Chapter 2

Micro and macro socio-economic drivers of the digital divide in South Africa

Ayanda Magida

Abstract

The term ‘digital divide’ pertains to the disparity between those with access to digital technologies and those without, encompassing individuals, households and businesses. Initially viewed as a simple dichotomy, the understanding of the digital divide has since evolved into a multidimensional framework, emphasising the importance of meaningful connectivity. This involves consistent and uninterrupted internet access, access to suitable devices, sufficient data, and affordable connections. The digital divide is further categorised into three levels. The first level concerns physical access to digital infrastructure, encompassing access to computers, the internet, and mobile phones. The second level relates to the effective use of digital technologies, including digital literacy and skills. The third level pertains to using digital technologies to engage in economic, social and political activities. The study described in this chapter was conducted to investigate the micro and macro drivers of the digital divide in the context of South Africa, employing a concurrent mixed-method approach. The micro-level findings indicate that age, geographic location and population group are significant socio-economic factors driving the first level of the digital divide. Additionally, economic activity, population group and education level influence the second level of the digital divide. Qualitative interviews revealed three themes contributing to the digital divide's macro drivers, including the affordability of internet access and ICT devices, the availability of infrastructure such as fibre and network connectivity, and the impact of electricity challenges on internet stability. By utilising mixed methods, this study provides valuable insights into the micro and macro drivers of the digital divide, making important empirical and methodological contributions to this area of research.

Keywords: Digital divide, socio-economic factors, internet access, internet usage, resources appropriation theory, digital divide levels

Introduction

The proliferation of digital technologies has exacerbated the long-standing digital divide issue, which has become a widely recognised problem. The COVID-19 pandemic and the increasing reliance on digital technologies for communication, transactions and work have brought the issue to the fore. The literature on the digital divide has evolved from a binary perspective to a multidimensional one, as highlighted by Gong (2020). This shift focuses on meaningful connectivity, including regular and uninterrupted internet access, suitable devices, sufficient data, and affordable connections. (It is important to note that the terms 'digital divide', 'digital disparity' and 'digital exclusion' are often used interchangeably in the literature.). Over the years, numerous studies have explored the digital divide issue, encompassing various factors such as access, skills, usage and outcomes. This body of work highlights the disparities between privileged and underprivileged groups regarding digital technology access and usage. Those with access to the internet, mobile phones and computers tend to have better and more frequently used skills, leading to quantifiable outcomes and offline benefits, compared to those who do not have access. A common theme in the literature on the digital divide is the different levels associated with it, namely the first, second and third levels of the digital divide.

Gillwald (2017) asserted that there is a digital divide in South Africa, with inequalities reflecting the country's societal and economic challenges. She emphasises the divide between those with and without access to services and the means to utilise them effectively. According to Research ICT Africa (RIA), 73% of South Africans with internet access use it for social media (44%), education material (30%), and job-related activities (26%) (Gillwald et al., 2018). These findings align with data from the South African General Household Survey, which showed that urban areas and metros have more internet users than rural areas (StatsSA, 2018). A recent ICASA (2023) report indicates a decline of 12.86% in mobile phone data subscriptions in South Africa between 2018 and 2022. While Stats SA provides data on internet access, further empirical data is needed to examine the use and skills of South Africans regarding digital technologies.

Various factors –including spectrum, regulation, and the cost of data –influence access to the Internet in South Africa. Despite government initiatives to address the issue, the gap between those with and without internet access continues to widen (Gillwald et al., 2018). South Africa faces a triple threat of poverty, unemployment and inequality. This study reframes the

triple threat by adding the digital divide as a form of inequality, given that access to and use of digital technologies have become essential to life, livelihoods, transactions and socialising. If left unattended, it could further perpetuate the levels of inequality. Secondly, South Africa has a dual economy, which further adds to the complexity of the digital divide. Thirdly, in South Africa, gross national income is linked to internet access, and mobile phone penetration exacerbates the divide between the rich and the poor due to high inflation rates and unemployment. According to ICASA (2023), there has been a 2.2% decrease in mobile cellular data usage over the past seven years (2015-2021), reflecting a 46% reduction in users.

