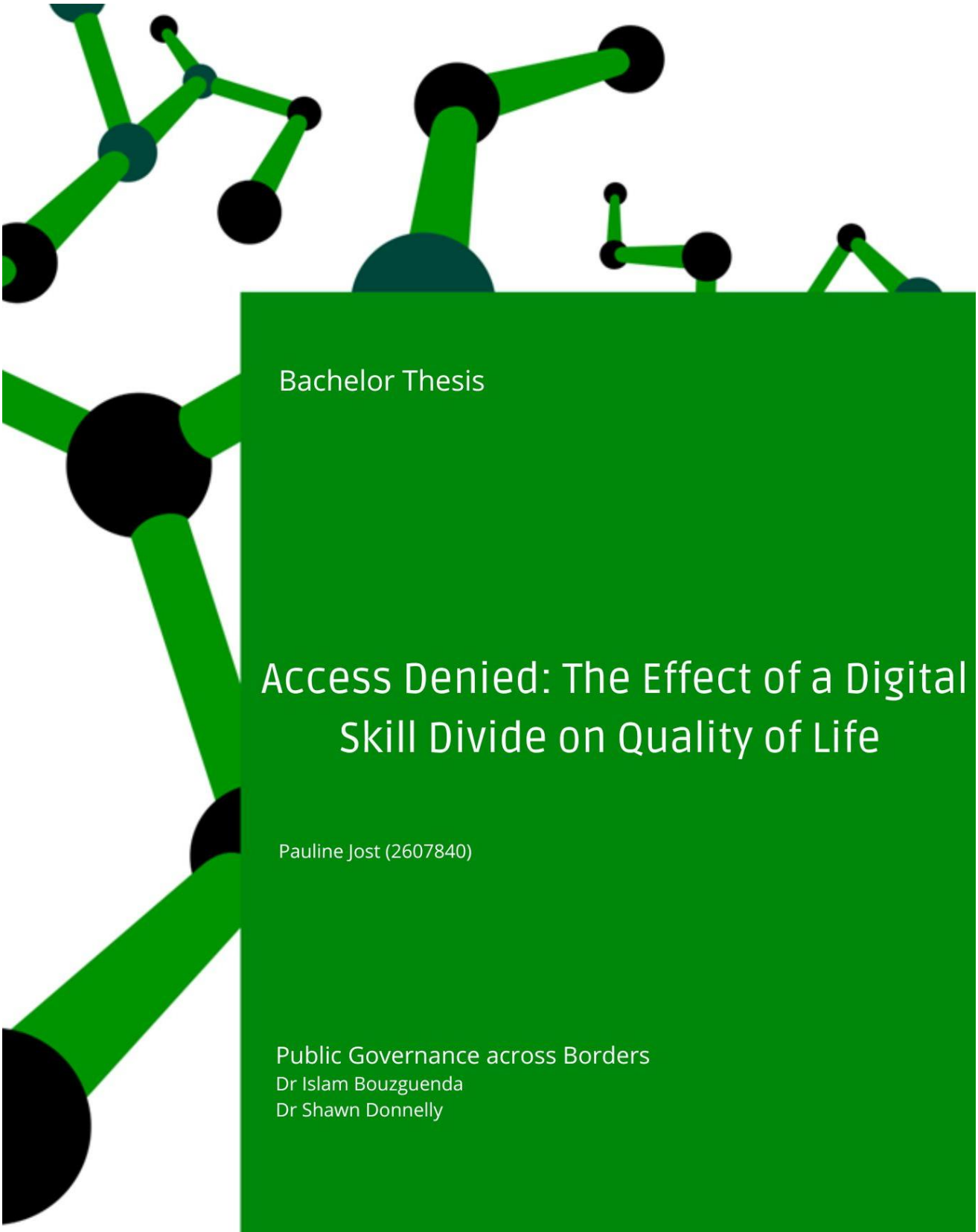

Bachelor Thesis

Access Denied: The Effect of a Digital Skill Divide on Quality of Life

Pauline Jost (2607840)

Public Governance across Borders
Dr Islam Bouzguenda
Dr Shawn Donnelly

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University of Twente
Enschede, Netherlands

WWU Münster
Münster, Germany

Content

Abstract

This study explores how the quality of life of individuals is affected by differences in digital skills, or the "second level digital divide" with regards to socially sustainable smart cities. In this context, Information and Communication Technologies (ICTs) have been identified to be a crucial tool to achieve development goals such as reducing social inequalities and enhancing individuals' quality of life, which is crucial for social sustainability. However, scholars have been concerned with digital inequalities, regarding differences in digital skills, that occur once access has been provided. Drawing upon Sen's capability approach, van Dijk's skill access framework, and previous empirical findings, this study contributes to the existing body of literature by exploring the effect of digital skills on quality of life of individuals. It utilizes data from the Eurobarometer 87.1 from 2017 and bivariate regression analyses is performed. Key findings are that (i) digital skills in general have a positive effect on the quality of life of individuals, which empirically supports the underlying theoretical frameworks and (ii) digital skills in professional life in particular, is causal for quality of life which replicates findings of several previous studies on the matter.

1 Introduction

Smart city initiatives have been emerging over the last several years to address challenges that the massive urbanisation of society has brought about using, amongst other things, new technologies (Dameir, 2016; Yigitcanlar et al., 2018). Essentially these first smart city initiatives were based on the processing and management of data provided by digital infrastructure, such as algorithms entangled in the urban environment, to improve urban management. This however has led smart cities to be reduced to "one-dimensional business models" (han & Hawken, 2018), as they are globally ranked by technological capability, similar to businesses like Amazon or Google. According to Han and Hawken (2018), such rankings neglect cultural nuances, human behaviours, and quality of life within the cities, factors that are crucial for smart cities to endure over time. Furthermore, they stress that a focus on data processing and management is not enough to achieve innovation across all areas of society, which include environmental, societal, and economic aspects. Yigitcanlar et al. (2018) underline this concern by pointing out that in most cases smart cities are known as "hubs of technological innovation" (p. 145) rather than places of sustainable development.

1.1 Socially Sustainable Smart Cities

These concerns identify a need to examine and consider social issues in smart cities, such as risks of social exclusion and polarization, gentrification, or urban poverty, in order for these projects to be successful and preserving. In their multidimensional smart city framework, Yigitcanlar et al. (2018) have identified liveability of the city and well-being of its citizens to be desired outcomes, under the umbrella of society as a fundamental development aim. This notion of social sustainability includes a shift from performance based smart cities towards a "connection between people and place" (Sugandha, Freestone, & Favaro, 2022, p. 1). In the course of achieving socially sustainable smart cities, increasing its citizens quality of life has been shifted into focus (De Guimaraes, Severo, Júnior, Da Costa, & Tasso Salmoria, 2020). According to De Guimaraes et al (2020) quality of life in a smart city context refers to "positive situations that result in citizen's cognitive, subjective and affective well-being" (p. 1). In other words, it is about making people happier and more satisfied by reducing unemployment, social inequalities, homelessness, etc.

