Faces of the Digital Divide

by

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AUTHOR'S DECLARATION

I, the undersigned, Blanka Balázs, candidate for the MA degree in Political Science declare herewith that the present thesis is exclusively my own work, based on my research and only such external information as properly credited in notes and bibliography. I declare that no unidentified and illegitimate use was made of the work of others, and no part of the thesis infringes on any person's or institution's copyright. I also declare that no part of the thesis has been submitted in this form to any other institution of higher education for an academic degree.

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signature

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Faces of the Digital Divide

Abstract:

Digital skills have become increasingly essential for both personal and professional life. However, a significant portion of Europeans lack these basic digital skills therefore there is a digital divide in Europe. This thesis investigates to what extent the digital divide correlates with the traditional inequality determinants within Europe. Based on the academic literature the main focus is on the correlation between income and digital literacy, but the paper also examines how the level of education, age, gender, geographical location, and feeling discriminated correlates with digital skills. The study investigates the variability of these relationships between different European countries and aims to understand the similarities and differences between them. These findings highlight the complex nature of the digital divide in Europe, shaped by both national contexts and socio-economic characteristics. These findings collectively highlight the multifaceted nature of the digital divide in Europe, influenced by both national contexts and socio-economic characteristics.

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1. Introduction

Digital skills have become increasingly essential for both personal and professional life. In Europe, more than 90 percent of professional roles require a basic level of digital knowledge, besides basic literacy and numeracy skills (European Commission 2023). Latest research shows that most of Europe's population is already internet users and roughly 90 percent of European households have internet access (Statista 2023). However, even with the increasing importance of digital skills and the high internet access in Europe, research shows that around 42% of Europeans still lack basic digital skills (European Commission 2023). Moreover, 37% of the population lack basic digital knowledge in the workforce (European Commission 2023). Even though the level of individual's digital skills varies in European countries, the Digital Economy and Society Index's measures show that over 70% of European businesses lack staff with adequate digital skills which is an obstacle to further investments (DESI, 2022). Therefore, the data shows that even despite the great infrastructural background more than half of Europe's population are lacking basic digital skills which affects these people's professional and personal lives.

Over the last few decades, digital technologies have spread across all regions globally; however, they are far from being equally distributed. For a long time, the global digital gap was thought to shrink with economic progress (Taylor 2024). The assumption was that as countries and people grew wealthier, they would invest in digital tools and infrastructure, naturally bridging this gap (Taylor 2024). However, the broader developmental advantages from using new technologies have lagged behind (World Bank 2016, 2). While digital technologies have spurred growth, widened opportunities,

and enhanced service delivery in numerous cases, their overall impact has been limited and unevenly distributed (World Bank 2016, 2). Despite rising incomes worldwide over the last two decades, access to digital services remains notably limited in many developing regions (Taylor 2024). This is often because of insufficient investment in internet infrastructure (Taylor 2024). As a result, internet penetration rates continue to vary significantly across continents and there is a danger of the data economy being controlled indefinitely by a small number of players from a few highly technologically advanced nations (United Nations 2023). Therefore, despite global economic progress and the widespread adoption of digital technologies, significant disparities in internet access and infrastructure investment persist, particularly in developing regions, leading to uneven distribution of the benefits and potential dominance of the data economy by a few technologically advanced nations.

However, Europe faces different challenges compared to countries in the global South. Initially, the high costs of ICT meant that only developed nations could afford it. Despite recent rapid advancements, this has resulted in disparities both between and within countries, leading to a digital divide (United Nations 2023). As of January 2024, there were 5.35 billion internet users globally, making up 66.2 percent of the world's population (Statista 2024). Northern Europe leads worldwide regions in internet usage, with over 99 percent of its population online as of April 2023, compared to the European average of around 90 percent (Statista 2024). This significant difference in internet access between Europe and the rest of the world highlights the unique challenges Europe faces, where internet access is nearing universality. Given the high level of internet access in Europe, the focus shifts to the effective use of digital technologies (van Dijk 2012). While other parts of the world still

grapple with providing basic internet access, Europe must now address the digital divide by emphasizing digital skills and literacy.

Besides the geographical digital divide, socioeconomic factors also correlate with internet usage and skills. As of 2022, women accounted for 63 percent of global internet users, which was six percent lower than men (Statista 2024). The gender gap in internet usage was more pronounced in the Arab States and Africa, where there was approximately a ten percent difference (Statista 2024). Conversely, regions like the United States and Europe exhibited a smaller gender disparity (Statista 2024). Across all regions, internet usage was highest among individuals aged 15 to 24, with young people in Europe having the highest usage rate at 98 percent (Statista 2024). Globally, the average internet usage for this age group was 75 percent (Statista 2024). Income levels also played a crucial role in internet access; high-income countries reported 92 percent internet usage among their populations, while only 26 percent of individuals in low-income countries had access to the internet (Statista 2024). In addition to geographical disparities, socioeconomic factors like gender, age, and income significantly influence internet usage, with women, younger individuals, and people in higher-income countries having higher access rates.

According to the United Nations (2014), it is a huge problem that people are being left behind because of their lack of skills to use technology. They are missing out on opportunities and the personal benefits that the online world offers. This is particularly evident when examining the global economic landscape, especially concerning the rapid rise in demand for jobs that necessitate digital literacy and skills (Taylor 2024). For example, in the United States, almost half of jobs in the fields of science, technology, engineering, and mathematics already require strong computer

skills which are expected to grow further in the next coming years (Zilberman and Ice 2021). Lacking access to acquiring these skills creates a barrier to entering such job sectors and gaining the associated income (Taylor 2024). However, the digital divide's effects extend beyond aspiring to tech careers, for example lack of digital skills can lead to the isolation of an individual or it can also be a barrier to education because education is increasingly delivered online and those who have limited technology skills, can be cut off from opportunities to develop (Taylor 2024). The digital divide is a significant issue, leaving many people without digital knowledge and excluding them from opportunities in education, employment, and personal development, particularly as digital literacy becomes increasingly crucial for job markets and everyday life.

Therefore, it is clear that there are still crucial global differences between different regions of the world in terms of access to technology and digital skills. Moreover, socioeconomic factors like income, gender, or age also seem to be an important determinant of who has the skills to use it effectively. However, most of the studies on digital divide, approach the problem from a global perspective and compare Europe and the United States to the rest of the world and do not take into consideration that the digital divide exists within wealthy countries as well. Even though several research studies show that there is a digital divide between continents, and it is well known that the digital divide still exists within Western countries, however, there is much less attention on who are the people within and across Western countries who lack basic digital knowledge and what socio-economic characteristics determine their digital literacy. I am interested in whether digital literacy is the continuation of the more "traditional" inequality trends, like level of education, gender, or wealth, because the digital divide builds on these already existing inequalities within society, or since the

digital divide is different from the traditional inequality trends it affects different groups of society and follows different trends.

I aim to answer the following ***research question*****:** *to what extent does the digital divide correlate with the traditional inequality determinants within Europe?* Traditional inequality trends in the research question refer to inequalities that are prevalent and significant in Europe and are likely to affect individuals' lives and their digital skills.

In the analysis, I focus exclusively on Europe, comparing European countries to each other and observing internal trends within a few European countries. Additionally, I focus on geographical, income, gender, educational, and age inequalities within Europe, as these are identified in the literature as relevant factors affecting digital skills on the continent.

The structure of this paper is as follows: First, in the literature review, I focus on the extent to which digital skills are widespread in European societies and how the academic literature defines the digital divide in Europe. Second, in the data chapter, I provide an overview of the data used for the analysis. Third, the analysis chapter is divided into three sections. The first section offers a descriptive statistical overview of current trends in digital literacy. The second section focuses on cross-country differences in terms of income's correlation with digital literacy. The third section aims to identify other socioeconomic factors influencing digital literacy in countries where income has the strongest and weakest correlation with digital knowledge. The final chapter aims to provide a conclusion for this thesis.

2. Literature Review

In this chapter, I aim to provide a comprehensive overview of academic literature on the digital divide. Initially, I delve into the evolution and intricacies of the digital divide on a global scale, with a specific focus on Europe. Following this, I shift the spotlight onto income as a pivotal determinant of the digital divide, highlighting its significance in shaping disparities in access to and utilization of ICT resources. Moving forward, I explore geographical variations within Europe, considering the diverse landscape of digital access and literacy across different countries within Europe. Additionally, I address the multifaceted nature of digital literacy by examining its intersection with key socio-economic factors such as education, gender, and age.

Each section follows a consistent structure, beginning with an overview of the socio-economic factor under consideration and its implications for European citizens. Then, I analyze the relationship between this factor and the digital divide, evaluating whether disparities in income, education, gender, and age correlate with digital skills.

2.1. Digital Divide

Throughout human history, communication has been an integral part of sharing information. The vast volume of data and the real-time transmission capabilities we enjoy are made possible by Information and Communication Technologies (ICT) (Elena-Bucea et al. 2021). Through enhancing connectivity and facilitating transformative ICT applications, developing countries can achieve significant development outcomes such as improved economic growth, job opportunities, productivity, transparency, accountability, and social inclusion (World Bank 2012). Data shows that technological advancements, particularly in ICT since 1990, have been

instrumental in lifting over 10 percent of the global population out of poverty (World Bank 2012).

In the last decades, ICT and Internet technologies gained widespread recognition in societies (Elena-Bucea et al. 2021). Despite this high adoption rate, Internet access remained exclusive for certain individuals, raising concerns about the implications of this access gap in the future (Elena-Bucea et al. 2021). Over time, these disparities widened, leading to the isolation and marginalization of individuals and communities due to unequal access to ICT resources (Elena-Bucea et al. 2021). The Organization for Economic Co-operation and Development (OECD) defines this problem as "the gap between individuals, households, businesses, and geographic areas at different socio-economic levels with regard to their opportunities to access information and communication technologies (ICTs) and to their use of the Internet for a wide variety of activities. The digital divide reflects various differences among and within countries." (OECD 2001: 5). In the following I will use the term "digital divide" to refer to the above-mentioned gap between different socio-economic levels in terms of opportunities to access ICTs and use the Internet for various activities.

Over the last few decades, there has been extensive research into the digital divide, yet there is no satisfactory solution to decrease this division in technologically advanced societies (Mubarak, Suomi, and Kantola 2020). In the meantime, the digital divide continues to widen in many societies (Dutton and Reisdorf 2016). Moreover, even though the digital divide has been studied for more than two decades, there are still some misunderstandings about the correct definition of the digital divide and what exactly it means (Mubarak, Suomi, and Kantola 2020). In the following, I aim to summarize how it developed and how to define the digital divide.

A crucial point that has to be emphasized is that the digital divide in Europe is not only about access to technology. The literature on the digital divide shows that the digital divide has an evolution. Riggins and Dewan (2005) argue in their work that as new ICT innovations become available for commercial use, their adoption rates vary among individuals, organizations, and countries. This leads to differences in levels of access (Riggins and Dewan 2005). Within all the adopter groups, there are also varying levels of proficiency in using the technology to gain comparative advantages (Riggins and Dewan 2005). Therefore, Riggins and Dewan (2005) argue that there are two types of inequalities: one related to access to technology and the other to the ability to use it effectively. They call this division first-order and second-order digital divides. First-order digital divide means the separation between those who have access to ICT and those who do not. The most obvious factor examined in assessing digital disparities among and within nations is access to ICTs (Ragnedda and Kreitem 2018). Nevertheless, while physical access, technological ownership, and connectivity are crucial, they are not the only elements for analyzing digital disparities (Ragnedda and Kreitem 2018). Internet penetration and access to ICT represent just a portion of the wider spectrum of digital inequalities (Ragnedda and Kreitem 2018). In contrast, the second-order digital divide focuses on inequality in the ability to use technology among those who do have access.