Dimensions of the digital divide

The literature on the digital divide typically acknowledges its multidimensional nature. Some scholars suggest four dimensions: access, skills, economic opportunities and democratic inequality (Mossberger et al., 2003). Others propose a different framework with three dimensions: access, usage and tangible outcomes (Ferro et al., 2011). The study in this chapter focuses on three dimensions, as displayed in Table 1 below.

Table 1: Dimensions of the digital divide

Dimension	Description	Source
First-level digital divide	Internet and mobile phone access Access to ICT devices	Montagnier & Wirthmann (2011); Van Deursen & Van Dijk (2019);
Second-level digital divide	Internet usage and skills	Van Deursen et al. (2014); Hilbert (2016)
Third-level digital divide	Benefits of internet access and usage	Van Deursen & Helsper (2018); Helsper & Van Deursen (2015; Van Deursen et al. (2014); Van Deursen & Van Dijk (2014)

The first level of the digital divide

The first level of the digital divide relates to physical access to digital infrastructure, which includes access to computers, the Internet, and mobile phones. The focus is on access to these

devices in various locations, such as schools, workplaces, homes and public places. Understanding the first-level digital divide requires considering these contextual factors. Developed countries have a much higher internet access rate than developing and less developed countries, highlighting the economic aspect of the digital divide. Better infrastructure and economic development are crucial for bridging the gap. Even though global internet access has improved, regional disparities persist; Africa has lower internet penetration due to barriers such as lack of digital experience and infrastructure. Van Dijk and Hacker (2003) identified these barriers, and studies suggest that political will is necessary for infrastructure implementation. It is critical that governments develop policies to foster internet access and infrastructure. Despite exponential growth in ICT uptake per 100 inhabitants, the African region must catch up in ICT product uptake, given the global decline in fixed-line telephone subscriptions.

Van Deursen and Helsper (2018) posited that the availability of internet access is crucial for social inclusion, as those needing it risk being left behind. Despite advancements in internet and information technology access, the disparity between those with and without access remains significant in developed countries as well as underdeveloped countries such as South Africa. The issue of access is a multifaceted phenomenon. Hilbert (2016) posited that a deficiency in broadband access significantly contributes to the first level of the digital divide. In South Africa, internet access remains a challenge, with only an estimated 58% of the population having access. The introduction of fibre in urban areas and the expected 5G technology further compound the problem, perpetuating the digital divide in the country.

The second level of the digital divide

The second level focuses on skills and usage. The research often examines both aspects of the digital divide, sometimes individually. Hargittai (2003) defined skills as the ability to use new technologies effectively, and stated that four factors – technical proficiency, autonomy of use, social support and network, and experience – determine one's skill level in internet use. Hargittai (2002) suggested that the digital divide should not only focus on online activity but also extend to associated skills. Hilbert (2016) built on this idea, arguing that the second dimension of the digital divide is linked to various cultural, demographic and social factors that cause differential usage patterns. He suggested examining different usage patterns, such as bandwidth usage, when assessing internet use. Studies have shown that digital bandwidth inequality is strongly associated with income inequality, contributing to the digital divide.

Research on second-level digital inequality suggests that providing universal internet access does not guarantee digital inclusion. Skill differences exist among mobile phone internet users.

The third level of the digital divide

The third level pertains to the disparities in the benefits of internet use among individuals with similar usage patterns and access to ICTs and internet infrastructure. This level, as defined by Helsper and Van Deursen (2015), refers to the gaps in an individual's ability to translate their internet access into favourable offline outcomes. This definition includes the activities and benefits associated with IT products (Van Deursen, 2014). Studies have suggested that four main factors drive the tangible outcomes of internet use: economic, social, cultural, and personal benefits (Helsper & Van Deursen, 2015). However, only some of the existing studies have investigated the third level of the digital divide, which assesses the offline benefits of internet use, largely due to the difficulty of measuring it (Van Deursen & Helsper, 2018). A recent study on a Nigerian population found that frequent internet use is strongly associated with personal development, and social and business activities, which can lead to personal development (Ogbo et al., 2021). While scholars have highlighted the challenges of assessing this dimension quantitatively, they have advocated for more qualitative studies. It is crucial to note that the third level of the digital divide perpetuates the binary view of research, where benefits are viewed in a binary manner: those who benefit and those who do not. Although numerous studies have been conducted on the digital divide, most research focuses on the first level (DiMaggio et al., 2004; Selwyn, 2004; Van Dijk, 2005) and second level (Blank, 2017; Hargittai, 2002; Kalmus et al., 2013; Min, 2010). However, there has been growing interest and a growing body of literature on the third dimension of the digital divide (Stern et al., 2009; Helsper & Van Deursen, 2015; Van Deursen, 2014; Van Dijk, 2005).