1.3 Role of Digital Technologies

On the one hand, Information and Communication Technologies (ICTs) have been identified to be a crucial tool to achieve development goals such as reducing social inequalities and enhancing individuals' quality of life (Dameir, 2016; Han & Hawken, 2018). For instance through providing access to important information, creating opportunities in education and employability and foster citizen involvement and participation in the economy (Han & Hawken, 2018). This can furthermore enhance citizen participation through social media, open data, and co-creation platforms which can help urban governance to understand the demands of the public and act accordingly. Another example of how ICT use can improve QoL would be the utilization of an Intelligent Transport System to collect and spread information that could potentially lead to less traffic. This could enhance citizens

perception of their work-life-balance and have a positive effect on their health and emotional well-being (Dameir, 2016). On the other hand, relying on ICTs seems to not be providing equal opportunities for all individuals and therefore creates *new* social inequalities (Han & Hawken, 2018). Scholars who have been concerned with the digitization of everyday life and these digital inequalities that have emerged because of it, have identified that not only access to these technologies but factors such as the ability to use them and produce meaningful outcomes play an important role as well (Lythreatis, Kumar Singh, & El-Kassar, 2022). This phenomenon of a "digital divide"

1.4 Relevance and Study Objectives

By focussing on the consequences of differences in digital skills on the quality of life of individuals, this study contributes to the existing body of digital divide and quality of life literature. It furthermore provides policy makers and urban planners with information for the implementation of ICT infrastructure in cities and how to generate a better quality of life for its citizens. Additionally, this study is relevant in a Smart City context as it challenges the assumption on which most Smart City projects are based: providing access to ICTs improves individuals' quality of life. This is to be achieved by exploring how the differences in abilities to use the provided ICTs affect quality of life. By doing so, it can be examined whether the provision of physical access to ICTs is enough to enhance the QoL of individuals or if further factors, such as digital skills, need to be considered to achieve social sustainability in Smart Cities. On the one hand, this contributes to the body on Smart City literature as further empirical results will be provided regarding society and technology, which are two crucial elements of Smart City Projects. On the other hand, the results of this study furthermore have practical implementation of Smart City projects especially with regards to social aspects of its implementation.

Given the brief literature review outlined above, the following, central research question has been developed: What is the effect of differences in digital skills on the quality of life of individuals?

As this study seeks to examine in how far a better QoL is determined by differences in digital skills, the research question is explanatory and examines individuals as the unit of analysis. Since this project will utilize a quantitative research design and statistical analysis it can be considered to be a positivist work.

2 Understanding the Digital Divide and Quality of Life – The State of the Art

This section briefly defines the concepts, quality of life and digital divide, the study is concerned with and furthermore elaborates on theoretical frameworks and empirical findings its hypotheses are based on based on. To recall, this study aims to explore whether the ability to use digital technologies has an effect on individuals' quality of life to determine whether providing access to ICTs is enough to contribute to more socially sustainable and persevering smart cities or if further measures should be taken to create urban environments with a high quality of life.

2.1 Quality of Life

There are several studies that use QoL as the focus of their research and seek to understand how and with what this concept is influenced. However, defining QoL has proven to be difficult and according to Marans and Stimson (2011) there is no standard definition nor measurement of the phenomenon. QoL can be understood as evaluating human circumstances, as individual's perceived position in life, or simply their overall well-being (Macke, Casagrande, Sarate, & Silva, 2018; Marans & Stimson, 2011; Nevado-Peña, López-Ruizb, & Alfaro-Navarrob, 2019). Nevertheless, most scholars seem to agree that it needs to be differentiated between objective QoL and subjective QoL, both of which can be measured. This distinction goes back to Cummins who stated that there is a "difference between objective population standards and personal well-being" (Cummins, 2000). The former is identified to be influenced by cultural definitions as well as physical, social, and economic aspects, for instance wages and rent, climate, and unemployment rate (Macke et al., 2018); (Nevado-Peña et al., 2019). Subjective QoL on the other hand is often investigated from an empiricists positivist approach focussing on the individuals state of satisfaction in several domains or in other words "'what it is' that makes one satisfied." (Marans & Stimson, 2011). Nevado- Peña et al. (2019) emphasise that the subjective QoL is significantly influenced by the individual's social and economic inclusion. This research will focus on this subjective QoL as it is measured at individual level and will be more fitting when considering that this study examines the relationship between digital skills of individuals and their QoL.

As mentioned before, a popular conceptualization of QoL has been conducted by Cummins (2000). He not only introduced a distinction between objective and subjective QoL but also identified seven domains of life satisfaction in which both concepts can be measured: material well-being, productivity, safety, emotional well-being, community, intimacy, and health. These can be examined on the one hand through objective measurements of QoL such as indices on the one hand and on the other hand through subjective measurements, i.e. individuals' rating their satisfaction in each of the domains. With regards to measuring objective QoL Cummins stated that "most objective measures compromise frequencies and counts" (Cummins, 2000). To give a crass example, an objective measurement of QoL in the safety domain would be for instance to look at the crime rate in a certain city or area. Measuring the subjective QoL in the safety domain in the same area could be done by conducting a social survey where the individuals are asked how satisfied they are with the safety in their area. Here the answers might differ to a large extend as there might be people who have experienced a crime and therefore are less satisfied than those who never experienced one.

2.2 The Digital Divide

The phenomenon of a "digital divide" has gained popularity within academic arenas in the early 1990s. It can be broadly defined as "the gap between people who have adequate access to information communication technology [ICT] and people who have poor or no access to ICT." (Lythreatis et al., 2022). This gap has the potential to intensify existing social inequalities through restricting or improving individuals' social and economic capital, as well as affecting their capability to participate in society. In

other words, people who do not have adequate connection to ICTs are likely to suffer from disadvantages such as social and economic exclusion (Lythreatis et al., 2022). An aftermath that became increasingly visible and intensified through the Covid-19 pandemic. As digital technologies were one of the main channels for states and crucial organisations such as the WHO to inform the citizens about the current situation and provide recommendations, those who did not have access or were not able to use these technologies had significant disadvantages and were arguably more exposed to the virus (Beaunoyer, Dupéré, & Guitton, 2020). Thus it can be argued that digital inequalities additionally have crucial implications for health aspects. In their analysis of a gender digital divide, Kerras, et al. (2020) furthermore emphasized that ICTs provide as faster and greater amount of information which enables those who have access to it to make faster better-informed decisions which gives them a competitive advantage over those who have no or less access.

The digital divide is furthermore a multi-level phenomenon. In the early stages of its exploration, the divide was understood as a binary division between people who have (physical) access to ICTs and those who have not. This access or first-level divide, however, has been extended through the notion of a digital skills or usage divide (Lythreatis et al., 2022). This second-level divide goes beyond access to ICTs and is concerned with inequalities regarding skills and knowledge about those types of technologies. In other words, even though people have access to ICTs because they own a computer for instance, does not mean they are able to use them adequately as they might not have the necessary skill set. Van Dijk calls this the *deepening divide* to show that the problem of digital inequalities begins with the incorporation of digital media in everyday life (van Dijk, 2011). For instance, social media platforms for maintaining friend- and relationships, online portals for job applications, or working together online using the cloud, and many more. The third-level divide deals with unequal capacities to generate beneficial outcomes of ICT usage in *offline* life. It is based on the assumption that access and skills/usage are not enough to benefit from everything technology has to offer (Lythreatis et al., 2022).