In the last decade, the second-order digital divide became more informative than the first-order digital divide. Based on van Dijk's (2006) work on the digital divide, the type of access to new technologies can be categorized into four groups: motivational, physical, skills, and usage. He states that there has been a noticeable shift in focus from physical access to skills and advanced usage. Van Dijk (2006) argues that while the

gap in physical access appears to be narrowing in highly developed nations, disparities persist or even widen in terms of digital skills and application usage. Therefore, in Europe, unequal access to computers and the Internet has shifted from unequal motivation and inequalities of skills and usage. In most countries in the global North studying the first-order digital divide has become outdated, oversimplified, and less precise (van Dijk 2012). As more participants in a country gain access to technology, the importance of the second-order divide in terms of the ability to use it becomes more significant compared to the first-order divide (van Dijk 2012). Therefore, in the analysis, I will only focus on the second-order digital divide because in Europe it gives a more precise and informative explanation of individuals' digital literacy.

While ICT access has improved, other challenges have deepened. The second-order digital divide seems to be even more important, complicated, and therefore, more difficult to bridge than the first-order digital divide (Elena-Bucea et al. 2021). This new divide focuses on capabilities and skills, which are crucial for maximizing the benefits of access (Elena-Bucea et al. 2021). Ritzhaupt et al. (2013) argue that the second-order digital divide separates those who can effectively utilize various technologies to enhance their opportunities and living standards from those who cannot. Therefore, this second form of inequality demands attention because individuals and organizations proficient in using computers and the Internet have a comparative advantage over those who are not (United Nations 2012). This digital competence is significant as it enables individuals to meet societal needs, fostering social, economic, cultural, and political development, while also facilitating innovative content creation (United Nations 2012). Therefore, it is crucial to study the second-order digital divide in Europe because it is more likely to create disadvantages within society.

The crucial topic about the digital divide is that some groups in society are more likely to face this challenge than others. The digital divide is often used to emphasize that specific individuals face barriers in accessing personal computers or the Internet and being able to use computers and the Internet effectively for their benefit (Riggins and Dewan 2005). These barriers can stem from various factors such as race, socio-economic status, age, gender, place of residence, education level, proficiency with technology, and social connections (Riggins and Dewan 2005). In the following, I focus on how the digital divide is connected to structural inequalities within societies.

Since the emergence of the digital divide concept in the mid-1990s, there has been extensive research into the disparities in access and utilization of ICT (Mubarak, Suomi, and Kantola 2020). According to van Dijk (2012: 72), disparities in skills, and usage gain greater strategic importance in modern societies and there are structural trends in who has these skills. Van Dijk (2012: 71) argues that unequal benefits of Internet use are most likely caused by differences in skills, motivations, and preferences of use which are most likely to belong to a particular age group, gender, or educational level. The digital gap typically widens across several demographics, including socioeconomic status, ethnicity, and gender (Ritzhaupt et al. 2013). For instance, in the United States, disadvantaged and minority households are less likely to possess a computer and stable Internet connection at home, and they also tend to lack the essential skills and knowledge needed to effectively utilize these resources (Ritzhaupt et al. 2013). Therefore, differences in skills and digital knowledge are rooted in inequalities within society and create further divisions.

It seems that digital literacy and the decreasing digital divide are becoming more and more important in the digitized and globalized world. It is widely acknowledged today

that ICT literacy is a crucial skill for students to excel in both academic and professional careers (Ritzhaupt et al. 2013). Students and adults are both increasingly required to produce content using ICT tools (Ritzhaupt et al. 2013). Given that people are competing for technology-based roles on a global scale, these competencies are particularly vital for the job market (Ritzhaupt et al. 2013). Therefore, the focus should shift to assessing whether people can effectively harness ICT resources for their personal empowerment.

To sum up the section, the evolution and complexities of the digital divide, includes both first-order and second-order disparities in ICT adoption. While access to technology has improved globally, the focus has shifted towards addressing the gap in digital skills, particularly in utilizing digital knowledge effectively. The digital divide is not just about physical access anymore but also about the ability to leverage technology for societal and economic benefits. As was mentioned above, the digital divide at the individual level can be rooted in many different sources. As an example, people who face significant disadvantages such as the elderly, those with lower education levels, women, and individuals with lower incomes contribute to the widening digital disparities within their respective countries due to their marginalized status in society. Therefore, in the following sections, I connect current inequality trends to the digital divide. I am focusing on within Europe differences, income inequality, gender inequality, education inequality, and inequalities between age groups. Within every section first I describe the inequality trend within Europe and then I connect it to the digital divide to see whether based on the literature digital correlates with the mentioned inequality trends.

2.2. Income and Digital Divide

In the last decade, increasing income inequality in the global North has gained great attention. Piketty, Saez, and Zucman (2018, 586) provide evidence that income inequality in the United States has increased since the 1980s, driven by a disproportionate increase in income for the top 10% and the top 1%. Piketty, Saez, and Zucmana's (2018) primary findings show a stagnation in income growth for the bottom 50%, which decreased from constituting 20% of total income growth in 1980 to just 12% in 2014. To some extent, these trends seem to be true for Europe as well. However, findings for large European economies are more nuanced (Hoffmann, Lee, and Lemieux 2020). Inequality in Germany, Italy, and the United Kingdom has increased at a pace comparable to that of the United States in recent years, while it has remained stable in France (Hoffmann, Lee, and Lemieux 2020). Additionally, the factors driving inequality, particularly the roles of capital income and education, have evolved differently in Europe compared to the United States (Hoffmann, Lee, and Lemieux 2020). The smaller contribution of capital income to inequality growth in Europe might indicate that US inequality began to rise earlier, gradually resulting in greater disparities in wealth and capital income (Hoffmann, Lee, and Lemieux 2020). Therefore, income inequality has significantly increased in the United States since the 1980s, primarily benefiting the top income earners, and while similar trends are observed in European countries, the factors driving inequality differ, with a lesser role of capital income in Europe.

Income inequality is identified as the primary driver of the digital divide. The World Bank (2012) views income level as a crucial element in digital disparities. Olaniran and Agnello (2008: 77) argue in their work that income inequality is the primary driver of

the digital divide, pointing out that digitally developed nations tend to have higher income levels while developing nations typically have lower income levels. Furthermore, Quibria et al. (2003: 5) results show that there is a strong correlation between computer usage and GDP per capita and Internet usage also shows a high correlation with income. Therefore, the evidence indicates a strong link between GDP per capita and digitalization trends (Quibria et al. 2003). Income level plays a crucial role in digital disparities, with higher income levels associated with greater digital development.

By using only GDP Cruz-Jesus et al. (2017) were able to explain 82.7% of the variation in the digital divide, across a set of 110 developed and developing countries. Furthermore, empirical analyses reveal that in developed countries, the spread of Internet usage was more rapid and the delay between the introduction of Internet technology and its widespread adoption was also shorter than in developing countries (Zhang 2013). The GDP per capita had positive correlation with the spread of Internet usage, while the Gini index had negative correlation (Zhang 2013). Therefore, wealthier countries with lower income inequality tend to adopt Internet technologies more quickly, leading to a widening gap in Internet adoption rates between rich and poor countries, especially noticeable in extreme income cases (Zhang 2013). Therefore, GDP per capita is a significant factor in explaining the digital divide, with higher GDP per capita associated with greater internet usage and adoption of internet technologies.

However, the correlation between income and the digital divide also exists at the personal level and not just at the country level. Lindblom and Räsänen (2017) argue that especially in the early days of technology diffusion, the primary factor affecting

internet consumption behavior is the income budget. In general, individuals with higher incomes could afford to purchase and use technologies more frequently, while those with lower-middle incomes, lacked opportunities to acquire digital devices (Lindblom and Räsänen 2017). Moreover, low-income groups who lack adequate access to ICT tools face challenges such as limited availability of public internet access or service instability (Lindblom and Räsänen 2017).

This section discussed the relationship between income inequality and the digital divide in European countries. The World Bank and various researchers emphasize income as a crucial factor in digital disparities, showing a strong correlation between higher income levels and greater digital access and skills. Empirical studies indicate that wealthier countries with lower income inequality adopt internet technologies more quickly, further widening the digital divide between rich and poor nations. Based on the literature income, both at the country and the personal level, is one of the most important determinants of individuals having more advanced digital skills. Therefore, the independent variable of the analysis is income and I aim to test how digital skills correlate with income and whether other socio-economic factors play a more important role than income.

2.3. Geographical Digital Divide

Inequalities between European countries have a rich history. Several studies examine poverty, wealth, and the unequal development dynamics among cities, regions, and countries across different contexts and levels within the continent (Ballas, Dorling, and Hennig 2018, 3). Heidenreich and Wunder (2008, 32) argue in their work that regional economic and income disparities can primarily be attributed to differences in

regional economic structures, labor market dynamics, and settlement patterns. These differences, the outcomes of innovative activities such as patents and knowledge-based industries, and services are extremely unevenly distributed in Europe (Heidenreich and Wunder 2008, 32). Innovation inputs such as research and development spending and personnel, as well as the outcomes of innovative activities such as patents and knowledge-based industries and services, are predominantly concentrated in Western and Northern EU countries (Heidenreich and Wunder 200,: 32). Specialized knowledge, research, and patent-intensive industries are characteristic of only a few countries in the core regions of Europe (Heidenreich and Wunder 2008, 32). Therefore, disparities between European countries stem from variations in regional economic structures, labor markets, and innovation dynamics, with specialized knowledge-based industries concentrated primarily in Western and Northern European countries.

However, Heidenreich and Wunder (2008, 19) also state in their work that while economic disparities between regions within European member states are growing, inequalities among nations within Europe have been decreasing in recent years. The economic gaps between Eastern and Western Europe are gradually shrinking, contributing to a more uniform economic, legal, and political landscape and fostering social and economic unity across Europe (Heidenreich and Wunder 2008, 13). Ballas, Dorling, and Hennig (2018) findings from ten years later still confirm that substantial disparities in quality of life and the challenges encountered by populations in Europe do not primarily occur across national boundaries but rather between regions within countries, among rural and urban areas, or between affluent and impoverished districts within cities (Ballas, Dorling, and Hennig 2018, 23). Therefore, research

shows that the rich parts of Europe tend to be more similar to each other than to the poorer areas that are nearer to them.

This trend within Europe that most economic disparities now occur within individual nations rather than between them is highly connected to an urban-rural divide within the continent (Heidenreich and Wunder 2008). The economic and income gaps within the expanded EU are largely shaped by diverse regional employment trends, industrial compositions, and geographic positioning within Europe: central urban areas with robust research and transportation infrastructures, skilled labor pools, high employment rates, and knowledge-intensive service sectors tend to correlate with higher income levels (Heidenreich and Wunder 2008: 19). These results, confirmed by Eurostat's (2023) report which shows that more individuals living in cities have at least basic digital skills than people in rural areas. Therefore, disparities within Europe are increasingly intranational rather than international, largely due to an urban-rural divide driven by regional employment trends and infrastructure discrepancies, with urban areas generally exhibiting higher income levels and digital skills compared to rural areas.

However, the digital divide research empirically proves the existence of digital inequalities between countries. Ragnedda and Kreitem's (2018) article aims to compare and contrast differences and similarities between and within Eastern and Western European countries, through the lens of digital inequalities and their consequences for everyday life. They argue that, while Internet penetration rates are steadily increasing across Europe, it would be overly optimistic to suggest that access inequalities have been completely resolved or that the initial digital divide has been eliminated (Ragnedda and Kreitem 2018). Significant disparities persist between

countries within Europe regarding Internet penetration and physical access to the Internet (Ragnedda and Kreitem 2018, 7). For instance, countries like Denmark, Luxembourg, and the Netherlands have nearly eliminated the digital divide in terms of access, with Internet access being nearly universal (above 95% of the population have Internet access) (Ragnedda and Kreitem 2018, 7). Conversely, other European nations like Bulgaria and Romania exhibit lower Internet penetration rates compared to their counterparts, highlighting a distinct gap or divide in ICT access (Ragnedda and Kreitem 2018, 7). Moreover, it is also important not to generalize Eastern and Western European countries as having uniform access levels; indeed, there are substantial variations in Internet access across more similar countries (Ragnedda and Kreitem 2018, 6). For instance, countries like Romania and Bulgaria exhibit lower-than-average Internet penetration rates, significantly below the EU average, whereas other Eastern European countries like Lithuania or Estonia surpass the EU average (Ragnedda and Kreitem 2018, 10). Therefore, research shows that differences between European countries in terms of Internet access exist, but it is more complex than the Eastern Western divide within the continent.

