuje profile uporabnikov in neuporabnikov digitalnih javnih storitev; in ugotavljalo, ali se ovire za dostop prenašajo iz osebnega v digitalno okolje. Tri hipoteze so preverjale vpliv sociodemografskih in socioekonomskih dejavnikov na ustvarjanje razlik v dostopu in vpliv ovir na enakopraven dostop za uporabnike osebnih javnih storitev, digitalne neuporabnike in digitalne uporabnike. Ugotovitve so bile podlaga za predloge ukrepov, ki bi lahko prispevali k odpravi ovir za dostop.

Raziskava je uporabila raziskovalni zaporedni dizajn, ki je vključeval kvalitativno in kvantitativno fazo. Kvalitativna faza, izvedena pred empiričnim testiranjem, je bila ključna za raziskovanje percepcij državljanov različnih ozadij glede digitalizacije in je omogočila oblikovanje kvantitativnega instrumenta za zbiranje podatkov, tj. vprašalnika. Anketna raziskava je bila izvedena na vzorcu anketirancev, ki je skušal odražati sociodemografsko in socioekonomsko strukturo nacionalnega prebivalstva. Glede teoretične podlage se prejšnje raziskave pri obravnavi dejavnikov neenakosti osredotočajo predvsem na vire, ta disertacija pa v ospredje postavlja ovire za dostop do javnih storitev. Takšen pristop je nakazal, da je mogoče doseči enake možnosti dostopa za vse državljane le z okoliščinam posameznikov prilagojenimi in vključujočimi rešitvami.

Rezultati potrjujejo, da sociodemografski in socioekonomski dejavniki vplivajo na prisotnost ovir pri osebnem dostopu do javnih storitev in določajo, ali bo posameznik uporabljal digitalne javne storitve ali ne. Rezultati potrjujejo tradicionalnime ugotovitve, npr. da imajo starejše starostne skupine, prebivalci podeželja in posamezniki z nižjo izobrazbo in dohodkom večje težave z dostopnostjo. Vendar pa so kvalitativne analize in analize znotraj skupin pokazale, da medsebojni vplivi napovednih spremenljivk povzročajo razlike znotraj skupin, kar nakazuje potrebo po prihodnjih, ciljno usmerjenih raziskavah o razlikah znotraj posameznih interesnih skupin. Ugotovitve so potrdile tudi prelivanje ovir iz osebne v digitalno domeno, pri čemer sta najbolj dosledna napovednika enakega dostopa do javnih storitev dimenziji prilagodljivosti in sprejemljivosti. Ta ugotovitev kaže, da državljani kljub ključni vlogi tehničnih pogojev, kot najpomembnejša napovednika enakega dostopa, prepoznavajo podporo, ki jo prejemajo v procesu, in uporabniško usmerjeno oblikovane storitve.

Disertacija predstavlja uporabniško usmerjeno raziskavo, katere cilj je, z zagotovitvijo celovitega niza podatkov o potrebah in zahtevah državljanov v zvezi z optimizacijo izkušenj z dostopom do javnih storitev, olajšati komunikacijo med državljani in vlado. Digitalizacija javnih storitev ne odpravlja ovir za dostop pri

osebnem dostopu do storitev, zato učinkovite politične rešitve za zmanjšanje razlik v dostopu med različnimi skupinami zahtevajo vzporedno obravnavanje ovir tako pri osebnem kot pri digitalnem dostopu. Namreč nerešene ovire pri osebnem dostopu do javnih storitev lahko povzročijo, da bodo prikrajšane skupine še bolj prikrajšane, medtem ko bodo zgodnji uporabniki digitalnih storitev napredovali in uživali prednosti digitalnega dostopa.

Državljani prepoznavajo potencial digitalnega dostopa, ki ga dojemajo kot enostaven, priročen in stroškovno učinkovit način dostopa do javnih storitev. Vendar pa odsotnost splošno dostopnih informacij, pomanjkanje digitalnih veščin in znanja ter zaskrbljenost glede zasebnosti povzročajo, da državljani iz določenih družbeno-demografskih in družbeno-ekonomskih okolij digitalnih javnih storitev ne uporabljajo. Zato ta raziskava, ki se nahaja na stičišču političnih ved, upravnih ved in ved o informacijskih sistemih, potrjuje vlogo tehnologije kot vira participacije državljanov in spodbuja komunikacijo med državljani in vlado, ki bi vodila k učinkoviti operacionalizaciji rešitev za digitalni dostop. Za doseganje družbeno sprejemljivih rezultatov in zagotavljanje optimalnih tehničnih rešitev, sociotehnična narava procesa digitalizacije neizogibno zahteva aktivno sodelovanje obeh skupin deležnikov.

Ključne besede: digitalna enakost, digitalizacija, družbeno-digitalne neenakosti, enakopraven dostop, javne storitve, ovire, spodbujevalci.

EXTENDED ABSTRACT

This dissertation addresses barriers to access to public services faced by individuals of different sociodemographic and socioeconomic backgrounds and explores the prospects of digitalization in fostering equal access. Access to public services is inextricably connected to sustaining and improving individual well-being, and advancing the overall societal development. In line with good governance principles, access to public services is paramount for ensuring just, fair, and equal opportunities for public participation. Access to public services as well defines the wider citizens' perceptions of trust in the public institutions, and represents the minimum condition to ensure a dignified and prosperous life for citizens. Considering its importance, equal access to public services is recognised as a fundamental human right, legally guaranteed at national, European, and international levels. Significant policy documents, including the United Nations Sustainable Development Goals (UN SDGs), place equal access to public services at the centre of their commitment to achieving the overarching goals of reducing inequalities and promoting social justice.

However, despite the commitments to ensuring optimal conditions, various environmental circumstances impede equal access opportunities. In-person or offline access is burdened with issues such as proximity, costs, long wait times, and complex procedures. Striving to exceed in-person barriers to access, governments worldwide turned to utilising Information and Communication Technology (ICT) to bring public services closer to citizens. Making the public services "a click away" from citizens became one of the most frequent phrases used nowadays in public administration reform strategies, aimed at overcoming existing offline barriers. However, while the promise is to make access to public services easier and convenient for everyone, digital access continues to generate access disparities. Namely, as widely discussed in previous research, instead of overcoming existing offline barriers, generic digital solutions that are not tied to user demands expand the access gap between citizens of different sociodemographic and socioeconomic backgrounds.

Therefore, this dissertation focuses on the user perspective in identifying barriers to access to public services and suggesting potential enablers, framed in the specific local context of North Macedonia. The goal of the research is to examine the prospects of digitalization to exceed existing access inequalities and foster equal access to public services. The five research questions explore the role of the sociodemographic and socioeconomic factors age, gender, education level, employment status, income level, disability status, ethnicity, and residence in generating access disparities; look into the profiles of users and non-users of digital public services; and examine whether the access barriers spill over from the offline

to the digital domain. In addition, the three hypotheses statistically test the relationships between sociodemographic and socioeconomic factors on one side, and their influence on generating access disparities; and the effect of access barriers on equal access for offline users, digital non-users, and digital users. The findings provided a basis for suggesting potential enablers that could contribute to removing access barriers.

The research employed an exploratory sequential design consisting of a qualitative and a quantitative phase. This approach was instrumental in exploring the perceptions of citizens of different backgrounds regarding digitalization, prior to conducting empirical testing. The qualitative phase contributed to building the quantitative data collection instrument, a questionnaire. The questionnaire was administered to a sample of respondents that strived to mirror the sociodemographic and socioeconomic structure of the national population. In terms of theoretical foundation, while previous research mostly focuses on resources as the main source of inequalities, this dissertation focused on barriers to access. Therefore, tailored and inclusive solutions should be adjusted to individuals' circumstances in the pursuit of achieving equal access opportunities.

Findings showed that sociodemographic and socioeconomic factors influence the presence of barriers in the offline access setting, and determine whether an individual will use or not use digital public services. The results confirmed traditional findings, e.g. that older age groups, rural residents and individuals of lower education and income backgrounds face higher accessibility barriers. However, the qualitative and within-group analyses showed that intersecting factors create differences inside the groups, highlighting the need for more targeted research. The findings also confirmed the spillover of barriers from the offline to the digital domain, with the dimensions of accommodation and acceptability being the most consistent predictors of barriers. This finding suggests that despite the importance of technical access prerequisites, citizens recognise the support received in the process and the user-oriented design of services as key predictors of equal access.