Micro drivers of the digital divide

Salajan et al. (2010) suggested a multi-perspective approach encompassing institutional, structural and demographic factors. The digital divide has macro and micro drivers, with policy and infrastructure affecting the macro level and individual factors influencing the micro level. For the study in this chapter, the following socio-economic factors driving the digital divide were investigated: age, gender, education and geographic location. The literature on age and gender disparities in the digital divide presents inconsistent findings.

While certain studies indicate that women are less likely to access and utilise ITC products due to gender-based societal dynamics, others have uncovered disparities in internet usage between men and women in regions such as Latin America and Jordan. Access to digital and information technologies can empower women and promote gender equity in Iran (Shirazi, 2012). Viollaz and Winkler's (2021) study found that women who utilise digital technologies are more likely to participate in the labour force than those who do not, regardless of their level of education or social standing. However, family and marital status appear to negatively impact women's adoption and use of the internet in some countries, as demonstrated by Al-Saggaf et al.'s (2017) study among Iranian women. Moreover, that study revealed that higher education and income levels in women increase their probability of using the Internet weekly.

Research has consistently demonstrated that several variables – including ethnicity, age, geography and gender – contribute to the digital divide. In this context, age is a particularly significant factor, as younger individuals are more proficient at using digital technologies than their older counterparts. Numerous studies have highlighted the challenges older individuals face in accessing and utilising the internet. As a result, they often have a less prominent online presence and engage in internet activities and on social network sites less frequently than younger individuals (Haight et al., 2014; Van Deursen & Van Dijk, 2019). Previous studies have indicated that certain individuals, specifically those belonging to ethnic minorities and those residing in rural areas, enjoy limited access to and utilisation of the internet (Dupagne & Salwen, 2005; Mesch & Talmud, 2011; Yoon et al., 2020). Moreover, research conducted during the pandemic revealed that children in black households experienced poor and unreliable internet connectivity for remote learning. In contrast, those in white households had a more stable connection (Francis & Weller, 2022). Rural residents are also less inclined to adopt digital technologies than their urban counterparts, due to the scarcity of infrastructure and resources in rural areas.

According to the research, individuals with higher levels of education tend to utilise the internet more frequently, and tertiary education has been positively associated with increased internet usage (Szeles, 2018; Várallyai et al., 2015). Van Deursen (2014) asserted that individuals with lower levels of education often use the internet for leisure activities, such as social media and gaming, while those with higher levels of education tend to use it for personal and professional development. Furthermore, individuals with lower levels of education are less likely to benefit economically from being online, such as through e-

commerce (Van Deursen & Van Dijk, 2014). On the other hand, higher education is associated with a greater likelihood of using laptops, smartphones, tablets and smart televisions (Van Deursen & Van Dijk, 2019). Lower-income individuals are less likely to have access to computers, the internet and mobile phones than their higher-income counterparts (Várallyai et al., 2015). However, high-income individuals are more likely to benefit from internet usage (Van Deursen and Van Dijk, 2019). The digital divide is an inherent aspect of technological progress, and it is essential to understand income and digital disparities. Income plays a significant role in the early diffusion of mobile phones in developing countries and is a potential driver of the digital divide. As shown by the studies above, socio-economic factors influence the adoption and use of digital technologies at the individual level. The study in this chapter aimed to contribute to the existing knowledge on the digital divide by analysing micro and macro drivers in the South African context.