Digital divide research so far has focussed mainly on causes rather than outcomes or consequences of those digital inequalities (van Dijk, 2011). In his book "The deepening divide: Inequalities in the Information Society" van Dijk (2005) does address potential consequences of a digital divide stating that "People with less access to digital media may become second- or third-class workers, students, citizens, consumers and so on" (van Dijk, 2005). He argues that the digital divide can either lead to people's inclusion in several fields of society such as the labour market, education, politics, etc. or facilitate their exclusion thereof. Büchi, Festic, & Latzer, (2018) conducted research on the effect of digital inequalities on subjective well-being and found that especially digital inequality outcomes (third-level divide) affect life chances in economic, social, political, institutional, or educational life domains. They furthermore argue that digital skills are a key factor in preventing social exclusion through enabling people to take part in information society, not only through finding a job or making friends online but by the feeling of not being left out and being part of a larger society. Additionally, they

mention a so-called feedback effect according to which people with higher internet skills are more likely gain more benefits in offline life (e.g. educational, economic, or cultural domain) which enables them to further increase their digital skills. Thus they are again more likely to achieve higher offline gains (Büchi et al., 2018). This feedback effect is comparable to van Dijk's notion of a deepening divide previously mentioned.

2.3 Theoretical Framework

The following section will present two frameworks that will help connecting digital skills and quality of life. Based on the two concepts, the main hypotheses in section 2.4 are formulated.

2.3.1 Sen's Capability Approach for QoL

A framework that could help to understand the connection between digital divide and individuals' subjective quality of life, especially with regards to differences in digital skills, is the capability approach: it is "a broad normative framework for the evaluation and assessment of individual well-being and social change" (Robeyns, 2005). Due to its interdisciplinary character, it considers multiple dimensions of well-being, however additional explanatory theories are required when applied to issues of policy and social change: it can be allocated to the liberal school of thought in political philosophy as it values individual freedom, and its beginnings can be traced back to Aristotle, Smith, and Marx. Contemporarily, Sen (1999) and Nussbaum (2004) are known to be the pioneering scholars who have continued to develop the capability approach. In general, it is about how policies should be focused on removing obstacles so that people "have more freedom to live the life that, upon reflection, they have reason to value" (Robeyns, 2005). Sen states that development should be achieved through focussing on human freedoms rather than on "growth of gross national product, or with the rise in personal incomes, or with industrialization, or with technological advance or with social modernization" (Sen, 1999). However, all these factors are nevertheless important as they can serve as tools to achieve these human freedoms. Nussbaum frames the capabilities approach as a contestation of the "idea of development as economic growth and insisted on the idea of 'human development'" (Nussbaum, 2004).

To be more precise, the capabilities approach entails that the aim of development is to give people "the necessary conditions of a life with human dignity" (Nussbaum, 2004). Inequalities do not only depend on having access to certain commodities (goods and services), here for instance ICTs but also to achieve certain functions, like being healthy or productive, the person's capabilities are essential (Zheng & Walsham, 2008). Capabilities are essentially defined as "what people are effectively able to do and to be" (Robeyns, 2005). In other words, it is possible that two people have access to the same set of commodities but gain different outcomes due to differences in their capabilities. By examining the relationship between digital divide and subjective quality of life through the lens of Sen's capability approach it can be expected that people who are prevented from benefiting from all opportunities ICT offers due to lack of capability, they are less likely to be satisfied with their current situation in several life domains and therefore account for a lower (subjective) QoL. As mentioned before the approach

often requires an additional explanatory theory to support its claim. For this reason, a second theoretical framework was used to explain the effect of differences in digital skills on the quality of life of individuals: van Dijk's skill access approach.

2.3.2 Van Dijk's Skill Access Approach

In his book "The Deepening Divide: Inequality in the Information Society" (2005) Jan van Dijk introduces a multidimensional framework of the digital divide, that includes both its causes as well as its consequences (van Dijk, 2005). He states that the inequalities with regards to digital technologies can occur on four different levels: motivational access, physical access, skill access, and usage access. Focussing on the skill access component, he argues that the divide here is even greater than in motivational or physical access. He stresses that whether someone has adequate skills to use digital technologies does not necessarily depend on certain courses or other types of formal education but is mainly attained through practice (van Dijk, 2005). Having the possibility to practice using digital technologies on a daily basis in turn depends on certain resources and positional and personal categories.

Van Dijk differentiates between three types of skills required for using technology: operational, informational, and strategic. For instance, for a person to be able to achieve the operational skills to use these technologies they need to have access to the hardware and software not only at work or in school but also at home, which comes with requirements of certain material resources. Another example would be that the skills needed to be able to navigate through the internet, the ability to select and evaluate the information presented there, are in fact intellectual skills that are attained in regular studies such as mathematics, language, or art. Strategic skills are defined as "(…) the capacities to use computer and network sources as the means for particular goals and for the general goal of improving one's position in society" (van Dijk, 2005). This can affect domains such as employment, social relationships, and educational careers. The acquisition of such strategic skills is especially dependant on positional categories as those with a better position in society generally get better chances of learning these skills, especially in school. This also shows how existing social inequalities are reflected and perhaps even intensified in digital inequalities. Van Dijk emphasizes that those who know how to protect themselves and their data in the digital world, as they have the necessary skills to understand how it works, are more likely to feel free to use these connections and are able to reap the benefits of digital technologies. This in turn leads them to have higher chances of developing strategic skills (van Dijk, 2005).

Additionally, to examining the causes of these differences in access to digital technologies, van Dijk addresses the consequences of such digital inequalities for our society. He begins by naming several motivations for closing this digital divide, such as having to support technological progress and development or from an economic perspective, considering the economic development of countries, the effectiveness and efficiency of companies or the improvement of individuals' position in the labour market. However, he emphasizes an ethical imperative of equal distribution of resources and life chances as well as social inclusion/participation as without adequate access to digital technologies "a large part

of the population might be excluded from meaningful participation in the society of the future" (van Dijk, 2005). As mentioned before, this could lead to the development of first-, second-, and third-class citizens. Van Dijk furthermore points out that through unequal access to digital technologies a feedback effect is created, meaning that people with high levels of access can secure better positions and resources of all kinds which enables them to acquire other resources that are denied for those who have lower levels of access (van Dijk, 2005).

He discusses how differences in digital skills can lead to absolute and relative exclusion or inclusion in several domains of societal participation, including the economic, educational, social, and spatial domain.

In the economic domain digital skill access matters because certain jobs require different types of digital skills, some being more complex than others. Those that require simple digital skills might be prone to be automated which would lead workers skilled only to this level to be excluded from the labour market. It furthermore influences their career opportunities which can affect the material well-being of the employees (van Dijk, 2005). In the educational domain, access to at least computers and the internet are indispensable for university education and increasingly for lower level as well as adult education, meaning that no access leads to exclusion from several educational opportunities and can affect other domains as well such as the economic one. Digital skills furthermore matter for social participation, as being able to use the internet for instance can increase social capital and lead to the ability to expand one's social network which can affect social and material resources, as well as the position in the labour, marriage, and friendship market. Van Dijk furthermore emphasises that "(T)he tool of the Internet strengthens the socially strong more that the socially weak" (van Dijk, 2005). With regards to spatial participation van Dijk states that "(N)ot having access to online environments increasingly also means absolute exclusion from particular offline environments and from a number of social, economic, and cultural opportunities." (van Dijk, 2005).