However, access to the Internet is only the first criteria to examine digital inequalities and in Europe it is becoming less and less relevant. Digital capabilities and skills, the second-order digital divide, in using the Internet efficiently and confidently play a key role in determining digital inequalities within Europe (Ragnedda and Kreitem 2018, 21). Bulgaria and Romania are at the very bottom of digital skills and capabilities ranks, well below the European Union average (Ragnedda and Kreitem 2018, 13). These results show that both in terms of Internet access and digital capabilities Bulgaria and Romania are among the worst in Europe (Ragnedda and Kreitem 2018, 13). However, it also has to be mentioned that Ragnedda and Kreitem (2018, 22)

observed that simply boosting Internet penetration does not guarantee a corresponding rise in digital skills or tangible advantages.

Schleife (2010) examines the regional aspect of the digital divide in Germany, focusing on the factors influencing home Internet usage at both the county and individual levels. The findings suggest that in addition to variations attributed to individual characteristics like age, education, and income, there exists a regional disparity in ICT utilization: rural areas exhibit lower Internet usage rates compared to urban areas (Schleife 2010). Eurostat's report on digital skills also examines place of residence. The results show that more individuals living in cities have at least basic digital skills than people in rural areas (Eurostat 2023). Moreover, the report (Eurostat 2023) also studies country differences within the EU and it argues when examining individual digital skills, it is essential to consider various dimensions and geography is a particularly significant one (Eurostat 2023). Therefore, understanding how digital skills vary across EU Member States is crucial (Eurostat 2023). The data reveals substantial disparities between member states, with percentages ranging from 30% to 80% of residents having at least basic digital skills (Eurostat 2023). Based on the report, European countries with the highest digital skills results are Denmark, Ireland, Cyprus, Finland, Luxembourg, the Netherlands, and Sweden and countries with the lowest results are Bulgaria, Romania, Italy, Lithuania, Hungary, and Italy (Eurostat 2023).

This section delves into the geographical digital divide within Europe, examining the disparities in economic structures, innovation dynamics, and digital access between regions and countries. While economic inequalities primarily occur within nations rather than between them, urban areas tend to have higher income levels and digital

skills compared to rural regions. Despite increasing Internet penetration rates across Europe, significant disparities persist, particularly in access and digital capabilities, with Bulgaria and Romania ranking among the lowest in terms of digital skills. Additionally, regional disparities in ICT utilization highlight the urban-rural digital gap, emphasizing the importance of considering geographical dimensions when examining digital inequalities within Europe.

2.4. Education and Digital Divide

Education is a complex issue that can be approached from various perspectives. There are many potential ways of measuring the level or quality of education however, in this research, I only focus on the proportion of higher educated people in European countries.

The proportion of the population with a higher education degree is higher in Nordic and Baltic countries, with women overall being more educated than men (Statista 2022). Luxembourg was the European country with the highest share of graduates in 2022 with 46 percent of those aged between 15 and 64 having a degree in that year (Statista 2022). Hofmarcher (2021) explores how education impacts poverty levels in adulthood. By analyzing 37 compulsory schooling reforms across 23 European countries, he discovered significant economic benefits of an extra year of education in reducing the chances of experiencing poverty (Hofmarcher 2021). Besides lowering the risk of income-related poverty, education also decreases the likelihood of lacking essential household necessities and living in households with limited labor market participation (Hofmarcher 2021). This trend remains consistent even when considering a comprehensive measure of poverty and social exclusion across these

three objective dimensions (Hofmarcher 2021). Moreover, his results also show more years in educational institutions not only lowers the probability of being officially classified as impoverished but also reduces individual's perception of living in poverty (Hofmarcher 2021). Higher education levels correlate with reduced poverty rates and improved socio-economic outcomes, as evidenced by studies showing the significant economic benefits of additional years of education in European countries.

Moreover, the academic literature shows that education is a key determinant of digital skills. Educational disparities in digital access persist in modern society, impacting digital development according to the United Nations (United Nations 2014). Nishijima, Ivanauskas, and Sarti's (2017) study examines two aspects of the digital divide: inequality in access to ICT and inequality in the ability to use ICT. The research is only based on data from Brazil and the researchers aimed to identify the key factors contributing to inequality indexes for ICT access (Nishijima, Ivanauskas, and Sarti 2017). The analysis of the digital divide indicates that lack of higher education is the primary obstacle to digital literacy (Nishijima, Ivanauskas, and Sarti 2017). Therefore, the results indicate that education is the primary factor behind inequalities in personal ICT skills (Nishijima, Ivanauskas, and Sarti 2017). Thus, enhancing education policies emerges as an effective long-term strategy to bridge the digital divide among individuals by addressing digital illiteracy barriers (Nishijima, Ivanauskas, and Sarti 2017). Education is a crucial determinant of digital skills, with disparities in educational access contributing significantly to the digital divide, particularly in terms of ICT usage, and addressing education policies is essential for bridging this gap.

Correa's (2016) research shows that higher levels of education lead to greater Internet experience and more cognitive resources. Miah's (2024) results also confirm that the

digital divide significantly affects educational outcomes. Students without access to digital resources and technology often fall behind their peers, leading to achievement gaps and fewer opportunities for success (Miah 2024). The COVID-19 pandemic has underscored these issues, emphasizing the need for broader access to digital resources and technology (Miah 2024). Miah (2024) argues that to address these challenges a comprehensive approach is necessary. Schools, governments, and community organizations must collaborate to ensure all students have access to digital resources, technology, and digital literacy training and support (Miah 2024). Additionally, addressing the root causes of digital inequality, such as poverty and disparities in education funding, is essential (Miah 2024).

Furthermore, the dominance of English-language content online, as mentioned by the United Nations (United Nations 2012), creates barriers for individuals with lower education levels and limited English proficiency. Therefore, education becomes crucial in bridging the digital divide by enhancing ICT understanding, and opening avenues for digital dividends and future employment opportunities (United Nations 2012).

However, contrary to some previous studies, Cruz-Jesus, Oliveira, and Bacao (2012) found that school attendance does not significantly impact the digital divide. The researchers used multivariate statistical methods and analyzed the digital divide within the EU (Cruz-Jesus, Oliveira, and Bacao 2012). Their findings indicate that the countries identified as the least digitally developed in earlier studies remain largely unchanged, as do the most digitally developed countries (Cruz-Jesus, Oliveira, and Bacao 2012). Their results show that digital disparities are linked to economic differences between countries, and the year of EU entry also appears to influence these divides (Cruz-Jesus, Oliveira, and Bacao 2012). However, as was mentioned above

they found that school attendance does not influence the digital divide. Therefore, while economic differences and the year of EU entry influence the digital divide within the EU, contrary to previous studies, school attendance does not significantly impact the digital disparities observed.

Even though several studies emphasized the importance of education in terms of the digital divide, the findings on whether education is a key determinant of digital skills within Europe are still debated.

2.5. Gender and Digital Divide

The principle of gender equality is a foundational value of the European Union, dating back to 1957 when the Treaty of Rome incorporated the principle of equal pay for equal work (Rosa, Drew, and Canavan 2020). However, even though the fight against gender inequality in Europe has been going on for decades and it is considered to be low compared to other parts of the world, the issue has not been solved yet.

In 2021, the gender pay gap in the EU remained at 12.7%, showing minimal change compared to the last few years (European Commission 2022). This translates to women earning an average of 13.0% less per hour than men (European Commission 2022). As of 2022, the gender employment gap was at 10.7%, with 69.3% of women employed across the EU compared to 80% of men (European Commission 2022). Furthermore, there are significant variations among EU countries regarding the gender pay gap (European Commission 2022). This gap ranges from less than 5% in countries like Luxembourg, Romania, Slovenia, Poland, Belgium, and Italy to over 17% in Hungary, Germany, Austria, and Estonia (European Commission 2022). Over the

past decade, the gender pay gap has generally decreased in most countries (European Commission 2022).

The gender pay gap is not the only gender divide within the EU. Another key metric in the gender divide is education statistics and the percentage of individuals who have completed tertiary education, which includes graduating from universities or other higher education institutions (Eurostat 2023). In 2023, the gender gap in tertiary education attainment in the EU was -10.9 percentage points (pp), indicating that the proportion of women aged 30-34 years with tertiary education exceeded that of men by 10.9 pp (Eurostat 2023). This negative gap means more women in this age group have completed tertiary education than men in the EU (Eurostat 2023). It has to be mentioned that the above only includes EU member countries, therefore, the results do not represent many countries in the Balkans and also some Western European countries.

The data regarding gender and digital skills are varied. While some studies indicate that gender is not closely linked to digital skills (van Dijk 2006). However, other studies show different results which argue that men and women do not differ significantly in their abilities, but women may perceive themselves as less competent and this affects their online behavior (Shafer 2004).

Correa's (2016) research results show that women and less educated people were less likely to have more advanced digital skills. Therefore, she argues that digital disparities reflect broader structural inequalities (Correa 2016). Consequently, variations in digital skills can be explained by the fact that people have been socialized with the idea that technology is a male domain (Correa 2016). Moreover, Cooper (2006) also argues

that the digital divide is rooted in computer anxiety ingrained in socialization processes among boys and girls, which intersects with the stereotype of computers being toys primarily for boys. The basis of this trend is that gender roles and stereotypes enforced by families, institutions, and religious beliefs contribute to these disparities which influence behaviors and expectations (Cooper 2006).

Even though the decreasing gender pay gap and the higher proportion of women in higher education research on digital skills shows mixed results: some studies find no significant gender difference, while others suggest women feel less competent and this affects their online behavior. The reason behind digital disparities between genders reflects broader structural inequalities and stereotypes that view technology as a male domain.

2.6. Age and Digital Divide

Even though Europe's population is in general known to be older than countries in the global South there are still some major differences within the continent. In 2023, Italy and Portugal had the highest proportion of elderly individuals among European countries, with 24 percent of their total population aged 65 years and older (Statista 2 2023). On average, the European Union had 21.3 percent of its population classified as elderly (Statista 2 2023). Conversely, Iceland, Luxembourg, and Turkey had the lowest shares of elderly individuals, all with less than 15 percent of their population in this age group (Statista 2 2023). These results show that there are around ten percent differences between the youngest and oldest European populations.

Since 2000, the European Union has implemented a directive prohibiting discrimination based on age in employment and occupation (European Commission 2020). It means that EU citizens are protected under law if they are treated unfairly by their boss or colleagues at the workplace because of their age (European Commission 2020).

Age seems to play a significant role in digital skills and digital literacy. The United Nations's report (UN 2012) confirms that the digital divide is closely tied to age. Nishijima, Ivanauskas, and Sarti (2017) argue that digital illiteracy is recognized as the primary barrier to ICT use among elderly individuals. Their study's results indicate that digital illiteracy, as measured by years of education, negatively impacts Internet access among the elderly as well (Nishijima, Ivanauskas, and Sarti 2017). However, the effect of aging on this issue has been diminishing in Brazil from 2005 to 2013 (Nishijima, Ivanauskas, and Sarti 2017).