Resources Appropriation Theory

The digital divide can be attributed to unequal distribution and acquisition of resources, as Van Dijk noted (2005). Access to information and communication technology (ICT) products benefits those who appropriate them swiftly, while those who do not face greater disadvantages. Unequal access to these technologies results in greater advantages for individuals who are ahead in society. Van Dijk (2005) also argued that categorical inequalities, such as gender and age, contribute to the uneven distribution of resources. This study uses Van Dijk's (2005) theoretical framework and posits that personal and positional categories are crucial to understanding the digital divide. Personal categories include age, gender, sex, race, cognitive level and personality type, while positional categories include labour, household, nationality and educational attainment. This study examined age, gender, sex and race as personal categories, and educational level and economic status as positional categories.

According to Van Dijk (2005), personal and positional categories do not directly result in access to new technologies. Rather, the distribution of resources, such as time, material, and mental, social and cultural resources, contributes to unequal access. These resources also include individual attitudes, technical capabilities, and access to digital tools. Access refers to the availability of technologies, while skills are essential for effective usage. The author identified three distribution mechanisms: social exclusion, exploitation, and control. The current study focuses on the second level of the digital divide, which relates to the usage of

the internet and mobile phones. However, the other aspect of this level, which involves skills, still needs further investigation. Participation in society involves using digital technologies to benefit individuals and contribute to their well-being. This concept is linked to the third level of the digital divide, which focuses on the outcomes of being online. However, the theory has limitations in terms of fully explaining the cognitive and behavioural attributes that lead to internet usage. It only considers limited personal and positional categories and lacks a thorough examination of resource availability. The table below outlines the connection between the digital divide dimensions and the Resources Appropriation Theory (RAT) principles, which were applied in the study in this chapter.

Table 2: RAT and levels of the digital divide

RAT	**Drivers**
Personal and positional resources and mechanism of distribution	Micro drivers
Access to ICT infrastructure	Macro drivers

Based on the theory presented above, the following was hypothesised:

- $H_0$1: There is a relationship between the socio-economic factors and internet access (first-level digital divide).
- $H_0$2: There is a relationship between socio-economic factors and internet usage (second-level digital divide).

Methodology

Research approach

The study used a concurrent mixed-method design involving two data collection methods (Creswell & Clark, 2017). This design does not have a clear beginning or end, as data collection occurs concurrently. Quantitative data was gathered through online and paper-based surveys. At the same time, qualitative interviews were conducted to delve into aspects of the digital divide and social cohesion that could not be adequately addressed through quantitative methods, providing a more comprehensive understanding of the issues.

Study setting, sample and participants

A concurrent mixed-method approach employing online and paper-based surveys and in-depth interviews necessitates non-probability sampling methods. Non-probability sampling is a method that selects accessible and available participants rather than attempting to generalise results. This differs from probability sampling, which involves randomisation and is a non-judgmental and unbiased sampling frame in which all population members are equally likely to be selected. Probability sampling is commonly used in quantitative studies because of the randomisation necessary for large samples. This study employed purposive and snowballing sampling techniques to distribute the survey. Snowballing sampling was used to distribute the survey through social media platforms and the University of the Witwatersrand (Wits) student community. Convenience sampling was used to collect paper-based data. Snowballing sampling was also utilised by giving paper-based surveys to respondents. This approach was used to adhere to COVID-19 regulations, as the country was subject to lockdown-level regulations at the time of data collection. Most participants were 18-24 years old (46%), followed by 25-34 (26%), 45-54 (8%), and 55 and above (3%). Regarding gender, the study comprised 58% females and 40% males, with 1% identifying as non-binary or third gender and 1% preferring not to say. Four population groups were sampled, with 78% identifying as African black, 11% as white, 7% as Asian/Indian, and 4% as coloured. This is in line with South Africa's population dynamics. Most participants were from sub-urban formal areas (71%), followed by sub-urban informal areas (22%) and rural areas (7%). In terms of education, the majority (46%) had a matric or high school qualification, followed by postgraduate (27%) and undergraduate (18%). A small number (0.8%) had primary schooling, 2% had no schooling, and 6% preferred not to say. Students comprised the largest sample proportion, accounting for 45% of the respondents. Full-time workers were the next-largest group, making up 29% of the sample, while part-time workers accounted for 9%. Unemployed respondents and those who are retired or ‘other’ constituted only 2% and 1% of the sample respectively. Most respondents had monthly personal income of R1 000-2 000, though 22.7% earned R26 000 or more. However, a substantial proportion (12.9%) reported no personal income, while 8.9% had income of R3 500-7 500. Additionally, 7.6% of respondents had income of R2 000-3 500, 6.8% had income of R7 500-15 000, and 6.2% had income of R15 000-25 000.