This dissertation presents a user-oriented research aimed at facilitating citizen-government communication by providing a comprehensive set of data of citizens' needs and requests regarding optimising the experience of accessing public services. Since offline access barriers still persist, effective policy solutions require simultaneous targeting of both offline and digital access barriers to minimise the potential access gap between different groups. Namely, unresolved offline access barriers risk leaving the disadvantaged groups further behind, while early adopters progress ahead with the benefits of digital access.

The potential of digital access is widely recognised by citizens, perceived as a mode of access to public services that is easy, convenient, and cost-efficient. However, the

absence of ubiquitous information, the lack of digital skills and the know-how, as well as the privacy concerns make citizens of specific sociodemographic and socioeconomic backgrounds unable or reluctant to use digital public services. Therefore, this research, situated at the intersection of political science, administrative science, and information systems science, acknowledges the role of technology as a resource of participation for citizens and encourages the citizen-government communication that would result in effective operationalisation of digital access solutions. The sociotechnical nature of the digitalization process, inevitably requires the cooperation of the two segments to be able to produce socially accepted outcomes, while at the same time providing optimal technical solutions.

PROŠIRENI SAŽETAK

IZGLEDI DIGITALIZACIJE ZA POBOLJŠANJE JEDNAKOSTI U PRISTUPU JAVNIM USLUGAMA U RAZLIČITIM SOCIO-EKONOMSKIM KONTEKSTIMA U SJEVERNOJ MAKEDONIJI

Disertacija se bavi preprekama u pristupu javnim uslugama s kojima se suočavaju pojedinci različitih sociodemografskih i socioekonomskih pozadina, te istražuje mogućnosti digitalizacije u promicanju jednakog pristupa. Pristup javnim uslugama neraskidivo je povezan s očuvanjem i poboljšanjem dobrobiti pojedinaca te općim razvojem društva. U skladu s načelima dobrog upravljanja, pristup javnim uslugama ključan je za osiguravanje pravednih, poštenih i jednakih mogućnosti za sudjelovanje javnosti. Pristup javnim uslugama također definira povjerenje građana u javne institucije i predstavlja minimalni uvjet za osiguravanje dostojnog i uspješnog života građana. S obzirom na njegovu važnost, jednak pristup javnim uslugama priznat je kao temeljno ljudsko pravo, zakonski zajamčeno na nacionalnoj, europskoj i međunarodnoj razini. Važni strateški dokumenti, uključujući ciljeve održivog razvoja Ujedinjenih naroda (UN SDGs), stavljaju jednak pristup javnim uslugama u središte svoje predanosti postizanju općih ciljeva smanjenja nejednakosti i promicanja socijalne pravde.

Unatoč obvezama o osiguravanju optimalnih uvjeta, različite okolnosti ometaju jednake mogućnosti pristupa. Osobni pristup javnim uslugama opterećen je problemima kao što su udaljenost, troškovi, liste čekanja i složeni postupci. U nastojanju da prevladaju prepreke u osobnom pristupu javnim uslugama, vlade diljem svijeta okreću se korištenju informacijsko-komunikacijske tehnologije (IKT). Omogućavanje javnih usluga "jednim klikom" postalo je jedna od najčešćih fraza koja se danas koristi u strategijama reforme javne uprave usmjerenim na prevladavanje prepreka u osobnom pristupu uslugama. Unatoč očekivanju da će pristup javnim uslugama biti lakši i prikladniji za sve, digitalni pristup i dalje stvara razlike u dostupnosti. Naime, kao što je utvrđeno u prethodnim istraživanjima, umjesto da prevladaju postojeće prepreke u stvarnom svijetu, opća digitalna rješenja koja nisu usklađena s potrebama korisnika dodatno povećavaju razlike u pristupu javnim uslugama među građanima s različitim sociodemografskim i socioekonomskim podrijetlom.

Zato se ova disertacija usredotočuje na perspektivu korisnika pri definiranju prepreka pristupu javnim uslugama i predlaganju mjera za poboljšanje, uzimajući u obzir specifični lokalni kontekst Sjeverne Makedonije. Cilj istraživanja bio je proučiti mogućnosti digitalizacije za prevladavanje postojećih nejednakosti i poboljšanje

ravnopravnosti u pristupu javnim uslugama. Kroz pet istraživačkih pitanja rad proučava ulogu sociodemografskih i socioekonomskih čimbenika, kao što su dob, spol, razina obrazovanja, zaposlenje, razina dohotka, invliaditet, etnička pripadnost i mjesto stanovanja, u stvaranju razlika u pristupu; ispituje profile korisnika i nekorisnika digitalnih javnih usluga; i utvrđuje prenose li se prepreke pristupu javnim uslugama iz osobnog u digitalno okruženje. Tri hipoteze ispitivale su utjecaj sociodemografskih i socioekonomskih čimbenika na stvaranje razlika u pristupu i utjecaj prepreka na ravnopravan pristup za korisnike osobnih javnih usluga, digitalne nekorisnike i digitalne korisnike. Ustanovljeni nalazi bili su temelj za prijedloge mjera koje bi mogle pridonijeti uklanjanju prepreka pristupu.

Istraživanje je koristilo istraživački sekvencijalni dizajn koji je uključivao kvalitativnu i kvantitativnu fazu. Kvalitativna faza, provedena prije empirijskog testiranja, bila je ključna za istraživanje percepcija građana različitih podrijetla o digitalizaciji i omogućila je oblikovanje kvantitativnog instrumenta za prikupljanje podataka, tj. upitnika. Anketno istraživanje provedeno je na uzorku ispitanika koji je nastojao odražavati sociodemografsku i socioekonomsku strukturu nacionalnog stanovništva. Što se tiče teorijske podloge, prethodna istraživanja pri razmatranju čimbenika nejednakosti usredotočuju se prvenstveno na resurse, dok ova disertacija u prvi plan stavlja prepreke pristupu javnim uslugama. Takav pristup je pokazao da prilagođena i uključiva rješenja trebaju biti prilagođena okolnostima pojedinaca u nastojanju da se postigne jednaka dostupnost.

Rezultati potvrđuju da sociodemografski i socioekonomski čimbenici utječu na prisutnost prepreka u osobnom pristupu javnim uslugama i određuju hoće li pojedinac koristiti digitalne javne usluge ili ne. Rezultati potvrđuju tradicionalne nalaze, npr. da starije dobne skupine, stanovnici ruralnih područja te pojedinci s nižim obrazovanjem i prihodima imaju veće poteškoće s dostupnošću. Međutim, kvalitativne i unutar-skupinske analize pokazale su da interakcije prediktivnih varijabli uzrokuju razlike unutar skupina, što ukazuje na potrebu za budućim, ciljano usmjerenim istraživanjima razlika unutar pojedinih interesnih skupina. Nalazi su potvrdili i prelijevanje prepreka iz osobne u digitalnu domenu, pri čemu su najdosljedniji prediktori jednakog pristupa javnim uslugama dimenzije prilagodljivosti i prihvatljivosti. Ovaj nalaz pokazuje da građani, unatoč ključnoj ulozi tehničkih uvjeta kao najvažnijih prediktora jednakog pristupa, prepoznaju podršku koju dobivaju u procesu i korisnički usmjerene usluge.

Disertacija predstavlja istraživanje usmjereno na korisnike, čiji je cilj olakšati komunikaciju između građana i vlade pružanjem sveobuhvatnog skupa podataka o potrebama i zahtjevima građana u vezi s optimizacijom iskustva pristupa javnim uslugama. Digitalizacija javnih usluga ne uklanja prepreke za pristup pri osobnom pristupu uslugama, stoga učinkovita politička rješenja za smanjenje razlika u pristupu

među različitim skupinama zahtijevaju paralelno rješavanje prepreka kako pri osobnom tako i pri digitalnom pristupu. Naime, neriješene prepreke za pristup mogu uzrokovati da uskraćene skupine budu još više uskraćene, dok će rani korisnici digitalnih usluga napredovati i uživati u prednostima digitalnog pristupa.

Građani prepoznaju potencijal digitalnog pristupa, koji doživljavaju kao jednostavan, prikladan i isplativ način pristupa javnim uslugama. Međutim, nedostatak javno dostupnih informacija, nedostatak digitalnih vještina i znanja te zabrinutost za privatnost uzrokuju da građani iz određenih socio-demografskih i socio-ekonomskih okruženja ne koriste digitalne javne usluge. Stoga ovo istraživanje, koje se nalazi na sjecištu političkih znanosti, upravnih znanosti i znanosti o informacijskim sustavima, potvrđuje ulogu tehnologije kao izvora sudjelovanja građana i potiče komunikaciju između građana i vlade, što bi dovelo do učinkovite operativizacije rješenja za digitalni pristup. Sociotehnička priroda procesa digitalizacije neizbježno zahtijeva suradnju dvaju segmenata kako bi se postigli društveno prihvatljivi rezultati, istodobno pružajući optimalna tehnička rješenja.