It can be concluded that on the one hand the digital divide reflects and amplifies existing social inequalities and on the other hand creates new, digital inequalities that ultimately lead to a tripartite society: First, the information elite with strong social and media network links, occupying the best jobs and positions in society and that has almost unlimited access to ICTs. Second, the participating majority which has smaller social and media networks, where ICTs are mainly used for entertainment purposes with less informational and strategic skills. And third, the unconnected and excluded who are found in all advanced high-tech societies and have next to no access to digital technologies This does not only have normative implications of exclusion of groups from relevant fields of society but also poses a threat to democracy as *"(…) all relevant decisions in society would be made by the information elite."* (van Dijk, 2005, p. 180).

Based on the two existing theoretical frameworks a first hypothesis can be formulated regarding digital skills to use technologies in daily life. As van Dijk (2005) pointed out, it is crucial to use digital

technologies outside of a professional or educational context to be able to sufficiently operate them. This ability could enhance the general understanding of digital technologies which can lead to increased social participation and a growing social network that can positively influence social as well as material well-being. In other words:

H1: People with higher digital tech usability skills in their daily life report a higher QoL.

2.4 Existing Findings

While the field of digital inequalities research and its effect on QoL is still relatively new, existing empirical findings generally support the premises on which most Smart City projects are built, that having access to ICTs enhances people's QoL. Ali et al. (2020) for instance have examined the relationship between digital inclusion and QoL at household-level in Australia and found that digital inclusion significantly predicts QoL along with socio-economic advantages, remoteness, rural-urban divide, and lifestyle (Ali, Alam, Taylor, & Rafiq, 2020). Nevado-Pena et al. found that individuals who live in regions with a high ICT use and capacity also assess their QoL as higher and conclude that the "digital citizen is happier" (Nevado-Peña et al., 2019). Similarly, Alhassan & Adam show that digital inclusion and ICT access also have a significant, positive relationship with individuals QoL at the global level (Alhassan & Adam, 2021). Büchi et al. (2018) on the other hand examined the influence of the perception of digital belongingness, meaning the feeling of belongingness to information society, digital potential (internet skills) as well as digital participation (internet use) on social well-being of individuals which they considered as a determinant of QoL. Their findings show that both digital belongingness and internet skills positively influence social well-being, while the actual digital participation is not as significant (Büchi et al., 2018).

Digital Skills and Material Well-being

Van Dijk's skill access approach touches upon the consequences of digital skills on the economic domain of life. However, this topic deserves further elaboration. The notion that digital skills are crucial to improve one's position on the labour market has been subject of several digital skills research in the past years with mostly similar outcomes: the demand for digital skills on the labour market has increased (Bejakovic & Mrnjavac, 2020; Hecker & Loprest, 2019). Scholars agree that the digitization of the workforce has, on the one hand, generated new occupations, such as data scientists or Internet engineers, that are based in digital technologies. On the other hand, it has led to the transformation of existing jobs that traditionally were not involved with digital technologies, such as teachers or construction supervisors (Bejakovic & Mrnjavac, 2020; Hecker & Loprest, 2019; Layla & Bledi, 2020). This, furthermore, underlines the fact that the increasing demand for, especially foundational digital skills such as using a computer, in professional life is a phenomenon that cuts across all occupational sectors and professions. Bejakovic and Mrnjavac (2020) found that lacking digital skills "affects the possibility of getting a job, getting a promotion, or a pay rise" (p. 927). Layla and Bledi (2020) explored the demand for digital skills in job vacancies in Germany. They analysed job posting data between 2014 and 2018

for levels and changes of demand for digital skills. Their findings show a high demand for digital skills across occupations and a direct positive correlation between digital skills and salary: people with high levels of digital skills earn more that people with low digital skills.

However, digital skills are not only vital for being able to efficiently perform at the workplace but also for upgrading one's general skills for employability and to increase human capital (Evangelista, Guerrieri, & Meliciani, 2014). Employability does not only include getting a job but also the ability to adapt to the changing working environment, enhancing one's capabilities, as well as meeting goals and promotions (Bejakovic & Mrnjavac, 2020). E-learning or Learning through Digital Technologies provides opportunities to access platforms such webinars, web blogs or expertise sessions that enhance the employability potential of employees and facilitates lifelong learning by helping to develop crucial skills such as networking, communication, and collaboration (Evangelista et al., 2014). E-learning can be understood as the "process in which the teacher or learner uses digital equipment to access digital tools (…) to improve their knowledge and skills" (Evangelista et al., 2014). E-learning therefore enables employees to increase their human capital and stay competitive on the labour market.

According to the current consensus in the literature it can be said that nowadays employees, even in occupations that do not primarily deal with digital technologies, are expected to have some level of digital skills to be productive in professional life and that digital learning increases employability and competitiveness in the labour market. The level of digital skills therefore affects the amount of financial return (income) and possibility of a promotion. This influences the satisfaction of financial domains such as: financial satisfaction in general, financial stress, feelings of financial security, etc. Factors that can influence the individual's subjective material well-being (Brulé & Suter, 2019).

Based on these findings the following two hypotheses will be tested in this study:

> *H2: People with higher digital tech usability skills in their professional life report a higher QoL.*
>
> *H3: People with higher digital skills to access digital learning opportunities report a higher QoL.*

3 Methodology

3.1 Data

To answer the research question and test the hypothesis outlined above this study utilizes a quantitative research design. The data used is derived from the Eurobarometer survey 87.1 2017. The Eurobarometer survey is regularly conducted since 1974, by the European Commission to observe public opinion of various topics in member states as well as potential member states (European Union, 2022). The theme of the Eurobarometer used in this study includes topics such as attitudes towards tobacco and electronic cigarettes, climate change, the impact of digitisation and automation on daily life, as well as coach services (GSIS, 2022).

The Eurobarometer 87.1 was conducted during the period 18th of March to 27th of March 2017. The data was gathered at individual level and includes 27901 respondents from 29 countries using a stratified sample. Before conducting the analyses, the data was filtered, leaving the study with a total of 11834 cases. The dataset entails 654 variables in total. For gathering the information face-to-face interviews with the respondents were conducted (GSIS, 2022). As mentioned above this Eurobarometer concerns several topics but most importantly, for this study, it includes the attitudes of individuals on the impact of digitisation and automation on daily life. Because the survey is measured at individual level the Eurobarometer 87.1 is appropriate to measure the subjective QoL and furthermore includes data on internet access, digital skills, etc. (see operationalization below

3.2 Methods

To answer the research question how differences in digital skills affect the quality of life of individuals a quantitative analysis approach was used in this study. Multiple bivariate linear regression analyses will be applied for the hypotheses and a hierarchical multiple regression analysis model for controlling for third variables, using SPSS. Such an analysis enables me to determine whether differences in the dependent variable, quality of life, can be explained by differences in the ability to use digital technologies and how strong this correlation is. Before starting the regression analyses, I will get an overview over the data via descriptive statistics and furthermore test for bivariate correlations between the predictor variables and quality of life. I will also test the variables that are used in the models for normality, multicollinearity, and linearity as well as reliability using Cronbach's alpha to test whether the data are fit for performing a bivariate regression analysis.

3.3 Operationalization of the data

3.3.1 Dependent Variable

As described before, this study examines the effect of a digital divide on the subjective quality of life of individuals. "Quality of Life" will therefore serve as the dependent variable in all hypotheses that are tested. In the Eurobarometer 87.1 (2017), a number of variables can be found that will be utilized to present the QoL. The following three questions that can be found in the survey will be combined to represent QoL. Variable "D70" one the one hand asks "On the whole, are you very satisfied, fairly satisfied, not very satisfied or not at all satisfied with the life you lead" and will be used as an indicator for the individual's overall life satisfaction. As elaborated in the hypotheses, this study mainly focusses on how digital skills affect the economic and educational domains of an individual which has a strong impact on the material well-being component of quality of life as it affects financial satisfaction and stress. The variables "D60: During the last twelve months, would you say you had difficulties to pay your bills at the end of the month...?" and D63 that asks the respondent to allocate themselves and their household to a certain social class can be used to measure the individual's perception of their material well-being.