Data analysis and interpretation

The study in this chapter used regression analysis for the analysis of the quantitative data, and thematic analysis for the analysis of the interviews. Regression analysis is a statistical method

for predicting an outcome variable based on one or multiple predictor variables. Regression analysis was used to examine the connection between the digital divide and socio-economic factors (Field, 2013, p. 198). Additionally, logistic regression was applied to evaluate the first level of the digital divide and its corresponding socio-economic drivers. Logistic regression is a mathematical modelling approach that can establish the relationship between multiple independent variables and a binary dependent variable (Kleinbaum & Klein, 2002, p. 5); it was employed to assess the first and second levels of the digital divide, as the survey questions about these variables were dichotomous. Inductive thematic analysis was used on the qualitative interviews.

Ethical considerations

The University of the Witwatersrand Human Research Ethics Committee (HREC) supplied the ethics clearance for this study. Participants in each phase received participant information outlining the purpose of the study. The participant information sheet form was also used to confirm informed consent and voluntary participation with no consequences for the participation of the subjects. The survey was anonymous; no personal information was collected. Pseudonyms were used for qualitative interviews.

Results and discussion

The first level of the digital divide (internet access)

The first-level digital divide data analysis involved utilising direct logistic regression to explore the impact of various socio-economic factors on internet access. The model incorporated six independent variables: age, gender, population group, geographic location, education level and economic activity. The complete model, encompassing all predictors, was statistically significant, as indicated by an X2 value of 120.9 (6, N=834) = <.001, signifying its ability to differentiate between respondents with and without internet access effectively. The model's explanatory power varied from 13.2% (Cox and Snell R square) to 39% (Nagelkerke R square) in predicting internet access, with a 95.1% correct classification rate. According to Table 3, only two independent variables, namely age and education level, uniquely and significantly contributed to the model, with the strongest odds ratios recorded at 1.66 and 1.60 respectively.

Table 3: Internet access

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
Age	.504	.135	13.867	1	.000	1.66	1.269	2.157
Gender	-.457	.360	1.613	1	.204	.63	.313	1.282
Population Group	-.124	.341	.131	1	.717	.88	.453	1.726
Geographic Location	.469	.195	5.782	1	.016	1.60	1.091	2.341
Education Level	-1.090	.233	21.888	1	.000	.37	.213	.531
Economic Activity	-.182	.136	1.802	1	.179	.83	.638	1.088
Constant	-.296	1.467	.041	1	.840	.74		
[a] -2 Log likelihood =231.476, Cox & Snell R Square = .132, Nagelkerke R Square =.390								

The data above suggests a strong positive correlation between the first-level digital divide and both age (p<.000) and education (p<.000). These findings support previous research on the digital gap across age groups (Abu-Shanab & Al-Jamal, 2015; Wang et al., 2023). The study reveals that higher levels of education are linked to increased internet usage, which is in line with Szeles' (2018) conclusions. Furthermore, the study indicates a positive relationship between age and internet access, mirroring Tsetsi and Rains' (2017) findings on the internet reliance of younger generations. In contrast, there was no significant correlation found between internet access and economic activity (p<.179), geographic location (p<.016), population group (p<.717), or gender (p<.204). Despite this, research shows that women are more likely to face digital exclusion than men (Kalmus et al., 2013; Mesch &Talmud, 2011). For instance, Abu-Shanab and Al-Jamal (2015) discovered a lack of support for internet access for women among men in Jordan, particularly in wealthier populations. Nevertheless, other studies suggest that embracing digital technology can enhance women's participation in the labour force (Viollaz & Winkler, 2021; Al-Saggaf et al., 2017). While the impact of population groups on internet access is not substantial, it is worth noting that ethnic minorities have been associated with the digital divide (Mesch & Talmud, 2011). For

instance, Kaila (2023) found that poorer ethnic minorities have lower rates of mobile phone and internet usage than other ethnic groups, which explains the persistence of the digital divide amid existing social and economic disparities.