Understanding the generational differences is crucial for grasping how ICT is integrated into daily life by both younger digital natives, who grew up surrounded by technology, and older digital immigrants, who had to adapt to ICT later in life (Ballano, Uribe, and Munté-Ramos 2014). Individuals who learned to use digital tools later and have a need or interest in incorporating them into all aspects of their daily lives are likely to use these tools more comprehensively (Ballano, Uribe, and Munté-Ramos 2014). This contrasts with those who, despite having no technical barriers, lack the motivation or necessary resources to make significant contributions in the digital realm (Ballano, Uribe, and Munté-Ramos 2014).

Older generations are more likely to have computer anxiety due to age-specific characteristics and less intuitive ICT skills, coupled with social factors such as disabilities, living alone, or lower education levels compared to active ICT users (van Dijk 2006). For example, a survey reveals that young people gather much more information about their medical conditions online compared to elderly individuals, who arguably would need this information more (van Dijk 2006).

However, it is also important to mention that even though young people have grown up with greater familiarity with new technologies and that generational gaps in technology use persist it does not explain differences among young people. Correa's (2016) study confirms that young people are not a homogeneous group regarding Internet skills and usage but there are major differences also among them.

Therefore, age significantly affects digital skills and literacy. Older adults, or digital immigrants, often face more challenges integrating technology into daily life compared to younger digital natives. However, generational differences in technology use are not uniform, as young people also vary in their Internet skills and usage.

2.7. Summary

Income, both at the national and individual levels, is highlighted as a crucial factor in digital disparities, with wealthier countries and individuals having greater digital access and skills. Empirical studies show that nations with higher income levels and lower income inequality adopt internet technologies more quickly, exacerbating the digital divide. Consequently, income is the primary variable in analyzing digital skills, with the aim of testing how these skills correlate with income and other socio-

economic factors. The section also examines the geographical digital divide within Europe, noting disparities in economic structures, innovation dynamics, and digital access between regions. Urban areas generally have higher income levels and digital skills compared to rural regions, despite rising internet penetration rates across Europe. Additionally, while the gender pay gap is decreasing and more women are attaining higher education, research on digital skills shows mixed results, suggesting broader structural inequalities and gender stereotypes influence digital disparities. Age also plays a significant role, with older adults facing more challenges in adopting digital technologies compared to younger generations, although young people's internet skills and usage are not homogeneous.

Moreover, it must be mentioned that an important potential inequality trend has not been discussed in the section. Race is another inequality in society that can influence the digital divide; however, in Europe which races and other minorities are discriminated against is highly different from country to country. Therefore, to still control for this determinant I focus on feeling discriminated against within the country. Furthermore, this variable also includes the LGBTQ+ group who were not included in the detailed literature review.

3. Data and Methods

To answer the research question, I conducted a quantitative research analysis. For the large-n analysis, the European Social Survey data set was used that was collected between 2020 and 2022. The analysis includes the following countries: Austria, Belgium, Bulgaria, Croatia, Czech, Cyprus, Estonia, Finland, France, Germany, Great Britain, Greece, Hungary, Ireland, Iceland, Italy, Latvia, Lithuania, Montenegro, North Macedonia, Netherlands, Norway, Portugal, Poland, Serbia, Slovenia, Slovakia, Spain, Sweden, and Switzerland. Some European countries like Denmark or Romania were not included in the data set and I decided to exclude Israel from the analysis because it is not a European country.

ESS data collection typically involves an hour-long face-to-face interview. However, due to the COVID-19 pandemic during Round 10, nine countries transitioned to a self-completion approach (via web and paper), while 22 countries maintained the usual face-to-face fieldwork method. Additionally, countries opting for the face-to-face approach could use video interviews as a backup.

Another effect of the pandemic was that Round 10 fieldwork spanned a longer period than usual. The first country began fieldwork in September 2020, and the last countries concluded in August 2022. The pandemic may have influenced attitudes and behaviors, making the timing of fieldwork particularly significant for this round. Users are encouraged to review the fieldwork dates for each country and consider this when analyzing data between countries participating in Round 10 or comparing Round 10 results with previous ESS rounds.

As was mentioned in the literature review, first-order digital is becoming less and less relevant and present in European countries; however, the second order digital is gaining more relevance and importance. Therefore, in this research I only focus on the second-order digital divide within Europe.

Eurostat (2023) undertakes the most comprehensive effort in quantifying the second-order digital divide in the EU. The report aims to measure the digital skills of EU citizens through various datasets about digital skills that include ICT in terms of the number of users, specialists, and training initiatives. An instrument stemming from these datasets is the Digital Skills Indicator 2.0 (DSI), serving as a metric for digital competency (Eurostat 2023). The DSI, detailed in its metadata, focuses on specific online or software-related tasks performed by individuals aged 16 to 74 across five key areas: information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving (Eurostat 2023). Within each area, two skill levels, "basic" and "above basic" are computed, culminating in an aggregated assessment of the proportion of individuals possessing certain levels of digital proficiency relative to the total population (Eurostat 2023). Eurostat's method is a highly complex and detailed measurement however their results do not go into detail to explain the correlation between socioeconomic factors and digital skills. By using the ESS dataset, I aim to discover how socioeconomic factors influence digital skills within Europe.

Even though it is challenging to measure respondents' actual digital literacy through a survey because of people's bias or misinterpretation of the questions, I am using the ESS dataset to answer my research question. As the dependent variable, I am focusing on the question that asks participants how familiar they are with some computer and

Internet-related items, like preference settings, advanced search, and PDF. Respondents could give their answers separately to preference setting, advanced search, and PDF on a 1 to 5 scale where 1 means not familiar at all and 5 means being completely familiar with the term.

Then I summed up the three variables that will be the dependent variable. I created this new variable because I am not interested separately in the three variables' results but rather to what extent people are familiar with these terms in general. Therefore, I am going to measure digital literacy on a 1-15 scale where 15 means being completely familiar with all three terms and 1 means not being familiar with either of them. This variable is considered to be a proxy to study digital literacy.

The independent variable of the analysis is the household's income where respondents' answers are categorized into ten percentiles. The question from the survey that I am using as an independent variable is the following: "using this card, please tell me which letter describes your household's total income, after tax and compulsory deductions, from all sources?" People's answers were coded into 10 declines where category 1 means the lowest income and category 10 is the highest income decline.

Unfortunately, respondents were less willing to answer questions about their financial situation or income, and consequently, I had many "Don't" know and "Refusal" answers that I had to code as NA values. In this case, it means 13081 missing values which is considered to be a lot however because the data set is very detailed I can still work with 46604 observations.

Furthermore, the regression analysis will include the following control variables: level of education, age, gender, living location, and belonging to a discriminated group.

4. Empirics and Discussion

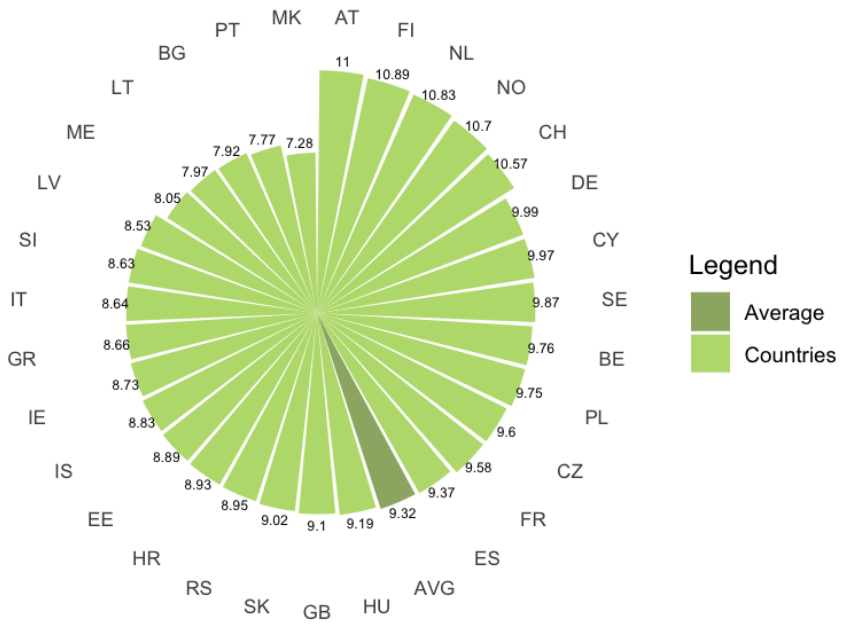
4. 1. Descriptive Statistics

In this section, I provide a general overview of the digital divide in Europe by analyzing data from the European Social Survey. The analysis examines how citizens' levels of digital knowledge vary across different European countries and how digital skills correlate with various socio-economic characteristics.

Figure 1 presents the average digital skills scores for each country. As previously mentioned, digital skills are measured on a scale from 1 to 15, and the graph displays the average scores for all the countries included in the analysis.

Figure 1: Average Digital Literacy by Country

Comparison of Digital Literacy Across European Countries



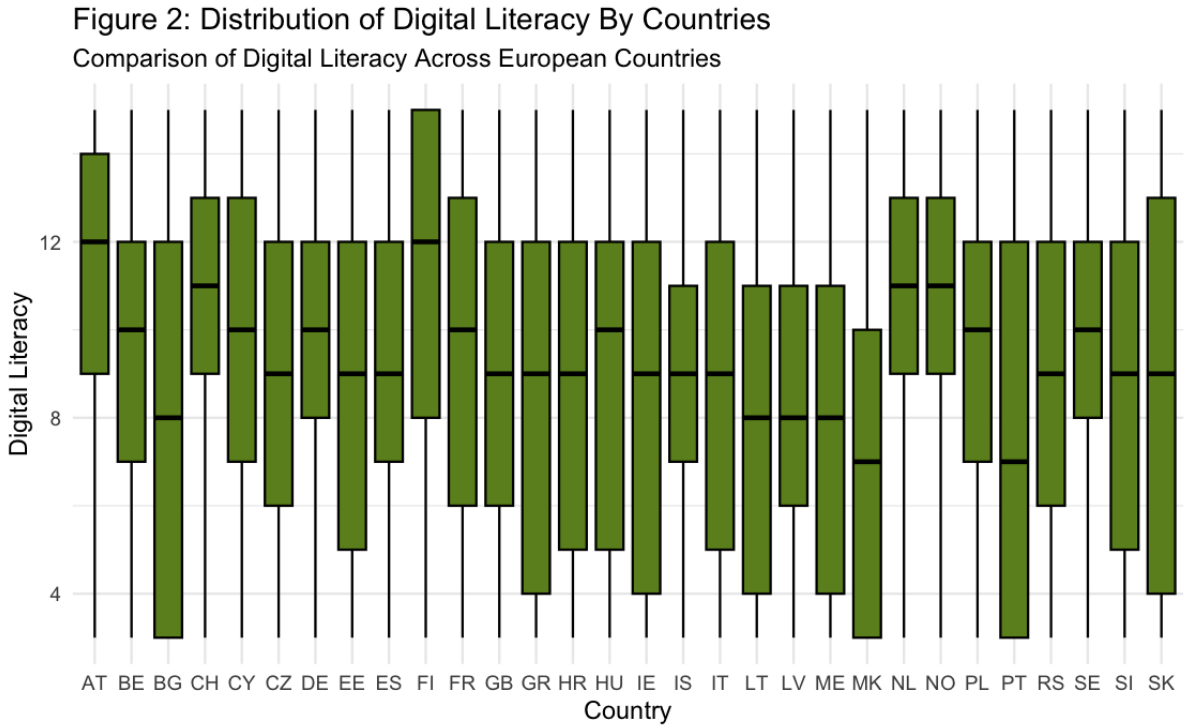
The graphs reveal significant differences in average digital literacy across European countries. Austria, Finland, Switzerland, the Netherlands, and Norway have exceptionally high average digital literacy scores, ranging between 10 and 11 on a 1 to 15 scale. In contrast, Bulgaria, North Macedonia, Montenegro, Latvia, and Portugal have the lowest averages, with scores between 7 and 8 in average digital knowledge. The European average is also included in the graph which is 9.3 on the scale.