Ključne riječi: digitalna jednakost, digitalizacija, socio-digitalne nejednakosti, jednak pristup, javne usluge, prepreke, omogućivači.

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https://ec.europa.eu/eurostat/databrowser/product/view/isoc_ci_in_h?category=isoc.isoc_i.isoc_ici

Individuals with basic or above basic digital skills:
https://ec.europa.eu/eurostat/databrowser/view/tepsr_sp410/default/table?lang=en&category=t_isoc.t_isoc_sk
Users of the internet (once a week, including every day)
https://ec.europa.eu/eurostat/databrowser/view/isoc_ci_ifp_fu/default/table?lang=en&category=isoc.isoc_i.isoc_iiu
E-government internet use: website or app of public authorities
https://ec.europa.eu/eurostat/databrowser/view/isoc_ciegi_ac/default/table?lang=en&category=isoc.isoc_i.isoc_ci_egi

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ANNEX 1: Questionnaire

Thank you for your interest in participating in the research on citizens' needs and experiences regarding access to public services. The following questionnaire is part of the research conducted by Tanja Paneva, student in the Joint doctoral degree programme of the University of Ljubljana and the University of Rijeka.

Thematically, the questionnaire is divided into two parts. The first part gathers information regarding the offline, in-person access experiences, while the second part refers to access to public services online, in digital format.

To complete the questionnaire, you will need about 15 minutes.
The questionnaire guarantees full anonymity and does not reveal your identity in any way.

Your participation will help the analysis aimed at improving access to public services based on the needs of citizens.

In case you have further questions, or you would like to receive the research findings, please feel free to contact me at tp3639@student.uni-lj.si.

I sincerely thank you for your time.

Part I: This part refers to gathering sociodemographic data that will help forming the different profiles of citizens, public service users.
In case you feel you do not want to share certain information, please select the option "I prefer not to answer".

Age – Please select your age group:

○ 18-29
○ 30-39
○ 40-49
○ 50-64
○ 65 or more
○ I prefer not to answer

Gender – Please select your gender:

○ Woman
○ Man
○ Other
○ I prefer not to answer

Education – Please select the highest level of completed education:

○ Primary education
○ Secondary education
○ Associate degree
○ BA degree
○ MA degree
○ PhD degree
○ Other
○ I prefer not to answer

Employment – Please select your current employment status:

○ Employed
○ Student
○ Retired
○ Unemployed
○ Other:
○ I prefer not to answer

Income – Please select the range of your monthly income:

○ Less than 22.000 MKD
○ Between 22.000 MKD and 42.000 MKD
○ Between 42.000 MKD and 100.000 MKD
○ More than 100.000 MKD
○ I do not have regular monthly income
○ I prefer not to answer

Disability – Do you consider having a disability or a chronic condition that affects your ability to perform daily tasks and activities?

○ Yes
○ No
○ I prefer not to answer

Ethnicity – Please select your ethnicity:

○ Macedonian
○ Albanian
○ Bosniak
○ Vlach
○ Roma
○ Serbian
○ Turk

○ Other
○ I prefer not to answer

Residence – Please select your type of residence:

○ Urban environment
○ Rural environment
○ I prefer not to answer

Please write the name of the municipality of your residence.

_____

Please write the names of the village and the municipality where you live.

_____

Type of service and frequency of use – Please indicate how often you have accessed the following public services in person.
Multiple answers allowed.

Type of public service	Once or several times per month	Once or several times per year	Once to three times in 5 years	Once or twice in 10 years
ID	○	○	○	○
Passport	○	○	○	○
Driving license	○	○	○	○
Birth certificate	○	○	○	○
Citizenship certificate	○	○	○	○
Criminal record certificate	○	○	○	○
Taxes related services	○	○	○	○
Real Estate Cadastre services	○	○	○	○

Central Registry services	○	○	○	○
Agricultural subsidies	○	○	○	○
Social benefits for individuals at social risk	○	○	○	○
Employment status certificates from the Employment Agency	○	○	○	○
Certificates and confirmations from the Pension and Disability Insurance Fund	○	○	○	○
Certificates and confirmations from the Health Insurance Fund	○	○	○	○

Offline access dimensions

Accessibility – On a scale from 1 (Strongly disagree) to 5 (Strongly agree) please rate the following statements based on your in-person access to public services.

Statement	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
The state institutions that deliver public services are in close proximity to my home.	○	○	○	○	○
I can reach public institutions by walking.	○	○	○	○	○
I can reach public institutions with my own mean of transport.	○	○	○	○	○
The premises of the public institutions are physically accessible (without many stairs, there is an accessible ramp).	○	○	○	○	○

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
The offices/counters in the public institutions are physically accessible (located on the ground floor or there is an elevator if necessary).	○	○	○	○	○

Affordability – On a scale from 1 (Strongly disagree) to 5 (Strongly agree) please rate the following statements based on your in-person access to public services.

Statement	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
The prices of the administrative fees are acceptable.	○	○	○	○	○
Paying the administrative fees burdens my personal budget.	○	○	○	○	○
Transportation costs and the costs incurred to reach the public institutions burden my personal budget.	○	○	○	○	○
Unexpected costs required on the spot sometimes prevent me from getting the public services I need.	○	○	○	○	○
The costs related to accessing public services affect my budget for covering other basic needs (food, hygiene, medicines).	○	○	○	○	○

Accommodation – On a scale from 1 (Strongly disagree) to 5 (Strongly agree) please rate the following statements based on your in-person access to public services at the public institutions.

Statement	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I can easily make an appointment at public institutions to get a public service.	○	○	○	○	○
There is a well-organized queuing system to access counters or enter the offices at public institutions.	○	○	○	○	○
In case of waiting, there are chairs in the waiting areas in front of counters or offices.	○	○	○	○	○
I can fill in the public services application forms on my own.	○	○	○	○	○
I get the public services within the scheduled appointment time.	○	○	○	○	○

Acceptability – On a scale from 1 (Strongly disagree) to 5 (Strongly agree) please rate the following statements based on your in-person access to public services at the public institutions.

Statement	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
The public official is willing to explain me how to get the service.	○	○	○	○	○
The public official is willing to help me with filling in the required forms when needed.	○	○	○	○	○
The public official is competent and	○	○	○	○	○

knowledgeable about the procedure of getting the public service.					
The public official is always available at the workplace during designated work hours.	○	○	○	○	○
It is easier to access the service if you personally know somebody at the public institution.	○	○	○	○	○

Equal access - On a scale from 1 (Strongly disagree) to 5 (Strongly agree) please rate the meaning of the following statements based on your experience of accessing public services in person.

Statement	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I can access public services in person anytime I need them.	○	○	○	○	○
The access to public services is adapted to my needs.	○	○	○	○	○
The rules to access public services are the same for all citizens.	○	○	○	○	○
I feel that public employees are treating me professionally, in the same manner they treat other citizens.	○	○	○	○	○
Overall, I am satisfied with the in-person access to public services.	○	○	○	○	○
Overall, in-person access to public services meets my expectations.	○	○	○	○	○

Enablers – Please select which of the following would improve in-person access to public services:
Multiple answers allowed.

☐ User support, efficiency and professional treatment of citizens by public employees
☐ Regular public transportation to reach public institutions
☐ Mobile teams in villages and remote areas to assist and enable access to public services
☐ Improved physical accessibility of the public institutions
☐ Introducing a queuing ticketing system to clearly indicate the order in which citizens will be served
☐ Simplified procedures, inter-institutional cooperation, and collecting documents ex-officio
☐ Lower administrative fees
☐ Public services offer in hybrid or a digital format.

Digital Indicators

Internet – Do you have an active internet plan at your home?

○ Yes
○ No

Mobile internet – Do you have an active mobile internet plan?

○ Yes
○ No

Email address – Do you have an email address?

○ Yes, and I can use it on my own.
○ Yes, but I am not able to use it on my own.
○ I do not have an email address.

Digital Device – Which of the following devices you have at home?
Multiple answers allowed.

☐ Smartphone
☐ Laptop
☐ Desktop computer
☐ Tablet
☐ Other:
☐ I do not possess a digital device

Use – For which of the following do you usually use the Internet:
 Multiple answers allowed.