The study revealed that geographic location is not a factor in determining internet access ($p<.016$), which contradicts previous research in Nigeria by Adeleke (2021) that found disparities in levels of internet access between different states, based on geographical distribution. Urban residents generally tend to have greater access to digital technologies than those in rural areas, a pattern observed in developed countries such as the United States (Vogels, 2021; Perrin, 2019). However, some studies have indicated no differences in internet access between rural and urban areas (Haight et al., 2014; Lembani et al., 2020). Additionally, the study found no correlation between economic activity and internet access. Low income is linked to lower access to computers, the internet and mobile phones (Várallyai et al., 2015). The likelihood of a high-income household having access to a computer and the internet is higher than that of a low-income household (Montagnier & Wirthmann, 2011; Kalmus et al., 2013). The research also indicated that only 68% of low-income earners or fewer are able to access a computer and the internet at home (Várallyai et al., 2015).

Micro drivers: second-level digital divide (internet use)

The current study aimed to examine the influence of socioeconomic factors on internet usage. It was hypothesised that a correlation exists between socioeconomic status and internet use. The results show that the overall model is significant, with an F-value of 62.085 and a p-value of less than 0.000, indicating the rejection of the null hypothesis at a 5% significance level, suggesting a relationship. The model's R-square value of 0.306 indicates that it accounts for 30.6% of the variation in the data. However, the adjusted R-square value of 0.301 suggests a less than 40% explanation of the variation, indicating a poor fit. In cases of high precision, the R-square value may still be useful. At the same time, other measures (such as the coefficient parameter) may be more appropriate for analysing unpredictable socio-economic data, as illustrated in Table 4 below.

Table 4: Internet use coefficients

	Sum of Squares	df	Mean Square	F	Sig.
Regression	814.197	6	135.700	62.085	.000[b]
Residual	1849.116	846	2.186		
Total	2663.313	852			

Table 5: Internet use regression

	Unstandardised Coefficients		Standardised Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	1.783	.363		4.911	.000		
Age	.049	.049	.031	.985	.325	.835	1.198
Gender	.123	.091	.039	1.349	.178	.962	1.040
Population group	.227	.060	.113	3.803	.000	.934	1.071
Geographic location	-.502	.052	-.332	-9.711	.000	.700	1.429
Education level	.232	.069	.127	3.362	.001	.574	1.743
Economic activity	.274	.047	.197	5.781	.000	.704	1.421

The parameter estimates presented in Table 5 were analysed, focusing on the main effects of age, gender, population group, geographic location, education level and economic activity. The estimated slope for the population group was 0.227 and was statistically significant ($t_{846} = 3.803$, $p < 0.000$), indicating disparities in internet usage among different population groups. Similarly, the estimated slope for geographic location was -0.502 and demonstrated statistical significance ($t_{846} = -9.711$, $p < 0.000$), suggesting an impact of geographic location on internet use. The estimated slope for education level was 0.232 and was statistically significant ($t_{846} = 5.781$, $p < 0.000$), suggesting that higher education levels are associated with increased internet usage. Previous research has supported this finding, indicating that education level is a significant factor in technology adoption and utilisation (Várallyai et al., 2015). However, it is worth noting that one study found that education level did not significantly impact internet access (Ahmed et al., 2015).

The estimated slope for economic activity was 0.274 and was also significant (t846 = 5.781, p < 0.000), suggesting that an increase in economic activity results in an increase in internet use. However, the estimated slope for age was 0.049 and was insignificant (t846 = 0.985, p < 0.325), indicating that age does not affect internet use. The same holds for gender, as there is no geographic effect. Furthermore, there is no multicollinearity in the data, as the condition index is low (<30) and the variance inflation factor is low (VIF<10). These findings did not identify gender- or age-related effects on internet usage; however, previous studies have suggested that in fact, gender can influence internet usage. For instance, Gray et al. (2017) revealed notable variations in internet usage between men and women, which aligns with the findings of Abu-Shanab and Al-Jamal (2015), who reported that men in Jordan were more likely to use the internet than women. Additionally, studies in Latin America and sub-Saharan Africa uncovered disparities in internet usage between men and women. Although some studies did not find significant differences in internet usage frequency between men and women, it was observed that women often use the internet for activities like shopping and education, while men tend to use it more for gaming.. Furthermore, mobile phone and smartphone ownership disparities were observed in South Africa, with more women owning smartphones than men. In contrast, men led in this statistic in the other five countries. In a large-scale study conducted across 28 European Union countries, there was no observable difference in the adoption and utilisation of digital technology between men and women (Elena-Bucea et al., 2020; Ahmed et al., 2015). This is supported by the findings of Haight (2014), which indicate that women had a higher rate of internet access and online activities than men, while men had a greater proportion of social network site usage. However, this contradicts the work that has shown gender disparities in internet usage between men and women (Elena-Bucea et al., 2020).