Although Eurostat's Digital Skills Indicator 2.0 (DSI) focuses on a more detailed dataset and areas such as information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving, the country's average results align with Eurostat's 2023 findings. According to Eurostat, Norway, Iceland, Finland, and the Netherlands achieved the highest scores, which closely matches my results, except for Switzerland. However, Eurostat's analysis only includes EU member countries, so Switzerland is not part of their dataset. At the lower end of the list, there are some differences: Eurostat's results place Portugal closer to the EU average, while Bulgaria remains at the bottom.

However, only focusing on the country averages can have misleading results because it does not show how the results are distributed within the group and it completely ignores outliers that potentially can influence the average. Therefore, to address these potential misinterpretations, I also created a box plot to illustrate the distribution of respondents' answers in each country.

Figure 2 illustrates the distribution of respondents' answers across all European countries using a box plot. The box plot displays the median, representing the midpoint of the data, and the upper and lower quartiles, which encompass the middle

50% of the data. This visualization helps to identify the spread and central tendency of digital literacy scores within each country.



The graph reveals significant differences in the distribution of respondents' answers between countries. Similar to Figure 1, Finland, Austria, Switzerland, the Netherlands, and Norway exhibit the most impressive digital literacy results. However, there are notable differences even among these top-performing countries.

Finland and Austria have the highest upper quartiles and medians, indicating strong overall performance. However, their wider distribution range suggests greater variability in respondents' digital literacy. This means that digital knowledge is more unevenly distributed in Finland and Austria compared to Norway and the Netherlands, where the upper quartile and median are slightly lower, but the distribution is narrower. This means that digital literacy is more consistent and less

varied among respondents in Norway, Switzerland, and the Netherlands than in Finland and Austria.

Furthermore, the graph indicates that Bulgaria, North Macedonia, and Portugal have the lowest results, with their lower quartiles at the bottom of the scale. Montenegro, Latvia, and Slovakia also have lower quartiles around 4 on the 1 to 15 scale. These results align with the averages shown in Figure 1.

Additionally, the box plot provides a more nuanced view of other countries. For instance, while Greece and Ireland have average digital literacy scores close to the European average, their lower quartiles are comparable to those of Montenegro and Latvia. This suggests that even though Greece and Ireland's digital literacy average is not outstanding, a significant portion of the population in these countries has very limited digital knowledge.

As the results have shown, country differences play a significant role in the digital divide within Europe. However, as the literature suggests, substantial disparities in quality of life and challenges faced by populations in Europe often occur not across national boundaries but rather between regions within countries. Therefore, after the country-based analysis, I am also interested in examining how the socio-economic characteristics of individuals relate to the digital skills of European citizens.

The independent variable in this analysis is income, so I first examine how digital literacy is distributed across different income groups within Europe. In the dataset, income is measured on a 1 to 10 scale. To analyze the differences between income groups, I categorized the data into four groups: income levels 1 to 2 represent the

lowest income group, levels 3 to 5 represent the lower middle-income group, levels 6 to 8 represent the upper middle-income group, levels 9 to 10 represent the highest income group.

Figure 3: Digital Divide Based on Income Groups

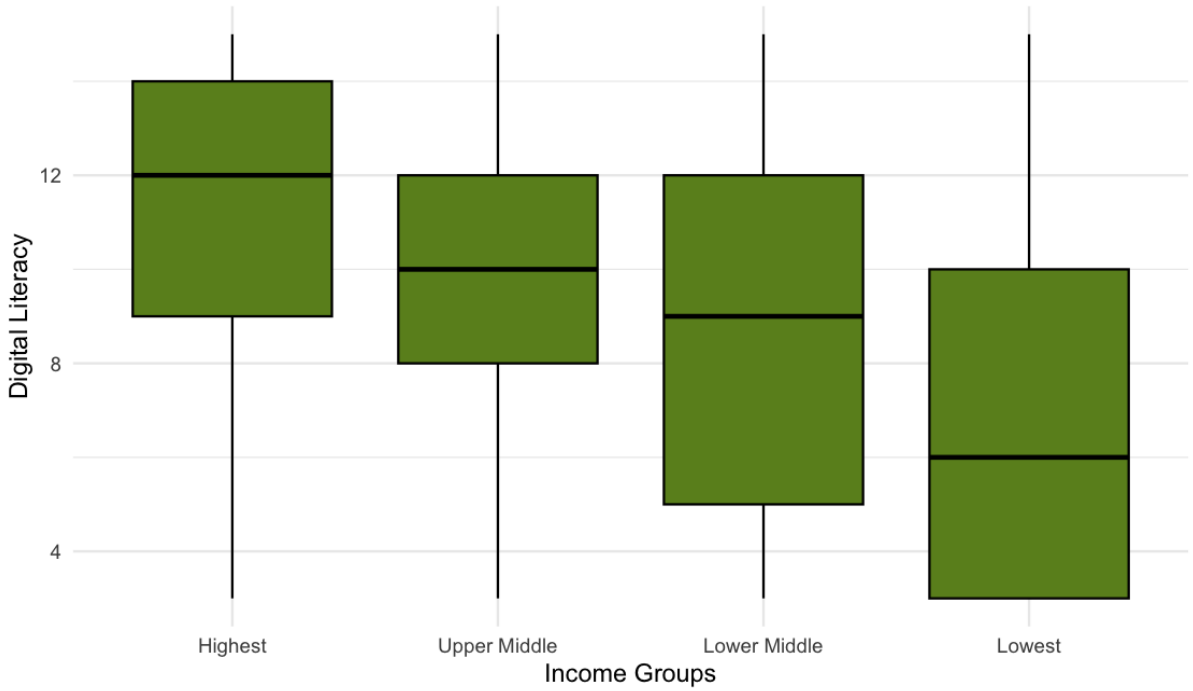


Figure 3 illustrates significant differences in digital literacy between income groups, particularly between the richest and poorest categories. The median digital literacy score for the highest income group is 12, while the lowest income group's median is 6, indicating a substantial disparity based on income. Interestingly, the middle 50% of scores (interquartile range) for the lowest and lower middle-income groups is more widely distributed compared to the highest and upper middle-income groups. This suggests that digital skills vary more widely among less wealthy individuals, whereas digital skills are more consistent among wealthier individuals. This means that people with higher incomes tend to have more similar levels of digital knowledge compared

to those with lower incomes. Therefore, my results confirm that income is strongly correlated with digital disparities.

Furthermore, the literature suggests that the level of education of an individual significantly influences the person's digital knowledge. To explore this, I plotted the distribution of digital skills across different education levels. As described in the previous chapter, education levels are categorized into three groups: university degree and above, higher education below university degree, and secondary education or lower.

Figure 4: Distribution of Digital Litercay and Highest Level of Education

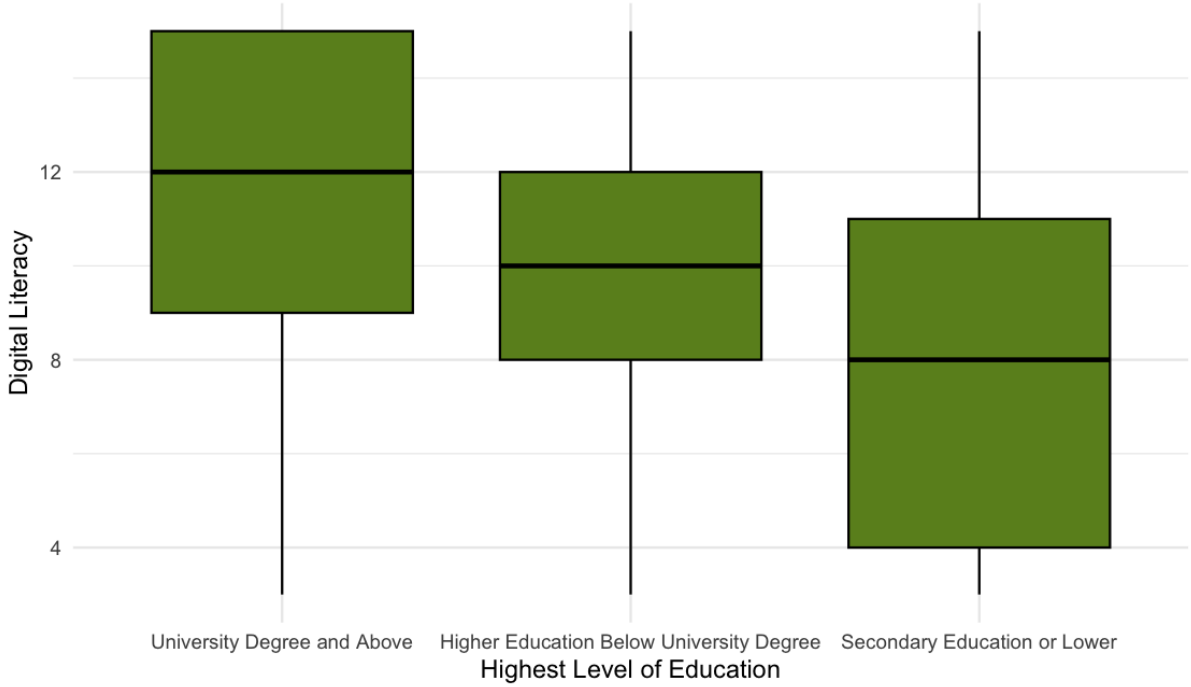


Figure 4 demonstrates that individuals with a university degree or higher possess more advanced digital knowledge compared to the other two education groups. The medians show a consistent 2-point difference: 12 for those with a university degree, 10 for those with higher education below a university degree, and 8 for those with secondary

education or lower. Additionally, the middle 50% distribution for the secondary or lower educated group is broader than for the other two groups, indicating greater variability in digital skills within this group. It means that among lower educated people the level of digital knowledge is more diverse than among higher educated people. In conclusion, these results support the literature's assertion that education is correlated with digital skills in Europe.

Furthermore, Ballas, Dorling, and Hennig (2018) argue that disparities in quality of life and challenges in Europe occur more between regions within countries, particularly between rural and urban areas, rather than across national boundaries. They suggest that affluent areas in Europe are more similar to each other than to the poorer areas nearby (Ballas, Dorling, and Hennig 2018). Therefore, I am also interested in examining whether living in a city, town, or village influences an individual's digital knowledge.