☐ Work or searching work-related information
☐ Study or searching for study-related information
☐ Social media (Facebook, Instagram, X, and others)
☐ Internet calls (Viber, Whatsapp, and others)
☐ Paying bills
☐ Electronic banking
☐ Communication with state institutions
☐ Online shopping
☐ Entertainment and leisure time, news, videos, music, video games
☐ I do not use the internet

How would you self-assess your digital skills in accessing and working with digital content?

○ I am an independent user and I can access on my own to different existing and new websites, platforms, applications and other internet content.
○ Most of the time I can use the internet on my own, however I need support to access new or complex internet content.
○ I have basic knowledge and can perform simple internet operations, but I need support most of the time.
○ I do not know how to use the internet.

Support – Who do you usually turn to when you need support to use the internet?
Multiple answers allowed

☐ Family
☐ Friends
☐ Work colleagues
☐ Neighbours
☐ Citizen organisations
☐ Public institutions
☐ I do not have who to turn to when I need support to use the internet
☐ Other:

Information – Are you informed that some of the public services are available online, in digital format?

○ I am completely informed.
○ I am informed for some, but not for the all available digital public services.

○ I have heard something, but I do not know where and how to access the digital public services.
○ I am not informed at all.

Information medium – Where do you usually get information related to available digital public services?
Multiple answers allowed.

☐ Family
☐ Friends
☐ Online media (social media, websites, blogs)
☐ On my own initiative through browsing the websites of public institutions or the National e-Services Portal
☐ Traditional media (newspapers, TV, radio, billboards)
☐ Information panels at public institutions
☐ At the workplace through colleagues
☐ Promotional campaigns
☐ Other:

Medium – What would be the best way to be fully informed for the processes related to digital public services?
Multiple answers allowed.

☐ Family
☐ Friends
☐ Traditional media (newspapers, TV, radio, billboards)
☐ The National e-Services Portal
☐ User information centres at my place of residence
☐ Online media (social media, websites, blogs)
☐ Information panels at the public institutions
☐ At the workplace through colleagues
☐ Other:

Digital access: Type of service and frequency of use

Use – Have you submitted a request or application, or received a document in electronic format using the National e-Services Portal or the designated websites of the public institutions?

○ Yes
○ No

In case of No: Reasons – What are the main reasons for not using digital public services?

Multiple answers allowed.

☐ I do not know how to use them, I lack the required skills and knowledge.
☐ I am not well informed about the procedures for accessing digital public services.
☐ I do not have the need to use them, in-person access is safer.
☐ I think the electronically issued documents will not be accepted by institutions.
☐ I am concerned that my personal data is not protected online.
☐ I do not have access to the internet.
☐ I do not possess digital devices.
☐ Other:

Type of service and frequency of use - Please indicate how often you have accessed the following public services in digital format through the National e-Services Portal (uslugi.gov.mk) or through the official websites of the public institutions:

Multiple answers allowed.

Type of public service	Once or several times per month	Once or several times per year	Once to three times in 5 years	Once or twice in 10 years
ID	○	○	○	○
Passport	○	○	○	○
Driving license	○	○	○	○
Birth certificate	○	○	○	○
Citizenship certificate	○	○	○	○
Criminal record certificate	○	○	○	○
Taxes related services	○	○	○	○
Real Estate Cadastre services	○	○	○	○

Central Registry services	○	○	○	○
Agricultural subsidies	○	○	○	○
Social benefits for individuals at social risk	○	○	○	○
Employment status certificates from the Employment Agency	○	○	○	○
Certificates and confirmations from the Pension and Disability Insurance Fund	○	○	○	○
Certificates and confirmations from the Health Insurance Fund	○	○	○	○

Digital access statements

Accessibility – On a scale from 1 (Strongly disagree) to 5 (Strongly agree) please rate the following statements based on your experience.

Statement	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
The quality of my internet connection at home is stable and reliable.	○	○	○	○	○
I can access digital public services on my own, at any time and place convenient for me.	○	○	○	○	○
I can access digital public services from a device that I personally own.	○	○	○	○	○
There is free Wi-Fi in public spaces in the place where I live.	○	○	○	○	○

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I can access the internet for free through public facilities (e.g. libraries, clubs, and organisations).	○	○	○	○	○

Affordability: On a scale from 1 (Strongly disagree) to 5 (Strongly agree) please rate the following statements based on your experience.

Statement	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
The price of the monthly internet fee is acceptable within my monthly budget.	○	○	○	○	○
I can afford paying a higher monthly subscription for faster and more stable internet.	○	○	○	○	○
The market prices of digital devices (telephones, computers) are acceptable within my monthly budget.	○	○	○	○	○
I can afford purchasing digital devices (telephones, computers) whenever I need them.	○	○	○	○	○
The costs of maintaining and repairing digital devices are acceptable within my monthly budget.	○	○	○	○	○

Accommodation for users of digital public services - On a scale from 1 (Strongly disagree) to 5 (Strongly agree) please rate the following statements based on your experience with digital access to public services.

Statement	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
The registration at the portal was simple.	○	○	○	○	○

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
The process of obtaining the service was easy and intuitive.	○	○	○	○	○
The portal offered different accessibility options (e.g. screen readers, larger text).	○	○	○	○	○
The portal provided detailed, step-by-step instructions on how to access the service.	○	○	○	○	○
The portal offered functional technical support through email, virtual assistant, or phone.	○	○	○	○	○

Acceptability for users of digital public services - On a scale from 1 (Strongly disagree) to 5 (Strongly agree) please rate the following statements based on your experience with digital access to public services.

Statement	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I believe that my personal data is protected in the process of obtaining public services through digital means.	○	○	○	○	○
I believe that the government introduces digital public services in the interest of citizens.	○	○	○	○	○
I believe that the documents issued in digital format are free of any errors.	○	○	○	○	○
Using digital public services saved me time and money.	○	○	○	○	○
I will continue using digital public services.	○	○	○	○	○

Equal access perceptions for users of digital public services
On a scale from 1 (Strongly disagree) to 5 (Strongly agree) please rate the following statements based on your experience with digital access to public services.

Statement	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I can access digital public services on my own anytime I need them.	○	○	○	○	○
The access to digital public services is adapted to my needs.	○	○	○	○	○
I now obtain most of the public services in digital format instead of going at the counter.	○	○	○	○	○
I think that the same rules of digital access apply to me as to anyone else.	○	○	○	○	○
I think the quality of user support is the same for me as for anyone else.	○	○	○	○	○
Overall, I am satisfied with digital access to public services.	○	○	○	○	○
Overall, digital access to public services meets my expectations	○	○	○	○	○

Accommodation for non-users of digital public services - On a scale from 1 (Strongly disagree) to 5 (Strongly agree) please rate the following statements based on your expectations of digital access to public services.

Statement	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I expect that I will be able to easily register at the digital public services portals.	○	○	○	○	○
I expect that the process of obtaining digital public services will be easy.	○	○	○	○	○
I expect that portals will provide screen readers, large text and similar options.	○	○	○	○	○
I expect the portal to offer a detailed, step-by-step instructions on how to access the service.	○	○	○	○	○
I expect to receive technical support through email, telephone, or a virtual assistant.	○	○	○	○	○

Acceptability for non-users of digital public services - On a scale from 1 (Strongly disagree) to 5 (Strongly agree) please rate the following statements based on your expectations of digital access to public services.

Statement	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I believe that my personal data will be protected in the process of accessing digital public services.	○	○	○	○	○
I believe that the government introduces digital public services in the interest of citizens.	○	○	○	○	○

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I believe that the documents issued in digital format will be free of any errors.	○	○	○	○	○
I think using digital public services will save me time and money.	○	○	○	○	○
I plan to try using digital public services.	○	○	○	○	○

Equal access perceptions for non-users of digital public services
On a scale from 1 (Strongly disagree) to 5 (Strongly agree) please rate the following statements based on your expectations of digital access.

Statement	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I think I will be able to access digital public services anytime I need them.	○	○	○	○	○
I think that digital access to public services will be adapted to my needs.	○	○	○	○	○
I now obtain most of the public services in digital format instead of going at the counter.	○	○	○	○	○
I think that the same rules of digital access will apply to me as to anyone else.	○	○	○	○	○
I think that the quality of user support will be the same for me as for anyone else.	○	○	○	○	○
Overall, I think I will be satisfied with digital access to public services.	○	○	○	○	○
Overall, I think digital access to public services will meet my expectations.	○	○	○	○	○

Enablers - Which of the following conditions could enable you to start using digital public services?

Multiple answers allowed.

☐ Having someone show me how to use them through training or courses.

☐ Existence of public centres where I could go and have access to digital devices and receive support if something is unclear.

☐ Establishing internet infrastructure in my place of residence.