To be able to construct the dependent variable "Quality of Life", the three variables need to be recoded so that they can be combined.

For all the models, the dependent variable is an ordinal 3-point scale variable, derived from three original questions asked in the dataset. Variable D70 gives information about the general life satisfaction of the respondent, asking "On the whole, are you very satisfied, fairly satisfied, not very satisfied or not at all satisfied with the life you lead?". Since this variable is originally coded as 1 = very satisfied through to 4 = not at all satisfied it needs to be recoded and flipped so that a higher value equals a higher level of satisfaction, for the correlation to be positive. Furthermore, answers of "not very satisfied" and "not at all satisfied" were combined to 1= not satisfied. All non-responses were excluded from the variable.

Since the responses for variable D60 were coded in a way that a lower value equals more difficulties in paying the bills at the end of the month, no recoding was needed and only non-responses were excluded. Like D70 the coding of the answers for D63 was flipped so that a lower value equals a perceived belonging to a lower social class. Answers with the original values of 1 = working class and 2 = lower middle class were combined, as well as 4 = upper middles class and 5 = upper class. The new variable was coded as 1 = lower class, 2 = middle class, and 3 = upper class. Answers with the values 6, 7, 97, and 98 were excluded as they were either refusing to answer or "don't know".

Table 1. Overview for Operationalization of Dependent Variable "Quality of Life"

Dependent Variable	Survey questions representing concept	Question statement	Original code	New code
Quality of Life	D70	On the whole, are you very satisfied, fairly satisfied, not very satisfied or not at all satisfied with the life you lead?	1= very satisfied 2= fairly satisfied 3= not very satisfied 4= not at all satisfied 5= don't know	1= not satisfied 2= fairly satisfied 3= very satisfied 5= 99 (missing)
	D60	During the last twelve months, would you say you had difficulties to pay your bills at the end of the month…?	1= most of the time 2= from time to time 3= almost never/never	1= most of the time 2= from time to time 3= almost never/never
	D63	Do you see yourself and your household belonging to…?	1= working class 2= lower middle class 3= middle class	1= lower class 2= middle class 3= higher class 5 through 9 = 99 (missing)

			4= upper middle class 5= higher class 6= other 7= none 8= refusal 9= don't know	

All three recoded variables were then combined to obtain the dependent variable QoL "Quality of Life", in which a lower score equals a lower perception of one's quality of life.

3.3.2 Independent Variables

In order to measure digital skills, variable QD4 was used as it measures the respondent's assessment of their individual skills in using digital technologies. The variable measures digital skills in five different domains, three of which will be used for the main hypotheses. QD4_1 assesses the individuals' digital skills with regards to use of digital technologies in their daily life and is used to as the independent variable in H1: *People with higher digital tech usability skills in daily life report a higher QoL*..For the second hypothesis (*People with higher digital tech usability skills in professional life report a higher QoL)* QD4_2 "You consider yourself to be sufficiently skilled in the use of digital technologies to do your job" will be used to measure digital skills in the economic domain and its effect on QoL. QD4_5 measures the individual's ability to access digital and online learning opportunities and serves as independent variable for H3: *People with higher digital skills to access digital learning opportunities report a higher QoL*. .

All three variables were answered on a scale from one to four where a low score equals the respondent considers themselves to be sufficiently skilled in digital technologies and a high score equals a low confidence in those skills. All variables were recoded and flipped so that in each of the newly obtained variables a higher score equals a higher degree of digital skills. Furthermore, all non-responses were excluded from the recoded variables.

Table 2. Overview of Operationalization of Independent Variables

Independent variables	Survey questions representing concept	Question statement	Original code	New code
Digital tech usability skills in daily life	QD4_1	To what extent do you agree or disagree with the following statements regarding your skills in the use of digital technologies: You consider yourself to be	1= totally agree 2= tend to agree 3= tend to disagree 4= totally disagree 5= don't know	1= totally disagree 2= tend to disagree 3= tend to agree 4= totally agree 5= 99 (missing)

		sufficiently skilled in the use of digital technologies in your daily life?		
Digital tech usability skills in job/professional life	QD4_2	To what extent do you agree or disagree with the following statements regarding your skills in the use of digital technologies: You consider yourself to be sufficiently skilled in the use of digital technologies to do your job?	1= totally agree 2= tend to agree 3= tend to disagree 4= totally disagree 5= don't know	1= totally disagree 2= tend to disagree 3= tend to agree 4= totally agree 5= 99 (missing)
Ability to use digital learning opportunities	QD4_5	To what extent do you agree or disagree with the following statements regarding your skills in the use of digital technologies: You consider yourself to be sufficiently skilled in the use of digital technologies to benefit from digital and online learning opportunities?	1= totally agree 2= tend to agree 3= tend to disagree 4= totally disagree 5= don't know	1= totally disagree 2= tend to disagree 3= tend to agree 4= totally agree 5= 99 (missing)

3.3.3 Control Variables

In order to increase the validity of this study a third variable control is conducted. A third variable, sometimes referred to as mediator or confounding variable, could influence both the independent and dependent variable. When failing to control for such a confounding effect it might seem that there is a correlation between two variables even though both can be explained by this third variable. To avoid this and be sure that there is in fact a correlation between digital skills and quality of life I will conduct hierarchical regression analyses by adding the third variables to the original model an see whether the effect of my independent variables is still significant.

The control variables I will use are gender, age, and education. For gender I have recoded variable D10 "Gender" so that 0 equals man and 1 equals woman. For age I will use the recoded variable D11R1 that is already found in the dataset and sorts age into four different categories: 1= 15-24, 2= 25-39, 3= 40-54, 4= 55 and older. For education I will also use an existing recoded variable D8R2 which entails the age at which the respondent has stopped their full-time education. There was no need for recoding, however I did exclude missing values.

4 Results

4.1 Assumptions and Reliability

The data is tested on normality, multicollinearity, and linearity before continuing with the analysis. The test for normality reported that the data is not normally distributed however, due to the large sample size, the regression analysis is robust to the violation of normality. The predictor variables were not multicollinear as the variance inflation factor (VIF) value was <5.00. Linearity was tested via a scatterplot to determine whether the predictor variables have a straight-line relationship with the outcome variable. With a Cronbach's alpha value of 0.775 the constructed variable "Quality of Life" is a good representation of reality.

Table 3. Cronbach's Alpha for Quality of Life

Construct	N of Items	Cronbachs alpha
Quality of Life	3	0.775

4.2 Descriptive Statistics and Correlation

Table 4. Descriptive Statistics (N = 11834)

	Min	Max	Mean	s.d.
Quality of Life	1.00	3.00	2.14	0.46
Digital Skills in Daily Life	1.00	4.00	3.24	0.85
Digital Skills to do your job	1.00	4.00	3.19	0.92
Benefit from digital learning opportunities	1.00	4.00	3.08	0.92

The sample as a whole seemed to be fairly satisfied with their quality of life (M = 2.14, SD = 0.46). On average the individuals assessed themselves to be *fairly skilled* in using digital technologies in their daily life (M = 3.24, SD = 0.85), to do their job (M = 3.19, SD = 0.92), and their ability to benefit from digital learning opportunities (M = 3.08, SD = 0.92) (see Table 1).