Figure 5: Distribution of Digital Litercay Between Settlements

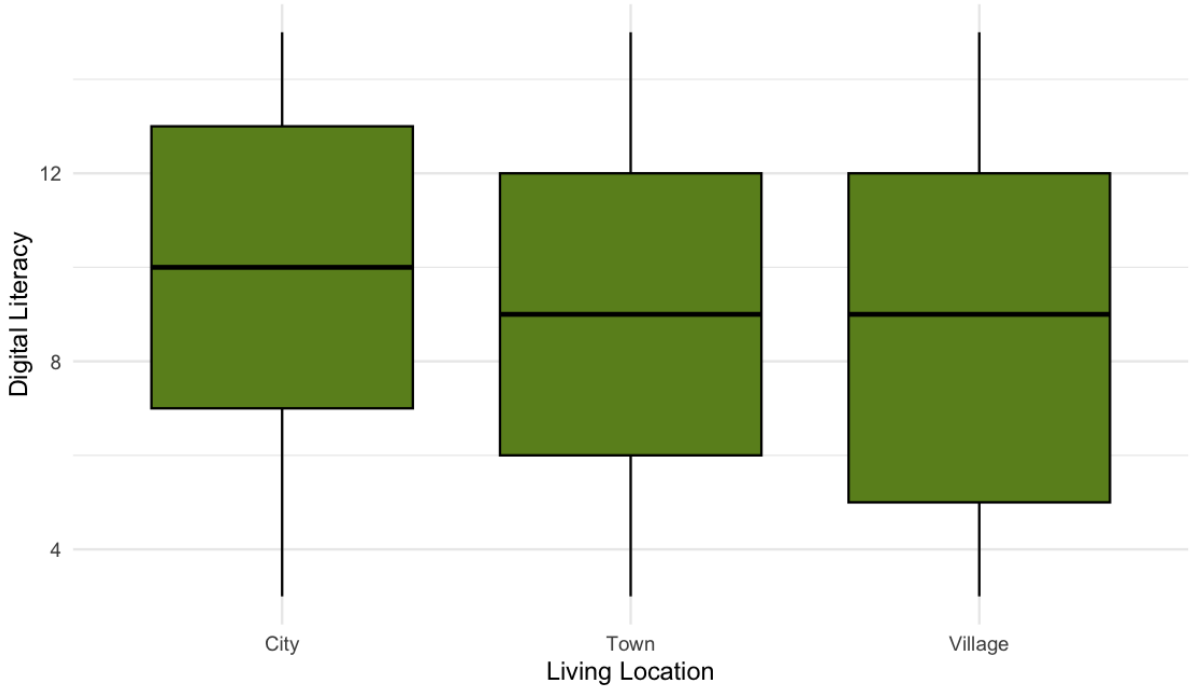
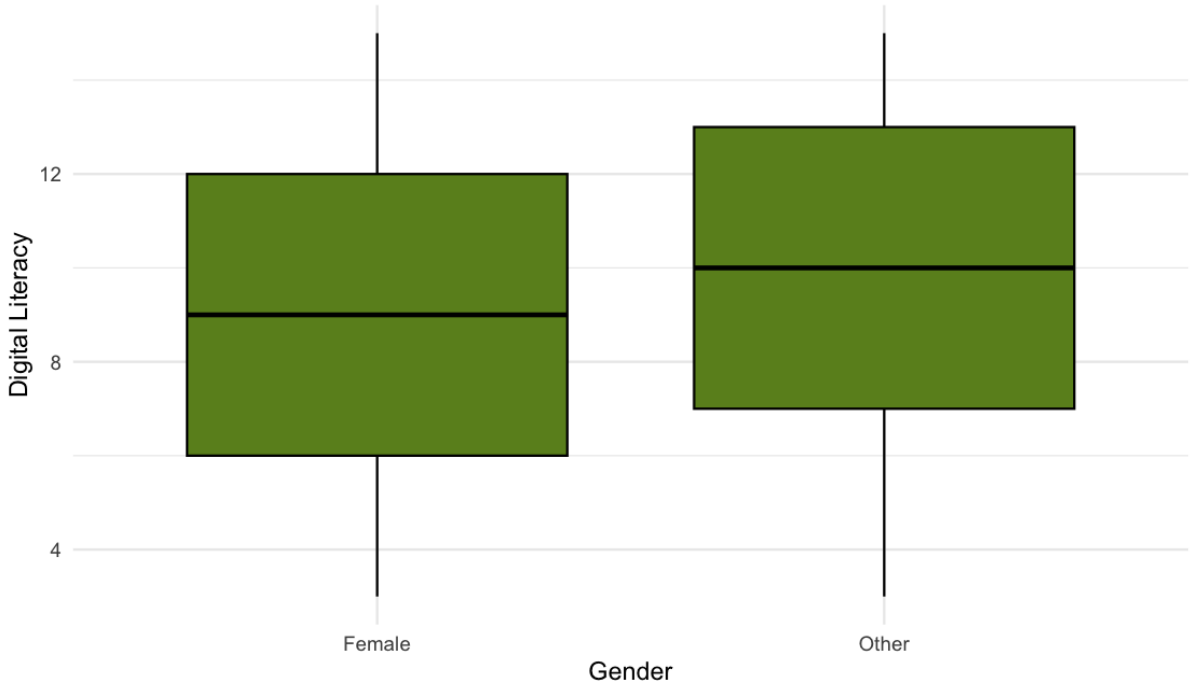


Figure 5 shows that people living in big cities are the most likely to have higher digital knowledge. However, the differences between city, town, and village residents are relatively small. The media for people who live in a city is 10 and it is 9 for twins and villages. Additionally, the distribution of the middle 50% is similar across these groups. While Europeans living in villages exhibit slightly more variability in digital skills, the overall differences in digital literacy between urban and rural areas are less pronounced compared to other factors, such as education. Therefore, in contrast with the existing literature, my results indicate that country differences appear to correlate more strongly with digital literacy than settlement differences. However, this conclusion is based solely on descriptive comparisons, and thus, it cannot be definitively stated that country differences are more significant than settlement differences in influencing digital literacy.

The literature indicates that gender differences in digital skills are narrowing but have not yet disappeared entirely. I am particularly interested in exploring whether this trend holds true in the dataset and whether there remains a significant difference in digital knowledge between male and female respondents.

Figure 6 indicates that female respondents tend to have slightly lower digital knowledge compared to the rest of the population. The median digital literacy score for females is about one point lower than for the rest of the population, and the distribution of digital knowledge is nearly identical between genders. However, the gender differences are less pronounced than those observed between different education or income groups. Therefore, while gender-based digital literacy inequalities still exist, they appear to be less significant compared to other factors such as education and income.

Figure 6: Distribution of Digital Literacy Between Gender

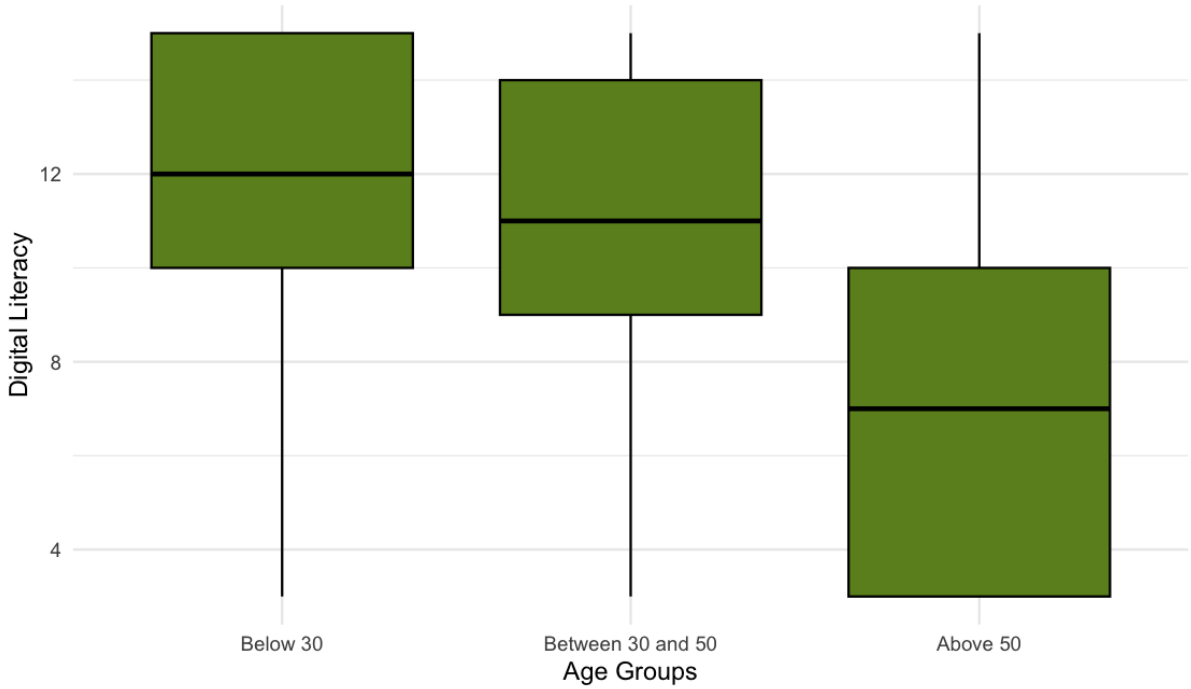


Finally, the literature suggests that age is a crucial determinant of digital skills. Due to the rapid pace of digital development in recent decades, older generations often find it more challenging to keep up with the required digital knowledge. Consequently, I am focusing on age to examine whether there are differences in digital literacy distribution among different age groups in Europe. The analysis is concentrated on three age categories: below 30, between 30 and 50, and above 50.

As Figure 7 illustrates, digital literacy levels vary significantly across the three age groups. The median score for the below-30 age group is 12, with the lower quartile ending at 9, indicating that 50% of this population scores between 9 and 12. The 30-50 age group's results are similar but slightly lower, reflecting a gradual decline in digital skills. However, a substantial difference is observed in the above-50 age group, where the median score drops to 8, which is lower than the lower quartile of the other

two groups. Additionally, the lower quartile for this group falls below 4. These results confirm the literature's assertion that age significantly impacts digital literacy, with older individuals generally exhibiting lower digital skills.

Figure 7: Distribution of Digital Literacy Between Age Groups



The descriptive analysis of digital literacy in Europe, based on data from the European Social Survey, reveals significant disparities across countries and socio-economic groups. Country-level averages show that nations like Austria, Finland, Switzerland, the Netherlands, and Norway lead in digital literacy, while Bulgaria, North Macedonia, Montenegro, Latvia, and Portugal lag behind. However, a closer look at the data distribution within countries using box plots uncovers more nuanced insights, highlighting that digital literacy is unevenly spread even within high-performing countries. For instance, Finland and Austria exhibit greater variability in digital knowledge compared to Norway and the Netherlands, where digital skills are more

uniformly distributed. This suggests that while certain countries excel on average, internal disparities persist.

Furthermore, the analysis delves into socio-economic factors such as income, education, and urban-rural divides. Higher income and education levels correlate strongly with better digital skills, reinforcing existing literature on the digital divide. Wealthier individuals and those with university degrees consistently score higher in digital literacy. Additionally, urban residents tend to have slightly better digital skills than their rural counterparts, though the differences are less pronounced than those based on income or education. Gender differences in digital literacy still exist but are less significant compared to other factors. Age remains a crucial determinant, with older individuals showing markedly lower digital skills. These findings collectively highlight the multifaceted nature of the digital divide in Europe, influenced by both national contexts and socio-economic characteristics.

4.2. Across Country Differences

The literature review demonstrated that socioeconomic characteristics significantly influence the level of digital literacy within a society. However, my previous analysis primarily focused on the distribution of digital literacy across specific demographic groups. Additionally, the results in section 4.1 indicated notable differences in digital literacy between European countries. Therefore, in this section, I aim to investigate the correlation between digital literacy and income, along with other control variables, and to examine how these relationships vary across European countries.

Before examining the differences between countries, I want to provide an overview of how socioeconomic characteristics correlate with digital literacy across Europe as a whole, without distinguishing between individual European countries. Table 1 presents the correlation between income, other control variables, and digital literacy. These relationships were analyzed using regression analysis.

Table 1: Impact of Income on Digital Literacy Within Europe

Term	Estimate	Std. Error	t value	Pr(>|t|)
Intercept	11.963***	0.0651259	183.687291	0.0000000
Income	0.29***	0.0057161	50.757509	0.0000000
University Degree	2.219***	0.0344015	64.492357	0.0000000
Higher Education Below University	1.43***	0.0431364	33.151908	0.0000000
Female	-0.552***	0.0287564	-19.191244	0.0000000
Age	-0.099***	0.0008169	-120.651250	0.0000000
City	0.468***	0.0348786	13.405317	0.0000000
Town	0.28***	0.0353688	7.916677	0.0000000
Discrimination Experience	-0.101*	0.0482667	-2.082456	0.0373065
Adjusted R-squared	0.422			
Number of Observations	44322			

The results of the analysis show the correlation of income with digital literacy within Europe reveal several significant relationships. Higher income is strongly associated with increased digital literacy, with each unit increase in income leading to a 0.29 unit rise in digital literacy. It means that if someone earns more money this person is more

likely to have more advanced digital knowledge. Furthermore, education levels also play a crucial role. The dummy variable in the analysis is people with secondary or lower education degrees. Having a university degree increases digital literacy by 2.219 units. Completing higher education below university level results in a 1.43 unit increase in digital literacy.