☐ Financial support for purchasing digital devices.

☐ Financial support for monthly internet subscription.

☐ Improvement of personal data security on the internet.

☐ Free Wi-Fi in public spaces in my area.

☐ I do not have the need to start using digital public services.

☐ Other:

Preferred future use – In the future, I prefer to access public services:

○ In person, at the counter because it feels safer and I trust the procedure.

○ In person, at the counter, because the public official could help me if something is unclear.

○ In person, at the counter, because I am used to doing it that way.

○ In digital format, because it feels safer and I trust the procedure more.

○ In digital format, if somebody shows me how to use the services and I have support during the process.

○ In digital format, because it would save me time and money.

○ It depends on the type of service and the procedure.

Optional – Thank you for your time and participation. Please share below in case there is anything else you would like to add regarding the experiences of access to public services.

_____

ANNEX 2: List of municipalities represented in the survey

Name of city (urban municipality)	Municipalities of the City of Skopje (capital)	Name of rural municipality
1. Bitola	1. Aerodrom	1. Bogovinje
2. Bogdanci	2. Butel	2. Bosilovo
3. Debar	3. Centar	3. Brvenica
4. Delchevo	4. Chair	4. Centar-Zhupa
5. Demir Hisar	5. Gazi Baba	5. Debrca
6. Gevgelija	6. Gjorche Petrov	6. Dojran
7. Gostivar	7. Karposh	7. Dolneni
8. Kavadarci	8. Kisela Voda	8. Gradsko
9. Kicevo	9. Saraj	9. Jegunovce
10. Kochani		10. Konche
11. Kratovo		11. Krivogashtani
12. Kriva Palanka		12. Lipkovo
13. Krushevo		13. Lozovo
14. Kumanovo		14. Mavrovo-Rostushe
15. Makedonska Kamenica		15. Mogila
16. Makedonski Brod		16. Novaci
17. Ohrid		17. Novo Selo
18. Prilep		18. Plasnica
19. Probishtip		19. Rankovce
20. Radovish		20. Staro Nagorichane
21. Resen		21. Tearce
22. Shtip		22. Vasilevo
23. Struga		23. Vevchani
24. Strumica		24. Vrapchishte
25. Sveti Nikole		25. Zhelino
26. Tetovo		
27. Valandovo		
28. Veles		
29. Vinica		

Note: The list shows the names of the 63 municipalities indicated in the survey as a place of residence of respondents. Both urban and rural municipalities include villages within their structure, which are considered rural settlements. Respondents also indicated 89 different villages as a place of their residence.

ANNEX 3: EFA and CFA supplementary content

EFA initial extraction matrix for the offline access model

	Factor							Uniqueness
	1	**2**	**3**	**4**	**5**	**6**	**7**	
Access_4b	0.733							0.33818
Access_4c	0.673							0.43072
Access_4a	0.653							0.51758
Access_b		0.899						0.18848
Access_a		0.872						0.21815
Access_2c_r		0.600		0.318				0.44669
Access_3e	0.316		0.639					0.41740
Access_4d	0.448		0.615					0.30344
Access_3b	0.312		0.597			0.344		0.38921
Access_2b_r				0.938				0.04922
Access_2a				0.543				0.50137
Access_d					0.953			0.00500
Access_e					0.588			0.52887
Access_2e_r				0.347		0.751		0.27436
Access_2d_r						0.624		0.53658
Access_3d						0.375		0.73218
Access_4e								0.92098
Access_3c	0.366						0.541	0.54298
Access_3a	0.341		0.368				0.466	0.46265
Access_c								0.92869

Note. 'Maximum likelihood' extraction method was used in combination with a 'varimax' rotation

CFA parameter estimates for the refined offline access model

Factor	Indicator	Estimate	SE	Z	p
Affordability_Off	Access_2b_r	0.594	0.0513	11.58	<.001
	Access_2e_r	1.047	0.0589	17.77	<.001
	Access_2d_r	0.728	0.0567	12.84	<.001
Access_Proxi_Off	Access_a	1.492	0.2627	5.68	<.001
	Access_b	1.016	0.1878	5.41	<.001
Accessibil_Physi_Off	Access_d	0.746	0.0501	14.89	<.001
	Access_e	0.815	0.0540	15.1	<.001
Acceptability_Off	Access_4b	0.890	0.0474	18.8	<.001
	Access_4a	0.730	0.0539	13.54	<.001
	Access_4c	0.751	0.0461	16.31	<.001

Accommodation_Off	Access_3e	0.875	0.0528	16.58	<.001
	Access_3b	0.872	0.0524	16.66	<.001

1. EFA initial extraction matrix for the offline equal access model

	Factor		
	1	2	Uniqueness
Q3a		0.839	0.253
Q3b	0.338	0.719	0.369
Q3e	0.880		0.170
Q3f	0.908		0.119
Q3d	0.586	0.388	0.506
Q3c	0.502	0.348	0.627

Note. 'Maximum likelihood' extraction method was used in combination with a 'varimax' rotation

2. CFA parameter estimates for the refined offline equal access model

Factor	Indicator	Estimate	SE	Z	p
Equal_Service	Q3f	0.910	0.0361	25.2	<.001
	Q3e	0.862	0.0354	24.4	<.001
	Q3d	0.755	0.0482	15.7	<.001
Equal_Treatment	Q3a	0.802	0.0519	15.5	<.001
	Q3b	0.942	0.0509	18.5	<.001

EFA initial extraction matrix for the digital non-users model

	Factor						
	1	2	3	4	5	6	Uniqueness
Accessibil_a					0.439		0.67345
Accessibil_b					0.953		0.00500
Accessibil_c					0.573		0.55503
Accessibil_d				0.750			0.34578
Accessibil_e				0.978			0.00500
Afford_a		0.627					0.49597
Afford_b		0.639					0.48204
Afford_c		0.539					0.70151
Afford_d		0.778					0.33607
Afford_e		0.677					0.41853
Accomm_a	0.553					0.544	0.24972
Accomm_b	0.510					0.744	0.03872
Accomm_c	0.667						0.44855

Accomm_d	0.930		0.07317
Accomm_e	0.715		0.42980
Acceptabil_a		0.347	0.83565
Acceptabil_b		0.825	0.24318
Acceptabil_c		0.611	0.51209
Acceptabil_d	0.422	0.349	0.65801

Note. 'Maximum likelihood' extraction method was used in combination with a 'varimax' rotation

CFA parameter estimates for the refined digital non-users model

Factor	Indicator	Estimate	SE	Z	p
Accommodation_On_U	**Accommod_a**	0.545	0.0911	5.98	<.001
	Accommod_c	0.652	0.0880	7.41	<.001
	Accommod_d	0.582	0.0914	6.36	<.001
	Accommod_e	0.872	0.0898	9.71	<.001
Affordability_On_U	**Afford_d**	0.830	0.0476	17.43	<.001
	Afford_e	0.753	0.0491	15.33	<.001
	Afford_b	0.708	0.0522	13.56	<.001
	Afford_a	0.608	0.0453	13.43	<.001
	Afford_c	0.488	0.0478	10.23	<.001
Accessi_Publ_On_Nu	**Accessibil_e**	0.894	0.0655	13.65	<.001
	Accessibil_d	1.140	0.0736	15.5	<.001
Accessibility_On_Nu	**Accessibil_b**	0.768	0.0382	20.12	<.001
	Accessibil_c	0.445	0.0317	14.06	<.001
	Accessibil_a	0.528	0.0497	10.61	<.001
Acceptability_On_Nu	**Acceptab_b**	0.810	0.0918	8.83	<.001
	Acceptab_c	1.061	0.0945	11.22	<.001

EFA initial extraction matrix for the equal access digital non-users model

	Factor			
	1	**2**	**3**	**Uniqueness**
Equalacces_2a	0.482		0.869	0.00500
Equalacces_2b	0.546		0.546	0.33171
Equalacces_2c				0.91886
Equalacces_2d	0.901			0.13026
Equalacces_2e	0.779			0.31969
Equalacces_2f	0.312	0.779		0.25423
Equalacces_2g		0.944		0.00500

Note. 'Maximum likelihood' extraction method was used in combination with a 'varimax' rotation

7. **CFA parameter estimates for the refined equal access digital non-users model**

Factor	Indicator	Estimate	SE	Z	p
Equal_Service_On_Nu	Equalacces_2b	0.921	0.0482	19.1	<.001
	Equalacces_2a	0.898	0.0576	15.6	<.001
	Equalacces_2d	0.536	0.0475	11.3	<.001
Equal_Treatment_On_Nu	Equalacces_2f	0.691	0.0403	17.2	<.001
	Equalacces_2g	0.751	0.0404	18.6	<.001