Table 5. Correlation Matrix (N = 11834)

	Quality of Life	Digital Skills in Daily Life	Digital Skills to do your Job	Ability to benefit from Online Learning Opportunities
Quality of Life	1.00			
Digital Skills in Daily Life	0.231**	1.00		
Digital Skills to do your Job	0.273**	0.751**	1.00	
Ability to benefit from Digital Learning Opportunities	0.262**	0.699**	0.694**	1.00

**p<.01; *p<.05, two-tailed test

The results of the Spearman correlation (see Table 2) indicate that there is significant but weak positive association between digital skills in daily life and quality of life with a value of .231. The same goes for digital skills in the job life and quality of life with .273. The association between ability to benefit from digital learning opportunities and quality of life is significantly positive as well 274. All correlations are statistically significant at a level of .01. These results support the assumptions of a relationship between the predictor variables and independent variable, as well as their direction, as expected. In other words, the results of the Spearman correlation support the assumptions made in the hypotheses that individuals who have higher levels of digital skills in daily and job life, as well as those who are able to benefit from digital learning opportunities, are more satisfied with the life they lead, aka with their quality of life.

4.3 Regression and Control Variables

The following section contains the results of the regression analysis for the main hypotheses, presented in Tables 6 to 8. It furthermore shows the hierarchical regression models, containing the control variables age, gender, and education (Tables 9 to 11).

Table 6. Regression Analysis of Quality of Life (N = 11834)

	b	s.e.
Constant	1.709***	.016
Digital Skills in Daily Life	.132***	.005
R^2	0.059	

*p<0.1;**p<0.05;***p<0.01

For H1 *People with higher digital tech usability skills in their daily life report a higher QoL* I reject the null hypothesis that there is no correlation between digital skills in daily life and quality of life. The p-value is 0.00 which means the regression is statistically significant as it is <0.01. The R^2-value of the

model is 0.059 which means that it explains 5.9% of quality of life. These results reflect the findings of the correlation, that there is a weak positive relationship between the two variables. In general, they indicate that people who have higher digital tech usability skills in their daily life also have a higher quality of life than those with lower digital tech usability skills in their daily life.

Table 7. Regression Analysis of Quality of Life (N = 11834)

	b	s.e.
Constant	1.682***	.015
Digital Skills in Job Life	.143***	.004
R^2	.079	

*p<0.1;**p<0.05;***p<0.01

Likewise, I reject the null hypothesis for the second hypothesis, that there is no correlation between digital tech usability skills in job/professional life and quality of life. Here again, the model is statistically significant with a p-value of 0.00. However, this model explains 7.9% of quality of life ($R^2 = 0.079$) which is slightly improved compared to the first model. Nevertheless, this value is low which means there is again a statistically significant but weak positive correlation between digital skills in job/professional life and quality of life. In other words, people with higher digital tech usability skills have a higher quality of life that people who have lower digital tech usability skills in job/professional life.

Table 8. Regression Analysis of Quality of Life (N = 11834)

	b	s.e.
Constant	1.709***	.014
Ability to benefit from Digital Learning Opportunities	.139***	.004
R^2	0.079	

*p<0.1;**p<0.05;***p<0.01

The same goes for H3: The higher the individual's ability to benefit from digital learning opportunities, the higher their quality of life. The p-value is 0.000 and therefore statistically significant and with an R^2-value of 0.079 the variable explains 7.9% of the model. This indicates that people with higher abilities to benefit from digital learning opportunities also have a higher quality of life compared to those with lower abilities.

Table 9. Hierarchical Linear Regression Analysis of Quality of Life (N = 11834)

	Model 1		Model 2		Model 3	
	b	s.e.	b	s.e.	b	s.e.
Constant	1.712***	(0.017)	1.605***	(0.020)	1.570***	(0.026)

Digital Skills in Daily Life	0.132***	(0.005)	0.088***	(0.005)	0.144***	(0.005)
Gender	-0.005	(0.008)				
Education (low = ref.)			-	-		
medium			0.142***	(0.017)		
high			0.379***	(0.018)		
Age (15-24 = ref)					-	-
25-39					0.067***	(0.021)
40-54					0.098***	(0.021)
55 and older					0.184***	(0.022)
R^2	0.059		0.132		0.70	

*p<0.1;**p<0.05;***p<0.01

Table 6 shows the results of a third variable control for the relationship between digital tech usability skills and quality of life. The findings indicate that gender does not influence this relationship. While the B-value is negative (B = -0.005), indicating that men tend to report a higher quality of life than women, the correlation is not statistically significant (p = 0.517). Additionally, the effect of digital tech usability skills remains significant (p = 0.00) and by adding the third variable gender R^2 remains at 0.059 showing that the overall model is not improved by the addition of gender. When testing for an interaction effect of education the results show that here is a statistically significant (p = 0.00) positive correlation between education and quality of life. In other words, people with higher levels of education report a higher quality of life than people with lower levels of education. The effect of digital skills in daily life remains significant (p = 0.00) however, the addition of education improves the overall model to 13.2% (R^2 = 0.132). Controlling for the third variable age shows a statistically significant (p = 0.00) positive effect of age on quality of life as well. This indicates that older people tend to report a higher quality of life than younger people. The overall model is slightly improved to R^2=0.70, however this improvement is not as severe as through the addition of education.

Table 10. Hierarchical Linear Regression Analysis of Quality of Life (N = 11834)

	Model 1		Model 2		Model 3	
	b	s.e.	b	s.e.	b	s.e.
Constant	1.686***	(0.015)	1.598***	(0.019)	1.562***	(0.024)
Digital Skills in Job Life	0.143***	(0.004)	0.099***	(0.005)	0.151***	(0.005)
Gender	-0.008	(0.008)				
Education (low = ref.)			-	-		
medium			0.125***	(0.017)		
high			0.349***	(0.018)		
Age (15-24 = ref)					-	-
25-39					0.058**	(0.021)
40-54					0.091***	(0.020)
55 and older					0.172***	(0.021)

R^2	0.079	0.142	0.087

*p<0.1;**p<0.05;***p<0.01

Table 7 shows the third variable control of gender, education, and age on the relationship between digital usability skills in job/professional life and quality of life. Like the previous control the finding indicate that gender does not significantly contribute to differences in quality of life (b= - 0.008, p= 0.331) and its addition does not improve the overall model as R^2 remains at 0.079. Education, however, does have a significant positive effect on quality of life (p = 0.00) and again improves the model so that 14.2% of a change in quality of life is explained (R^2= 0.142). The effect of digital skills in job/professional life remains significant as well (p = 0.00). The third variable age also has a statistically significant positive effect on quality of life (p = 0.00) and its addition slightly improves the overall model to 8.7% (R^2= 0.086). The effect of digital skills again remains positive and significant (p = 0.00).