Gender disparities are evident, with females exhibiting a 0.552 unit decrease in digital literacy compared to the rest of the population. It means that female respondents are less likely to have higher digital literacy results. Age negatively correlated with digital literacy, with each additional year associated with a 0.099 unit decline in digital literacy which means that younger people are more likely to have digital knowledge. Moreover, citizens who live in big cities or towns are more likely to have digital knowledge than those who live in villages. Living in a city is associated with a 0.468 unit increase in digital literacy. Living in a town result in a 0.28 unit increase in digital literacy. Experiencing discrimination is linked to a 0.101 unit decrease in digital literacy and this is the only variable that is only statistically significant at the 5% level. Moreover, the adjusted r-squared is 0.42 which means that the independent and the control variables explain digital literacy by 42%.

Overall, these results highlight that socioeconomic status, income and education, demographic, and geographical location significantly influence digital literacy levels within Europe. Notably, higher income and education levels are major positive contributors, while being female, older, and experiencing discrimination are associated with lower digital literacy.

However, I am not only interested in the general correlation between income and digital literacy in Europe, but also in how this relationship varies across different countries within the continent. To explore this, I conducted a regression analysis comparing the correlation between digital literacy and income across various European countries. To calculate this, I included the interaction between income and the country factor. Including this interaction term allows the model to estimate how the effect of income on digital literacy varies across different countries. In the analysis, Austria is used as the reference category.

Including the interaction term between income and country variable in the regression model allows for a more nuanced analysis. It not only assesses the overall correlation of income and digital literacy but also how this relationship varies across different countries, providing a detailed understanding of the interplay between income and country-specific factors in influencing digital literacy.

The findings in Table 2 reveal that the strength and direction of the correlation between income and digital literacy differ from country to country. In most countries, the correlation is positive, indicating that higher income is generally associated with higher digital literacy. However, the magnitude of this effect varies. In some countries, the correlation is weaker than in Austria, while in others, it is stronger.

Table 2: Differences Between Countries in Impact of Income on Digital Literacy

Term	Estimate	Std. Error	t value	Pr(>|t|)
Intercept	13.879***	0.204	67.955	0.000
Income	0.192***	0.029	6.583	0.000
University Degree	2.206***	0.035	63.940	0.000
Higher Education Below University	1.256***	0.043	28.926	0.000
Female	-0.521***	0.028	-18.542	0.000
Age	-0.098***	0.001	-121.262	0.000
City	0.576***	0.035	16.546	0.000
Town	0.366***	0.035	10.501	0.000
Discrimination Experience	-0.117*	0.048	-2.414	0.016
Belgium	0.051	0.045	1.129	0.259
Bulgaria	0.182***	0.037	4.857	0.000
Switzerland	-0.025	0.043	-0.583	0.560
Cyprus	0.033	0.053	0.618	0.537
Czech Republic	0.12**	0.039	3.074	0.002
Germany	-0.057	0.032	-1.759	0.079
Estonia	0.087*	0.042	2.088	0.037
Spain	0.054	0.039	1.379	0.168
Finland	0.037	0.040	0.930	0.353
France	0.071	0.038	1.880	0.060
Great Britain	0.082	0.043	1.909	0.056
Greece	-0.002	0.050	-0.050	0.960
Croatia	0.2***	0.043	4.600	0.000
Hungary	0.288***	0.041	6.998	0.000
Ireland	0.094*	0.043	2.188	0.029
Iceland	-0.078	0.050	-1.562	0.118
Italy	0.224***	0.042	5.322	0.000
Lithuania	0.116**	0.039	2.938	0.003
Latvia	-0.023	0.050	-0.459	0.647
Montenegro	0.158***	0.047	3.347	0.001
North Macedonia	0.097*	0.048	2.039	0.041
Netherlands	-0.089*	0.042	-2.106	0.035
Norway	-0.085*	0.041	-2.062	0.039
Poland	0.076	0.039	1.956	0.050
Portugal	0.322***	0.044	7.360	0.000
Serbia	0.087*	0.043	2.004	0.045
Sweden	-0.049	0.038	-1.291	0.197
Slovenia	0.138**	0.044	3.118	0.002
Slovakia	0.289***	0.050	5.792	0.000
Adjusted R-squared	0.463			
Number of Observations	43550			

Interestingly, countries with higher average digital literacy scores and less variation in these scores tend to show a weaker correlation between digital literacy and income. For instance, in Sweden, Norway, the Netherlands, Iceland, and Switzerland, the correlation is smaller than in Austria. This suggests that in these countries, digital literacy is less dependent on income. Germany, which also has high average digital literacy and low variability, fits this pattern as well.

On the other hand, Latvia and Greece, despite having lower average digital literacy scores, also exhibit a weaker correlation between digital literacy and income compared to Austria. This indicates that factors other than income might play a more significant role in digital literacy in these countries.

Conversely, the countries with the strongest positive correlation between digital literacy and income are Portugal, Slovakia, and Hungary. These countries tend to have lower average digital literacy scores compared to the European average, and their digital literacy scores are more widely distributed, especially in Portugal. This suggests that in these countries, income is a more critical factor in determining digital literacy.

In summary, the relationship between income and digital literacy varies significantly across Europe. In countries with higher average digital literacy and less score variation, income has a less pronounced effect. Conversely, in countries with lower average digital literacy and more score variability, income plays a more critical role in determining digital literacy.

To visualize and gain a better understanding of these country differences in the following I only focus on the three countries where the correlation between income and digital literacy is the strongest and the weakest. As was mentioned, countries with

the weakest correlation are Iceland, Norway, and the Netherlands and countries with the strongest are Portugal, Hungary, and Slovakia.

Table 3 only includes the shortened list of countries with the weakest and strongest correlation between income and digital literacy. The reference category is Austria.

Table 3: Differences Between Counries in Impact of Income on Digital Literacy

Term	Estimate	Std. Error	t value	Pr(>|t|)
Intercept	13.879***	0.2042429	67.954519	0.0000000
Income	0.192***	0.0291697	6.583402	0.0000000
University Degree	2.206***	0.0345087	63.939649	0.0000000
Higher Education Below University	1.256***	0.0434258	28.925619	0.0000000
Female	-0.521***	0.0281017	-18.542436	0.0000000
Age	-0.098***	0.0008093	-121.262243	0.0000000
City	0.576***	0.0347957	16.545685	0.0000000
Town	0.366***	0.0348696	10.500914	0.0000000
Discrimination Experience	-0.117*	0.0484947	-2.414250	0.0157718
Hungary	0.288***	0.0410918	6.997802	0.0000000
Iceland	-0.078	0.0501326	-1.561508	0.1184113
Netherlands	-0.089*	0.0422661	-2.106008	0.0352094
Norway	-0.085*	0.0414318	-2.061640	0.0392479
Portugal	0.322***	0.0436841	7.360462	0.0000000
Slovakia	0.289***	0.0498669	5.792177	0.0000000

Furthermore, to gain a greater overview of the differences between the mentioned countries should be plotted. The dependent variable is digital literacy, and I am generating a plot that visualizes the predicted values of digital literacy across different levels of household income and the chosen country variables.

In Figure 8 I show each combination of household income and country and the model calculates the predicted digital literacy scores. The plot illustrates the effect of household income on digital literacy within each country. This means that I compare how digital literacy changes with income across different countries.

Figure 8: Effect of Income on Digital Literacy Based on Country Differences

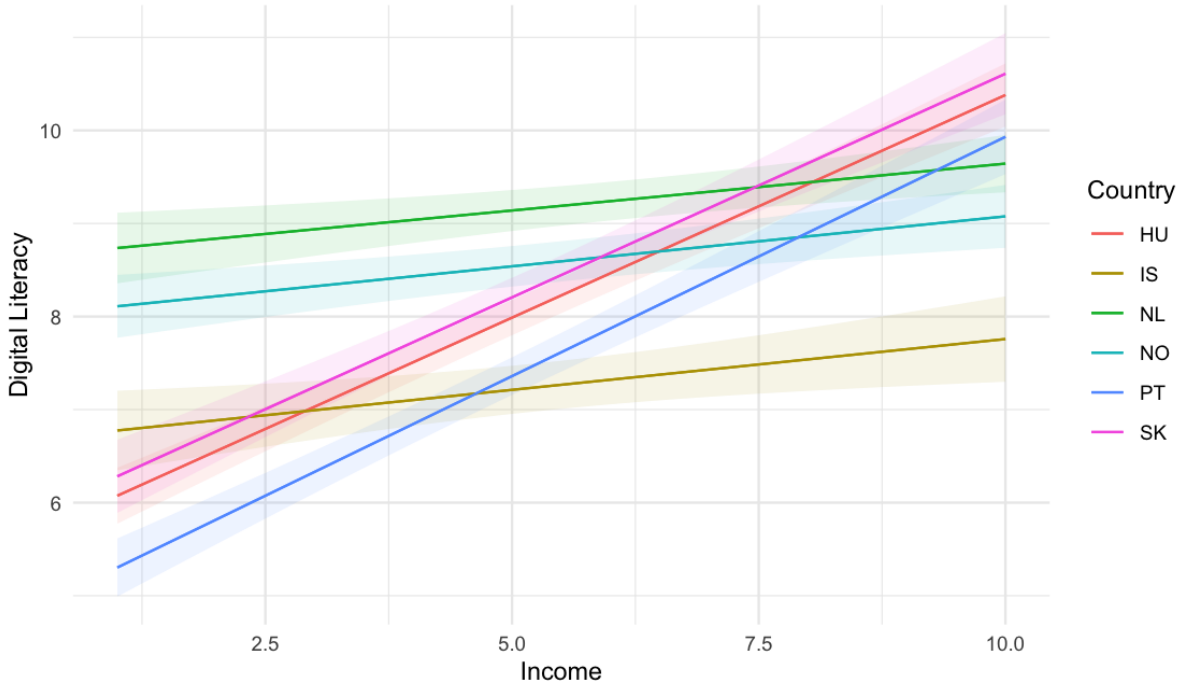


Figure 8 shows that there is a positive correlation between income and digital literacy across all the countries shown. As income increases, digital literacy also increases, which is consistent with the hypothesis that higher income levels are associated with greater digital access and skills. The shaded areas around each line represent

confidence intervals, providing a sense of the variability and reliability of the estimates. Most countries show relatively narrow confidence intervals, indicating precise estimates of the relationship between income and digital literacy. Iceland, however, has a wider confidence interval, suggesting greater variability or less precision in the data.

Countries like Hungary, Slovakia, and Portugal exhibit the strongest positive effects of income on digital literacy, suggesting that income plays a significant role in determining digital skills in these countries. Conversely, Iceland, Norway, and the Netherlands show a weak relationship, implying that factors other than income might play a more substantial role in influencing digital literacy in these countries. Interestingly the correlation between income and digital literacy is similar in these countries however, in Iceland people tend to have lower digital knowledge results than in Norway and the Netherlands. It is true for Portugal as well compared to Hungary and Slovakia. Therefore, Figure 8 indicates that the impact of income on digital literacy is context-dependent and influenced by broader socio-economic factors.

Therefore, in the next section, I aim to gain a better understanding of how digital literacy correlates with income and other control variables in the observed countries.

4.3. Within Country Analysis

In this last section within the empirics' chapter, I aim to gain a better understanding of how digital literacy correlates with income and the other control variables in the chosen countries. I will focus on Iceland, Norway, and the Netherlands, where the correlation between income and digital literacy is the weakest, and on Portugal, Hungary, and Slovakia, where this correlation is the strongest within Europe. This

analysis will provide insights into the varying impacts of income on digital literacy across different contexts.