8. **EFA initial extraction matrix for the digital users model**

	Factor					
	1	2	3	4	5	Uniqueness
Accessibil_a			0.612			0.52453
Accessibil_b			0.980			0.00499
Accessibil_c			0.723			0.45715
Accessibil_d					0.921	0.05919
Accessibil_e					0.683	0.46728
Afford_a				0.338	0.342	0.71299
Afford_b				0.447		0.61942
Afford_c				0.615		0.60338
Afford_d				0.816		0.30184
Afford_e				0.643		0.49089
Accommod_a	0.737					0.41965
Accommod_b	0.611					0.52600
Accommod_c	0.549					0.56701
Accommod_d	0.648					0.55060
Accommod_e	0.537	0.487				0.43721
Acceptab_a		0.533				0.65038
Acceptab_b		0.764				0.33246
Acceptab_c		0.859				0.15651
Acceptab_d		0.371				0.73011
Acceptab_e	0.369					0.78537

Note. 'Maximum likelihood' extraction method was used in combination with a 'varimax' rotation

CFA parameter estimates for the refined digital users model

Factor	Indicator	Estimate	SE	Z	p
Accessibility_On_U	Accessibil_b	0.775	0.039	19.85	<.001
	Accessibil_c	0.442	0.0321	13.78	<.001
	Accessibil_a	0.523	0.0499	10.48	<.001
Acceptability_U	Acceptab_b	0.866	0.0861	10.06	<.001
	Acceptab_c	1.000	0.0915	10.93	<.001
	Acceptab_a	0.551	0.0772	7.13	<.001
Accommodation_U	Accommod_a	0.679	0.0874	7.77	<.001
	Accommod_b	0.737	0.0883	8.35	<.001
	Accommod_d	0.594	0.0922	6.44	<.001
	Accommod_c	0.653	0.0892	7.33	<.001
Affordability_U	Afford_d	0.889	0.048	18.51	<.001
	Afford_e	0.742	0.05	14.85	<.001
	Afford_c	0.515	0.0471	10.92	<.001
	Afford_b	0.655	0.0529	12.37	<.001
Access_Publ_On_U	Accessibil_d	1.11	0.0769	14.44	<.001
	Accessibil_e	0.918	0.069	13.31	<.001

EFA initial extraction matrix for the equal access digital users model

	Factor			
	1	2	3	Uniqueness
Q7a		0.323	0.535	0.57312
Q7b			0.940	0.00500
Q7c				0.89489
Q7d		0.591		0.52593
Q7e		0.961		0.00500
Q7f	0.967			0.00500
Q7g	0.613			0.55414

Note. 'Maximum likelihood' extraction method was used in combination with a 'varimax' rotation

9. CFA parameter estimates for the refined equal access digital users model

Factor	Indicator	Estimate	SE	Z	p
Equal_Service_U	Q7e	0.761	0.0819	9.3	<.001
	Q7d	0.787	0.086	9.15	<.001
	Q7a	0.497	0.0767	6.48	<.001
Equal_Treatment_U	Q7f	0.723	0.0967	7.47	<.001
	Q7g	0.677	0.0977	6.93	<.001

ANNEX 4: Hypothesis 1 assumption tests results

Offline access – VIF values

Term	GVIF	Df	VIF_adj	Tolerance_adj	VIF	Tolerance
Employment_2	1.488	1	1.220	0.820	1.488	0.672
Disability	1.451	1	1.205	0.830	1.451	0.689
Income_ordinal	4.426	4	1.204	0.830	NA	NA
Age	4.044	4	1.191	0.840	NA	NA
Residence	1.334	1	1.155	0.866	1.334	0.750
Education	3.189	5	1.123	0.890	NA	NA
Ethnicity_3	1.265	2	1.060	0.943	NA	NA
Gender	1.113	1	1.055	0.948	1.113	0.899

Digital non-users – VIF values

Term	GVIF	Df	VIF_adj	Tolerance_adj	VIF	Tolerance
Employment_2	1.537	1	1.240	0.807	1.537	0.651
Income_ordinal	4.579	4	1.209	0.827	NA	NA
Age	3.772	4	1.181	0.847	NA	NA
Disability	1.264	1	1.124	0.889	1.264	0.791
Residence	1.242	1	1.114	0.897	1.242	0.805
Education	2.790	5	1.108	0.902	NA	NA
Gender	1.167	1	1.080	0.925	1.167	0.857
Ethnicity_3	1.284	2	1.065	0.939	NA	NA

Digital users – VIF values

Term	GVIF	Df	VIF_adj	Tolerance_adj	VIF	Tolerance
Disability	2.298	1	1.516	0.660	2.298	0.435
Residence	1.665	1	1.291	0.775	1.665	0.600
Age	3.971	4	1.188	0.842	NA	NA
Income_ordinal	3.932	4	1.187	0.843	NA	NA
Education	5.321	5	1.182	0.846	NA	NA
Ethnicity_3	1.923	2	1.178	0.849	NA	NA
Employment_2	1.287	1	1.135	0.881	1.287	0.777
Gender	1.216	1	1.103	0.907	1.216	0.822

ANNEX 5: Hypothesis 3 assumption tests results

Offline access VIF results table

Variable	VIF	1/VIF
Accommodation	1.05	0.950
Acceptability	1.05	0.951
Affordability	1	0.995
Accessibility Physical	1	0.997
Accessibility Proximity	1	1.000
Mean_VIF	1.02	

Digital non-users VIF results table

Variable	VIF	1/VIF
Acceptability	1.01	0.989
Accommodation	1.01	0.991
Accessibility	1	0.997
Affordability	1	0.998
Accessibility Public	1	1.000
Mean_VIF	1.01	

Digital users VIF results table

Variable	VIF	1/VIF
Accommodation	1.01	0.990
Acceptability	1.01	0.991
Affordability	1	0.997
Accessibility Public	1	0.999
Accessibility	1	1.000
Mean_VIF	1	

Offline access equal service assumption tests results

Test	chi2_df	chi2	p
Breusch-Pagan	1	0.01	0.925
White	20	29.17	0.085
IM-Heteroskedasticity	20	29.17	0.085
IM-Skewness	5	8.6	0.126
IM-Kurtosis	1	0.44	0.508
IM-Total	26	38.21	0.058

Offline access equal treatment assumption tests results

Test	chi2_df	chi2	p
Breusch-Pagan	1	26.83	0.000
White	20	52.62	0.000
IM-Heteroskedasticity	20	52.62	0.000
IM-Skewness	5	13.24	0.021
IM-Kurtosis	1	0.6	0.439
IM-Total	26	66.46	0.000