Table 11. Hierarchical Linear Regression Analysis of Quality of Life (N = 11834)

	Model 1		Model 2		Model 3	
	b	s.e.	b	s.e.	b	s.e.
Constant	1.713***	(0.015)	1.606***	(0.019)	1.563***	(0.025)
Ability to benefit from Digital Learning Opportunities	0.139***	(0.004)	0.096***	(0.005)	0.151***	(0.005)
Gender	-0.009	(0.008)				
Education (low = ref.)			-	-		
medium			0.135***	(0.017)		
high			0.361***	(0.018)		
Age (15-24 = ref)					-	-
25-39					0.070**	(0.021)
40-54					0.110***	(0.020)
55 and older					0.194***	(0.021)
R^2	0.079		0.141		0.87	

*p<0.1;**p<0.05;***p<0.01

When controlling for interaction effects of gender, education, and age on the relationship between the ability to benefit from digital learning opportunities and quality of life (Table 8) the findings were similar to those of the first to controls. Gender has no significant effect (p = 0.250) and does not improve the model with R^2 remaining at 0.079. Education (p = 0.00) and age (p = 0.00) both have a statistically significant positive effect on quality of life. Again, education improves the overall model (R^2 = 0.141) to a larger extend than age (R^2 = 0.87). For all additions, the effect of the ability to benefit from digital learning opportunities on the quality of life remains positive and statistically significant (p = 0.00).

5 Discussion

The main objective of this paper was to examine the relationship between digital skills and Quality of Life. As was expected, the findings revealed a positive correlation between the predictor variables, digital skill in daily life, in professional life, and ability to benefit from online learning opportunities and the outcome variable, Quality of Life. So overall it could be said that people with higher levels of digital skills generally report a higher Quality of Life. However, the correlations found were not very strong, indicating quality of life is further influenced by other factors. The linear regression analyses showed that out of all the independent variables, digital skills in professional life seemed to have explained the differences in quality of life the best. To recall the hypothesis tested was that *People with higher digital tech usability skills report a higher QoL*. The findings support the results of several previous studies that have found that digital skills at the work place influence financial aspects such as income and promotions due to an increasing demand for, at the least, foundational digital skills such as the ability to use computers or certain programs (Bejakovic & Mrnjavac, 2020; Hecker & Loprest, 2019; Layla & Bledi, 2020).

H1: *People with higher digital tech usability skills report a higher QoL* and H3: *People with higher digital skills to access digital learning opportunities report a higher QoL* can also be accepted, however the effect is again not very strong indicating the need for further variables that explain differences in quality of life. Three of such possible factors were explored in this study as well:

When controlling for possible interaction effects of third variables, the results of the hierarchical multiple regression analyses showed that gender did not have a significant effect on quality of life, whereas both, education, and age, seemed to have positive effects and improved the overall model. While the effect of the domains of digital skills remained significant it is still worth to put these findings into a broader context.

When considering the relationship between gender and quality of life it should be noted that "findings on gender differences in subjective well-being have been inconsistent" (Batz-Barbarich, Tay, Kuykendall, & Kwan Cheung, 2018). In their mixed method analysis (meta-analysis and literature review) Batz-Barbarich (2018) found no evidence for gender differences in job satisfaction or life satisfaction. While other studies have found that women tend do have lower job satisfaction than men but no differences in life satisfaction whatsoever (Batz-Barbarich et al., 2018). The results of this research, that gender does not have a statistically significant effect on quality of life, support the findings of these previous studies.

The results with regards to the effect of education on quality of life showed that generally higher educated people report a higher quality of life than those with lower levels of education. These findings coincide with those of (Land et al., 2012) who conducted a literature review of research on education of the past 40 years to determine its effect across the seven quality of life domains conducted by Cummins.

Their findings emphasizes that the effect of education on quality of life is multidimensional (affects several life domains) and reciprocal. With regards to material well-being the findings show that generally education directly affects occupational status, and the level of education influences the amount of economic returns (financial earnings). They furthermore found that "better educated individuals are generally less likely to be employed in dangerous working conditions" (Land et al., 2012) which increases their overall job satisfaction. The positive effect of education on material well-being can be explained by the role of schooling as a tool of socialization via "passing along values, knowledge, and skills deemed important" (Land et al., 2012) in modern capitalist society. But also, by higher levels of education leading to a greater worker productivity which leads to higher socioeconomic attainment (better employment and income).

The results of this research have furthermore shown that there is a significant but weak, positive effect of age on quality of life. This supports the findings of previous studies that there is a weak association between age and material well-being and that it is highly dependent on the national context (Joshanloo, Sirgy, & Park, 2018). For instance, on the one hand it can be argued that income levels drop with age for various reason, e.g. retirement or lack of job opportunities. This would indicate that age has a negative effect on material well-being. On the other hand, it could be argued that due to the importance of the national context, elderly people who live in economically strong countries are less likely to face financial challenges due to a strong welfare system. According to (Joshanloo et al., 2018) there is still little research on what exactly these national factors are and how they work. The results of this study with regards to the effect of age on quality of life, could be used as a starting point for further research in the field.

6 Conclusion

In summary this study reveals that digital skills have a positive correlation with quality of life among individuals in European countries. In other words, the higher the individuals' digital skills the higher their quality of life. Meanwhile a multiple linear regression analysis also shows that digital skills in job life and the ability to benefit from digital learning opportunities significantly predict quality of life. Additionally, this study revealed that the factors gender, age, and education affect the individual's quality of life as well.

As there is surprisingly little research on the effects of the digital divide in general and difference in digital skills (second-level divide) in particular the aim of this work was to document and explore its effect on the quality of life of individuals, keeping the implications for a Smart City background in mind. I utilise Sen's capability approach, complemented by the skills access theory developed by van Dijk (2005). The former posits that inequalities depend on having access to certain goods and services as well as the individual's capabilities and that those are essential for them to ultimately be able to live the life they want or in other words: be satisfied with the life they lead. Van Dijk's skill access approach

complements Sen's framework by not only considering causes for inequalities in information society but including consequences of such inequalities, which can be found in several different life domains.

6.1 Implications

Building on the notion of Smart City projects that providing citizens with access to digital technologies enhances their quality of life, this quantitative study was conducted for individuals across European countries. The results of this study can be used by (smart) cities in Europe and beyond to improve the quality of life of their citizens, for instance by encouraging policy makers and city planners to (…). Policy makers may also ask for additional research on differences in digital skills in a particular city or whether there are different subgroups in the population who struggle with different aspects of skill access (e.g. language, informational, operational, etc.). This could help detect where the main difficulties lie after being provided with material access to digital technologies. In general, I suggest further studies on the effect of digital skills on other domains of quality of life (e.g. mental well-being) and perhaps include different methodological approaches such as interviews as well.

6.2 Strength and Limitations

To conclude, I belief that this work has provided further evidence to support Sen's capability approach as well as van Dijk's skill access theory, documenting the influence of digital skills on quality of life of individuals across European Countries and going beyond examining the material access of digital technologies. This study has furthermore provided empirical results on a topic where quantitative data is fairly rare.

However, this work has a number of limitations. First, it focusses solely on overall life satisfaction and material well-being as determinants of quality of life. There are however different domains in which quality of life can be measured and digital skills might have a different effect on the other domains. Second, this work only considers the skill access component of van Dijk's theory while his framework includes a total of four different stages of ICT access. Considering the interaction between all four components might lead to a different result and should be considered in future research.