Table 4 represents the results of what socio-economic factors to what extent have an influence on digital literacy in Norway.

Table 4: Impact of Income on Digital Literacy in Norway

Term	Estimate	Std. Error	t value	Pr(>|t|)
Intercept	12.332***	0.295	41.738	0.000
Income	0.149***	0.027	5.533	0.000
University Degree	1.81***	0.163	11.111	0.000
Higher Education Below University	1.111***	0.207	5.368	0.000
Female	-1.063***	0.139	-7.655	0.000
Age	-0.068***	0.004	-16.792	0.000
City	0.482**	0.167	2.889	0.004
Town	0.362*	0.177	2.042	0.041
Discrimination Experience	0.282	0.281	1.003	0.316
Adjusted R-squared	0.297			
Number of Observations	1318			

The results in Table 4 show that the factors that significantly increase digital literacy in Norway are higher income, having a university degree, higher education below university, and living in urban areas (city or town). In contrast, being female and older age is associated with lower digital literacy. Discrimination experience does not show a significant impact on digital literacy in this context.

Table 5, which focuses on the Netherlands, highlights that income, education level, gender, and age are key determinants of digital literacy. Interestingly, unlike in Norway, the type of residential area, village, town, or big city, does not significantly influence digital literacy. Furthermore, experiencing discrimination is a more significant factor affecting digital literacy in the Netherlands compared to Norway.

Table 5: Impact of Income on Digital Literacy in The Netherlands

Term	Estimate	Std. Error	t value	Pr(>|t|)
Intercept	12.235***	0.380	32.169	0.000
Income	0.175***	0.032	5.416	0.000
University Degree	1.852***	0.173	10.689	0.000
Higher Education Below University	1.574***	0.306	5.149	0.000
Female	-0.88***	0.157	-5.608	0.000
Age	-0.061***	0.005	-13.251	0.000
City	-0.009	0.186	-0.047	0.963
Town	0.207	0.193	1.072	0.284
Discrimination Experience	0.526*	0.247	2.134	0.033
Adjusted R-squared	0.278			
Number of Observations	1286			

Table 6 presents the results for Iceland. Similar to Norway and the Netherlands, higher income, holding a university degree, and having higher education below university level, as well as gender and age, strongly correlate with digital literacy. Additionally, living in a big city, as opposed to a village, positively influences digital literacy.

However, there is no significant difference in digital literacy between living in a town and living in a village. In Iceland, experiencing discrimination within society also does not significantly impact digital literacy.

Table 6: Impact of Income on Digital Literacy in Iceland

Term	Estimate	Std. Error	t value	Pr(>|t|)
Intercept	11.572***	0.431	26.856	0.000
Income	0.129***	0.038	3.425	0.001
University Degree	2.18***	0.197	11.058	0.000
Higher Education Below University	0.904**	0.280	3.230	0.001
Female	-0.744***	0.178	-4.169	0.000
Age	-0.089***	0.005	-17.335	0.000
City	0.834**	0.263	3.172	0.002
Town	0.488	0.258	1.890	0.059
Discrimination Experience	-0.076	0.235	-0.325	0.745
Adjusted R-squared	0.41			
Number of Observations	793			

To summarize, the correlation between income and digital literacy in Norway, Iceland, and the Netherlands is between 0.12 and 0.17 which means that when income increases by 1-point digital literacy increases between 0.12-0.17 points in these three countries. Moreover, belonging to a discriminated group does not seem to have any correlation with digital knowledge and town, city, and village differences also seem to be less correlated compared to the European average. As an example, in the

Netherlands there is not significantly different regarding digital literacy if someone is living in a city, or a town compared to a village.

Then, I examine the countries where digital literacy and income have the strongest correlation within Europe. Table 7 highlights the correlation of income and digital literacy in Portugal. Factors such as income, possessing a university degree, age, and living in a city or town, as opposed to a village, significantly influence digital literacy. Conversely, factors such as having higher education below a university degree, gender, and experiencing discrimination do not affect digital literacy in Portugal.

Table 7: Impact of Income on Digital Literacy in Portugal

Term	Estimate	Std. Error	t value	Pr(>|t|)
Intercept	11.517***	0.422	27.283	0.000
Income	0.45***	0.039	11.445	0.000
University Degree	2.168***	0.250	8.680	0.000
Higher Education Below University	1.114	0.571	1.953	0.051
Female	-0.223	0.178	-1.256	0.209
Age	-0.123***	0.005	-24.056	0.000
City	1.139***	0.227	5.026	0.000
Town	0.71***	0.207	3.430	0.001
Discrimination Experience	-0.65	0.411	-1.583	0.114
Adjusted R-squared	0.571			
Number of Observations	1181			

The next country analyzed is Hungary, with the findings presented in Table 8. Key determinants of digital literacy in Hungary include income, having any higher

education degree compared to only secondary education, age, living in a major city, and experiencing discrimination. In contrast, gender and residing in a town rather than a village appear to be less significant factors in explaining digital literacy.

Table 8: Impact of Income on Digital Literacy in Hungary

Term	Estimate	Std. Error	t value	Pr(>|t|)
Intercept	13.014***	0.344	37.846	0.000
Income	0.37***	0.031	11.889	0.000
University Degree	2.542***	0.248	10.262	0.000
Higher Education Below University	1.459***	0.300	4.871	0.000
Female	0.329*	0.162	2.037	0.042
Age	-0.135***	0.005	-30.019	0.000
City	1.147***	0.196	5.856	0.000
Town	0.045	0.187	0.239	0.811
Discrimination Experience	-1.789***	0.372	-4.814	0.000
Adjusted R-squared	0.586			
Number of Observations	1289			

Table 9 focuses on Slovakia, revealing results that are very similar to those for Hungary. However, gender does not impact digital literacy in Slovakia, and the differences between living in a city, town, or village is not significant. Key determinants of digital literacy in Slovakia include income, higher education, age, and experiencing discrimination.

Table 9: Impact of Income on Digital Literacy in Slovakia

Term	Estimate	Std. Error	t value	Pr(>|t|)
Intercept	12.95***	0.605	21.418	0.000
Income	0.388***	0.051	7.611	0.000
University Degree	2.748***	0.291	9.437	0.000
Higher Education Below University	2.147***	0.474	4.533	0.000
Female	-0.29	0.219	-1.325	0.186
Age	-0.122***	0.008	-15.979	0.000
City	0.328	0.291	1.130	0.259
Town	0.208	0.264	0.788	0.431
Discrimination Experience	-2.125***	0.520	-4.089	0.000
Adjusted R-squared	0.442			
Number of Observations	912			

In summary, the correlation between digital literacy and income in Portugal, Hungary, and Slovakia ranges from 0.37 to 0.44, indicating a stronger association compared to Norway, Iceland, and the Netherlands. Notably, there is no significant gender gap in digital literacy in Portugal and Slovakia, unlike in Hungary, Norway, Iceland, and the Netherlands. Interestingly, in countries where income has a lesser impact on digital literacy, Norway, the Netherlands, and Iceland, gender emerges as a key determinant. Conversely, in countries where income plays a more crucial role in explaining digital knowledge, gender appears to have less significance.

Education level emerges as a pivotal factor across all six countries. However, Portugal stands out as the sole exception, where possessing a higher degree below university does not impact digital knowledge. Furthermore, membership in a discriminated group shows no significant correlation in Portugal, Iceland, and Norway. Conversely, it exhibits a strong negative correlation with digital literacy scores in Hungary and Slovakia. This indicates that individuals belonging to a discriminated group in these countries tend to have digital literacy scores lower by -2.12 and -1.8, respectively.

4.4. Summary

The first section of the analysis of digital literacy in Europe, highlights significant disparities across countries and socio-economic groups. Countries like Austria, Finland, Switzerland, the Netherlands, and Norway have high average digital literacy scores, while Bulgaria, North Macedonia, Montenegro, Latvia, and Portugal lag behind. However, internal disparities within these countries reveal that digital literacy is unevenly distributed, even among high-performing nations.

Socio-economic factors such as income and education strongly correlate with digital skills. Wealthier individuals and those with higher education levels consistently show better digital literacy. Urban residents tend to have slightly better digital skills than rural ones, though these differences are less pronounced than those based on income or education. Gender differences in digital literacy exist but are less significant compared to other factors. Age is a crucial determinant, with older individuals generally exhibiting lower digital skills. These findings underscore the complex nature of the digital divide in Europe, shaped by both national contexts and socio-economic characteristics.

The second section of the analysis investigates how socioeconomic characteristics correlate with digital literacy across Europe and examines the variability of these relationships between different countries. Initially, the results reveal that higher income and education levels are strongly associated with better digital literacy. Gender, age, and urban-rural living also significantly affect digital literacy, with females, older individuals, and rural residents generally showing lower digital skills.

The study then focuses on the correlation between income and digital literacy across different European countries. The results show that this relationship varies significantly between countries. In countries with high average digital literacy and low variability, like Sweden, Norway, the Netherlands, Iceland, and Switzerland, the correlation between income and digital literacy is weaker. This suggests that in these countries, digital literacy is less dependent on income. Conversely, in countries with lower average digital literacy and higher variability, such as Portugal, Slovakia, and Hungary, income plays a more critical role in determining digital literacy.

Overall, the findings highlight that while higher income generally leads to better digital literacy, the extent of this effect varies across Europe, influenced by broader socio-economic contexts. The analysis underscores the importance of considering country-specific factors when addressing the digital divide.

5. Conclusions and Limitations

The research paper highlights significant disparities in digital literacy across and within European countries. Despite Europe's notably high internet and technology access rates compared to other regions globally, a substantial portion of the population exhibits low digital skills according to the measurement used in the study. While the digital literacy scale employed serves as a proxy for assessing digital knowledge in Europe, the pronounced divisions in the results raise important questions and concerns.

The study reveals major differences in digital literacy levels among European countries. However, interesting trends emerge when examining countries with high average digital literacy and narrow distributions within the middle 50%. These countries include Norway, the Netherlands, Switzerland, Iceland, and Germany, where the correlation between income and digital literacy is weakest. These findings could potentially suggest that in societies with widespread advanced digital skills, an individual's financial background is less likely to impact their digital literacy.

Alternatively, based on other literature, high GDP per capita might explain the prevalence of advanced digital skills in these countries. Thus, another potential interpretation is that high GDP per capita enhances digital skills, thereby reducing the influence of individual income on digital literacy. Therefore, further research is needed to understand why digital skills and income levels correlate differently across European countries. Such research could provide insights into improving digital knowledge in various societies.

Furthermore, there are notable differences between countries regarding which socio-economic factors correlate with digital skills, warranting further investigation. For instance, in Hungary and Slovakia, a strong correlation exists between feelings of discrimination and lower digital literacy scores. It is essential to explore whether being discriminated against in these countries directly leads to limited digital skills and who are the who feel discriminated in the country.

Additionally, my findings indicate that in the Netherlands and Slovakia, living in a small town or big city compared to a village does not correlate with an individual's digital literacy. This suggests that, contrary to the prevailing literature, the urban-rural divide in terms of digital literacy may not be significant in these countries. It should be further reached if this is the case in Slovakia and the Netherlands because there are no differences between living in an urban or a rural area.

Moreover, an interesting finding of the thesis is that in countries where household income strongly correlates with digital literacy, there is no significant correlation between gender and digital knowledge. This contrasts with Norway, the Netherlands, and Iceland, where being a woman is significantly negatively correlated with digital skills. These results should be further researched because it would be interesting to know whether a strong correlation between income and digital skills impacts gender differences in the country or if there are other factors behind this trend.

In conclusion, the results demonstrate that different socio-economic factors correlate with digital literacy in different countries. It is crucial to study which socio-economic characteristics are determinants in various European countries to gain a better understanding and address the unique challenges each country faces. There is no one

digital divide in Europe but multiple ones. Tailored solutions can ensure that already disadvantaged groups are not left behind.

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