Offline access equal service normality assessment (Q-Q plot)
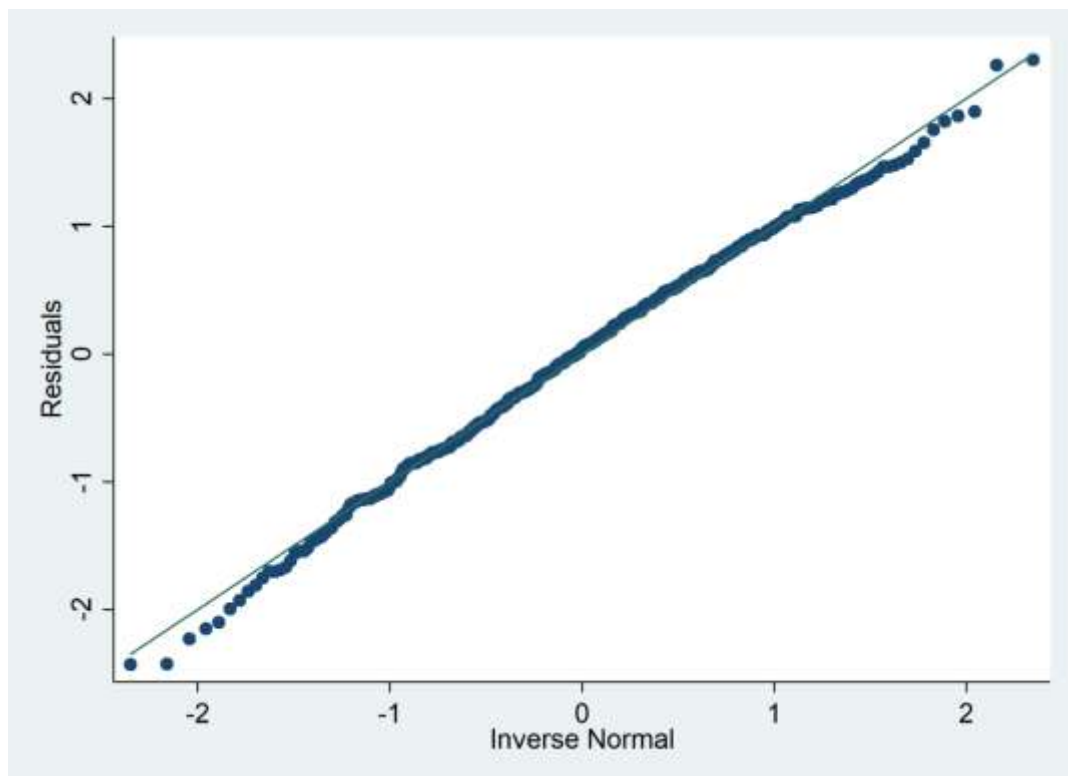
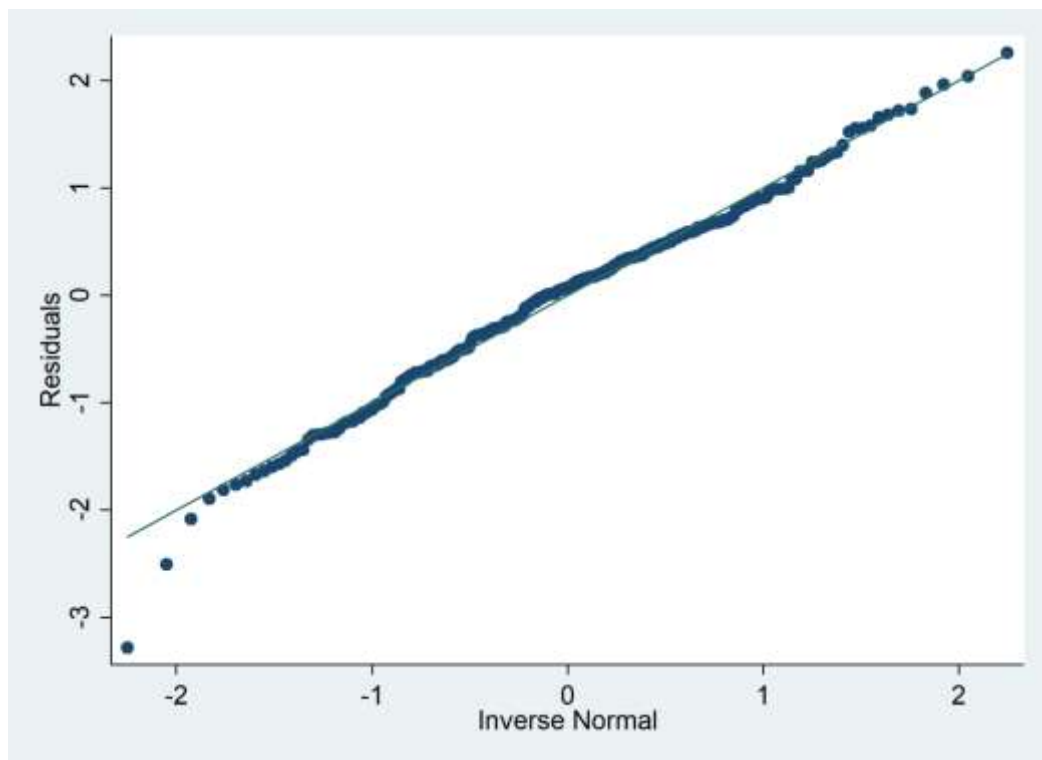## Offline access equal treatment normality assessment (Q-Q plot)
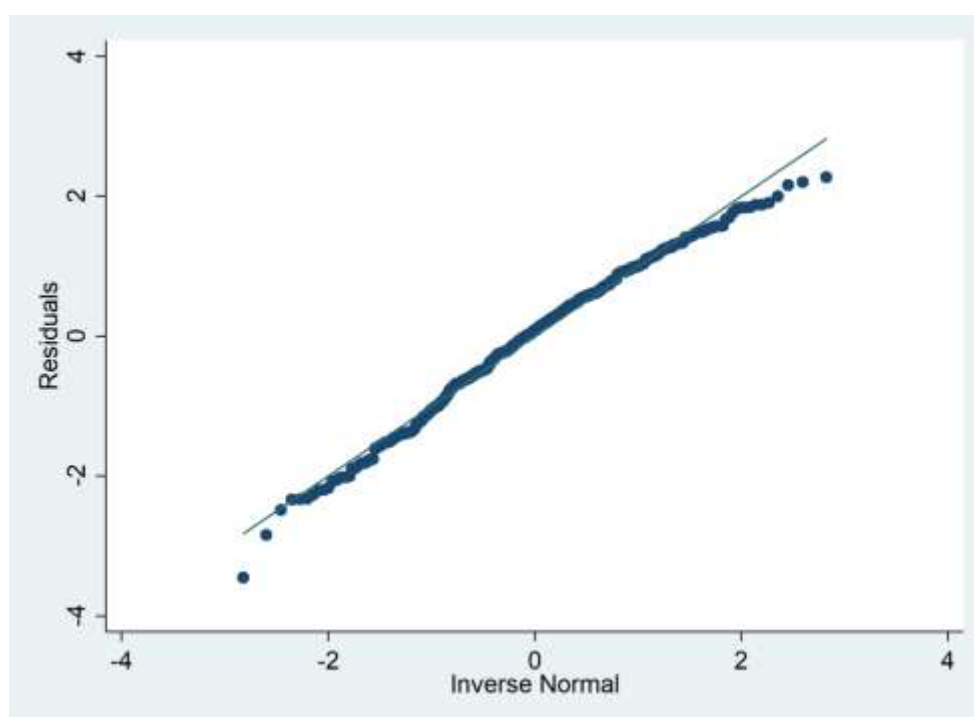
Digital non-users equal service assumption tests results

Test	chi2_df	chi2	p
Breusch-Pagan	1	1.12	0.290
White	20	33.42	0.030
IM-Heteroskedasticity	20	33.42	0.030
IM-Skewness	5	10.98	0.052
IM-Kurtosis	1	1.11	0.293
IM-Total	26	45.51	0.010

Digital non-users equal treatment assumption test results

Test	chi2_df	chi2	p
Breusch-Pagan	1	0	0.958
White	20	32.04	0.043
IM-Heteroskedasticity	20	32.04	0.043
IM-Skewness	5	12.73	0.026
IM-Kurtosis	1	0.01	0.931
IM-Total	26	44.77	0.013

Digital non-users equal service normality assessment (Q-Q plot)

Digital non-users equal treatment normality assessment (Q-Q plot)
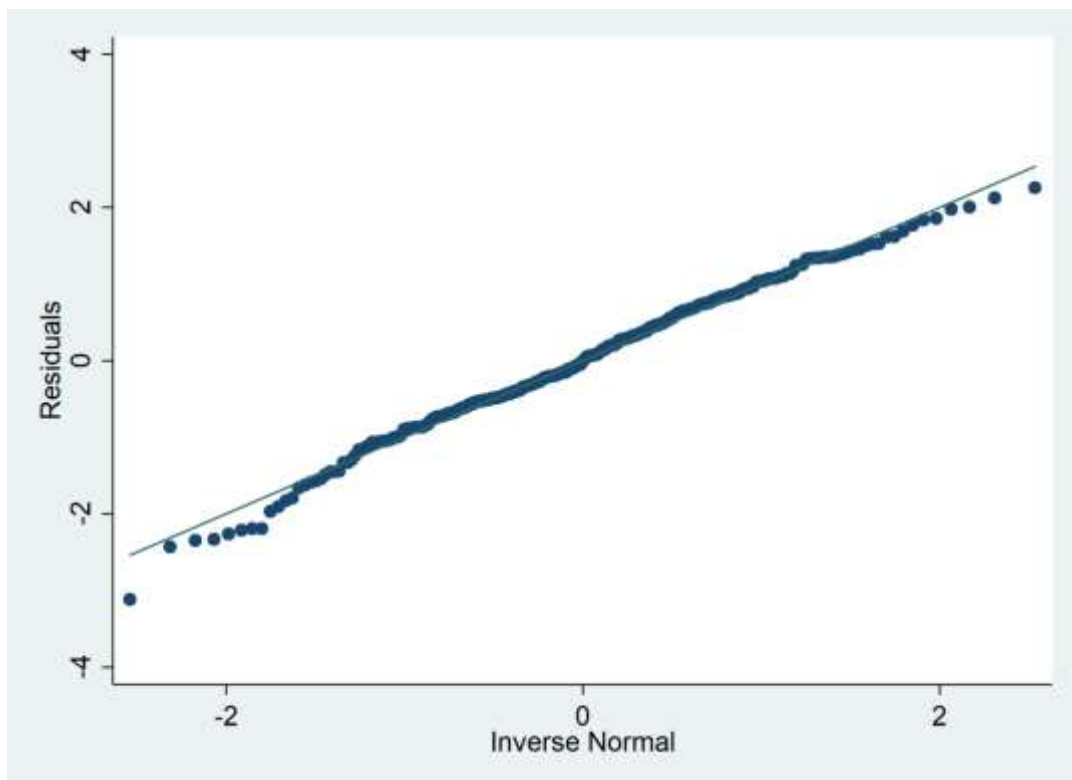
Digital users equal service assumption test results

| Test	chi2_df	chi2	p
Breusch-Pagan	1	5.11	0.024
White	20	32.19	0.041
IM-Heteroskedasticity	20	32.19	0.041
IM-Skewness	5	22.52	0.000
IM-Kurtosis	1	0.21	0.651
IM-Total	26	54.92	0.001