6.3 Future research

As mentioned above, further studies on the effect of digital skills on all or at least multiple domains of quality of life should be considered. Furthermore, it would be interesting to explore the deepening digital divide, for instance through a cross-sectional study with the aim to examine whether people who already have higher digital skills were in fact able to further develop and improve those skills faster compared to those who had poorer skills to begin with. It could also be interesting to conduct a comparative case study of smart cities to determine whether there are differences in skill access across cities or not. Furthermore, I would suggest further empirical research on the effect of the digital divide (all levels) and quality of life, as the existence of empirical data in this field is still sparse. Finally, it would be interesting and timely to continue to the work of Beaunoyer et al. (2020) and explore the effects of digital skills on the health domain with regards to the Covid-19 pandemic.

References

Alhassan, M. D., & Adam, I. O. (2021). The effects of digital inclusion and ICT access on the quality of life: A global perspective. *Technology in Society*, *64*, 1–7. https://doi.org/10.1016/j.techsoc.2020.101511

Ali, M.A., Alam, K., Taylor, B., & Rafiq, S. (2020). Does digital inclusion affect quality of life? Evidence from Australian household panel data. *Telematics and Informatics*, *51*, 1–18. https://doi.org/10.1016/j.tele.2020.101405

Batz-Barbarich, C., Tay, L., Kuykendall, L., & Kwan Cheung, H. (2018). A Meta-Analysis of Gender Differences in Subjective Well-Being: Estimating Effect Sizes and Associations With Gender Inequality. *Assoiciation for Psycological Studies*, *29*(9), 1491–1503. https://doi.org/10.1177/0956797618774796

Beaunoyer, E., Dupéré, S., & Guitton, M. J. (2020). COVID-19 and digital inequalities: Reciprocal impacts and mitigation strategies. *Computer and Human Behavior*, *111*, 1–9. Retrieved from https://pdf.sciencedirectassets.com/271802/1-s2.0-S0747563220X00069/1-s2.0-S0747563220301771/main.pdf

Bejakovic, P., & Mrnjavac, Z. (2020). The importance of digital literacy on the labour market. *Employee Relations: The International Journal*, *42*(4), 921–932. Retrieved from https://doi.org/10.1108/ER-07-2019-0274

Brulé, G., & Suter, C. (Eds.) (2019). *Wealth(s) and Subjective Well-Being: Social Indicators research Series*. Springer Link. Retrieved from https://doi.org/10.1007/978-3-030-05535-6_3

Büchi, M., Festic, N., & Latzer, M. (2018). How Social Well-Being is Affected by Digital Inequalities. *International Journal of Communication*, *12*, 3686–3706. Retrieved from https://ssrn.com/abstract=3871751

Cummins, R. A. (2000). Objective and Subjective Quality of Life: An Interactive Model. *Social Indicators Research*, *52*, 55–72. https://doi.org/10.1023/A:1007027822521

Dameir, R. P. (2016). *Smart City Implementation*. Springer. https://doi.org/10.1007/978-3-319-45766-6_3

De Guimaraes, J. C. F., Severo, E. A., Júnior, L. A. F., Da Costa, W. P. L. B., & Tasso Salmoria, F. (2020). Governance and quality of life in smart cities: Towards sustainable development goals. *Journal of Cleaner Production*, *253*, 1–13. https://doi.org/10.1016/j.jclepro.2019.119926

European Union (2022). Eurobarometer: About Eurobarometer. Retrieved from https://europa-eu.ezproxy2.utwente.nl/eurobarometer/about/eurobarometer

Evangelista, R., Guerrieri, P., & Meliciani, V. (2014). The economic impact of digital technologies in Europe. *Economics of Innovation and New Technology*, *23*(8), 802–824. Retrieved from https://doi.org/10.1080/10438599.2014.918438

GSIS (2022). Eurobarometer 87.1 (2017). Retrieved from https://search.gesis.org/research_data/ZA6861

Han, H., & Hawken, S. (2018). Introduction: Innovation and identity in next-generation smart citie. *City, Culture and Society*, *12*, 1–4. Retrieved from https://doi.org/10.1016/j.ccs.2017.12.003

Hecker, I., & Loprest, P. (2019). *Foundational Digital Skills for Career Progress*. Retrieved from Urban Institute website: https://eric.ed.gov/?id=ED601774

Joshanloo, M., Sirgy, M. J., & Park, J. (2018). The importance of national levels of eudaimonic well-being to life satisfaction in old age: a global study. *Quality of Life Research*, *27*, 3303–3311. Retrieved from https://doi.org/10.1007/s11136-018-1977-2

Land et al., K. C. (Ed.) (2012). *Handbook of Social Indicators and Quality of Life Research*. Springer Science+Business Media. Retrieved from 10.1007/978-94-007-2421-1_12

Layla, O.'K., & Bledi, J. (2020). *Digitalization in the German Labor Market: Analyzing Demand for Digital Skills in Job Vacancies*. Retrieved from Bertlesman Stiftung website: http://aei.pitt.edu.ezproxy2.utwente.nl/103213/

Lythreatis, S., Kumar Singh, S., & El-Kassar, A.-N. (2022). The digital divide: A review and future research agenda. *Technological Forecasting & Social Change*, *175*, 1–11. Retrieved from https://doi.org/10.1016/j.techfore.2021.121359

Macke, J., Casagrande, R. M., Sarate, J. A. R., & Silva, K. A. (2018). Smart city and quality of life: Citizens' perception in a Brazilian case study. *Journal of Cleaner Production*, *182*, 717–726. https://doi.org/10.1016/j.jclepro.2018.02.078

Marans, R. W., & Stimson, R. J. (Eds.) (2011). *Investigating Quality of Urban Life: Theory, Methods and Empirical Research*. Springer. https://doi.org/10.1007/978-94-007-1742-8

Nevado-Peña, D., López-Ruizb, V.-R., & Alfaro-Navarrob, J.-L. (2019). Improving quality of life perception with ICT use and technological capacity in Europe. *Technological Forecasting & Social Change*, *148*, 1–11. https://doi.org/10.1016/j.techfore.2019.119734

Nussbaum, M. C. (2004). Beyond the Social Contract: Capabilities and Global Justice: An Olaf Palme Lecture, delivered in Oxford on 19 June 2003, *32*(1), 3–18. https://doi.org/10.1080/1360081042000184093

Robeyns, I. (2005). The Capability Approach: a theoretical survey. *Journal of Human Development*, *6*(1), 93–117. https://doi.org/10.1080/146498805200034266

Sen, A. (1999). *Development as Freedom*. New York: Alfre A. Knopf, Inc.

Sugandha, Freestone, R., & Favaro, P. (2022). The social sustainability of smart cities: A conceptual framework. *City, Culture and Society*, *29*. Retrieved from https://doi.org/10.1016/j.ccs.2022.100460

Van Dijk, J. A. G. M. (2005). *The Deepening Divide: Inequality in the Information Society*. SAGE Publications.

Van Dijk, J. A. G. M. (2011). *Digital Divide: Impact of Access*. Retrieved from The International Encyclopedia of Media Effects website: https://ris.utwente.nl/ws/portalfiles/portal/5597980/Digital+Divide-+Impact+of+Access.pdf

Yigitcanlar, T., Kamruzzaman, M., Buys, L., Ioppolo, G., Sabatini-Marques, J., da Costa, E. M., & Yun, J. J. (2018). Understanding 'smart cities': Intertwining development drivers with desired outcomes in a multidimensional framework. *Cities*, *81*, 145–160.

Zheng, Y., & Walsham, G. (2008). Inequality of what? Social exclusion in the e-society as capability deprivation. *Information Technology & People*, *21*(3), 222–243. https://doi.org/10.1108/09593840810896000