Digital users equal treatment assumption test results

Test	chi2_df	chi2	p
Breusch-Pagan	1	0.08	0.774
White	20	10.87	0.950
IM-Heteroskedasticity	20	10.87	0.950
IM-Skewness	5	6.88	0.230
IM-Kurtosis	1	0.01	0.939
IM-Total	26	17.75	0.885

Digital users equal service normality assessment (Q-Q plot)
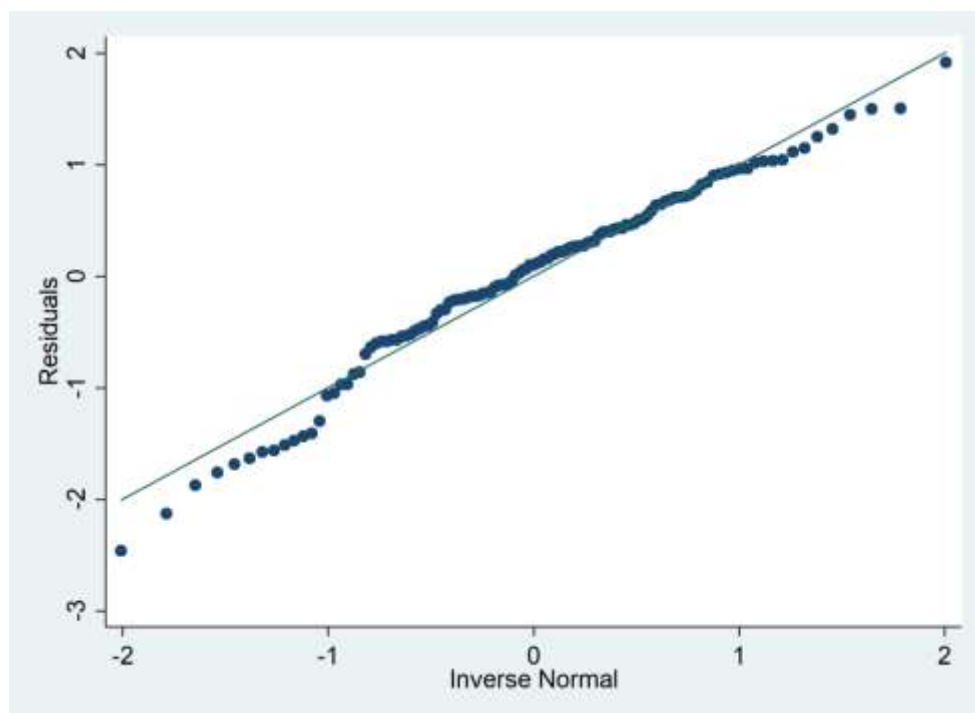
Digital users equal treatment normality assessment (Q-Q plot)
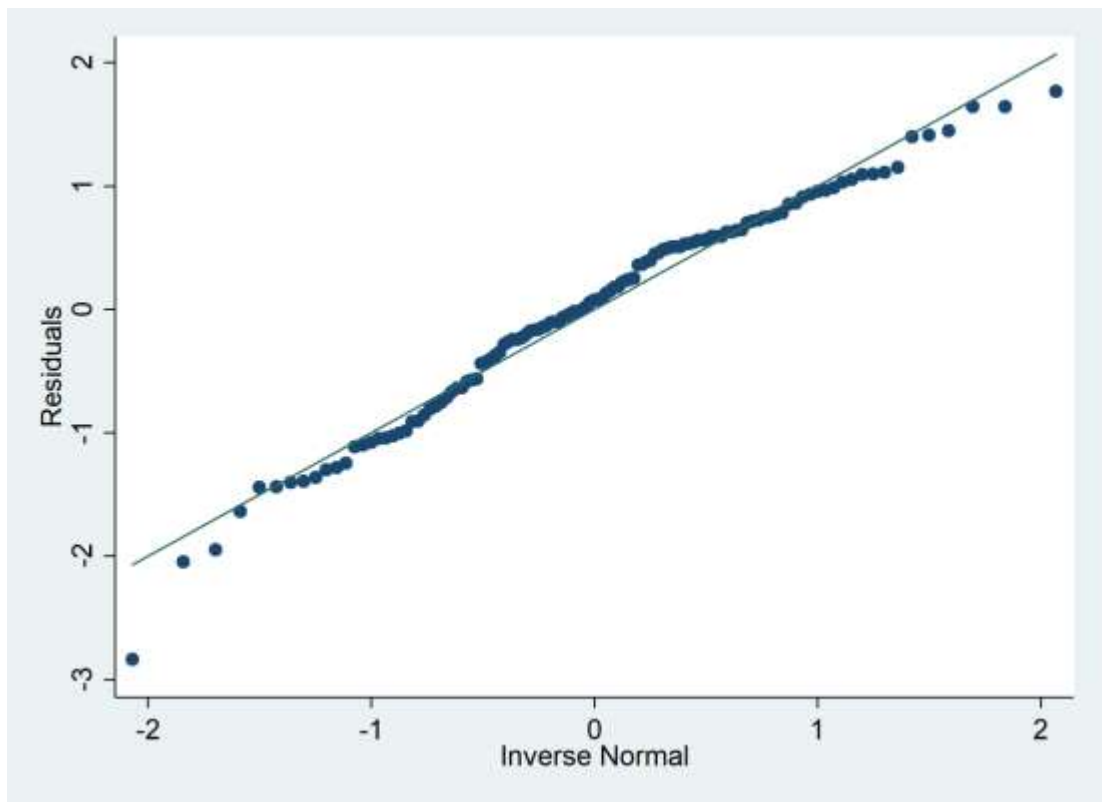
ANNEX 6: Chi-square test contingency tables

Contingency Table Age

	Use_2		
Age	**No**	**Yes**	**Total**
18-29	67	38	105
30-39	64	35	99
40-49	66	28	94
50-64	70	20	90
65 or more	60	3	63
I prefer not to answer	1	0	1
Total	328	124	452

Contingency Table Gender

	Use_2		
Gender	**No**	**Yes**	**Total**
Women	161	69	230
Men	166	55	221
Total	327	124	451

Contingency Tables Education

	Use_2		
Education	**No**	**Yes**	**Total**
Primary education	46	1	47
High school	155	32	187
Associate degree	20	4	24
BA degree	92	65	157
MA degree	11	19	30
PhD Degree	1	3	4
Total	325	124	449

Contingency tables Employment status

Employment	Use_2		Total
	No	Yes	
Employed	183	88	271
Student	29	20	49
Retired	70	4	74
Unemployed	38	6	44
Total	320	118	438

Contingency tables income level

Income	Use_2		Total
	No	Yes	
Less than 22.000 MKD	83	13	96
Between 22.000 MKD and 42.000 MKD	146	56	202
Between 42.000 MKD and 100.000 MKD	32	27	59
More than 100.000 MKD	4	5	9
I don't have regular monthly income	40	12	52
Total	305	113	418

Contingency tables disability status

Disability	Use_2		Total
	No	Yes	
No	288	120	408
Yes	38	2	40
Total	326	122	448

Contingency tables ethnicity

Ethnicity_3	Use_2		Total
	No	Yes	
1 Macedonian	233	87	320
2 Albanian	69	32	101
3 Other	26	5	31
Total	328	124	452

Contingency tables type of residence

Residence	Use_2		Total
	No	**Yes**	
Urban environment	166	99	265
Rural environment	161	24	185
Total	327	123	450