The research indicates that internet usage is impacted by demographic factors such as population group, geographical location, educational attainment and economic activity. The current study observed a relationship between geographical location and internet usage, consistent with prior findings by Haight et al. (2014) and Cruz-Jesus et al. (2018). Lai and Widmar (2021) also noted an inverse correlation between internet speed and internet usage in rural areas, where limited internet adoption and usage are prevalent in developing nations (Hadi, 2018). Moreover, the study suggests that age plays a minor role in internet usage. Van

Deursen and Van Dijk (2019) found that younger individuals were more likely to use the internet than older individuals.

Macro drivers of the digital divide

Twelve participants were interviewed to gain diverse perspectives and deeper insights into the factors driving the digital divide. Despite their differing viewpoints, all participants agreed on three key factors contributing to the digital divide in South Africa. The main themes identified in the study were infrastructure, data cost and affordability, and electricity. Participants consistently emphasised these factors, showing a shared understanding of their significance in shaping the digital divide. The participants recognised the importance of addressing these factors to reduce discrepancies in digital access and usage across different populations in South Africa. Thus, the qualitative interviews pinpointed infrastructure, affordability and electricity as the primary factors contributing to the digital divide in South Africa.

Infrastructure

The study participants highlighted infrastructure as a significant factor contributing to the digital divide in South Africa, specifically citing the lack of fibre and necessary spectrum. They emphasised that inadequate infrastructure restricts internet access and widens the digital gap. The participants recognised the critical role of infrastructure, such as fibre connections, in ensuring fair access to digital resources. However, they noted that the limited availability and required spectrum led to unequal access to high-speed internet, particularly in remote areas.

> "I think infrastructure has been skewed very much to the metro areas. In so many rural areas, a big part of South Africa, in those areas physical infrastructure such as roads and internet connectivity remains a challenge. That impact on access to just the infrastructure to bring those services to them... These things in turn contribute a huge digital divide in our country." – **Participant 8**

> "Access to infrastructure. So, if you look at rural areas, if you have any relatives at all, in the rural areas, when you visit – in some areas, to make a telephone call… you have to drive out of the village to go and make a telephone call. Because there is no network within the village in some of the townships, there is no access. So, I think the issues are

around the infrastructure and layout in terms of the infrastructure; secondly, socio-economic issues would create the digital divide." – **Participant 6**

Most participants highlighted the critical importance of improving infrastructure to narrow the digital divide, a challenge in South Africa and in several developed nations (West, 2015). Research has shown that infrastructure significantly affects the digital gap in developing countries (Shenglin et al., 2017; Umezuruike et al., 2015). These nations' lack of infrastructure exacerbates this issue. Access is at the core of the digital divide; according to Hudson (2016), investing in infrastructure might offer a solution to bridging this gap. However, some participants observed that mobile network providers present ongoing challenges, especially in remote and rural areas that require additional resources. This sentiment is echoed in other authors' studies of rural internet access (Hadi, 2018; Hollman et al., 2021; Martínez-Domínguez & Mora-Rivera, 2020). In some countries, underutilisation of network infrastructure due to over-provisioning and user traffic is a common issue (Sathiaseelan et al., 2015). Furthermore, high costs associated with digital infrastructure worsen the problem of limited internet access. West (2015) argued that weak infrastructure poses a significant barrier to digital access, encompassing elements such as fibre optic lines, cell towers, internet routers, wireless spectrum, and reliable electricity. Kaila (2023) noted that in Vietnam, phone infrastructure is more prevalent in urban areas than in rural and remote regions, affecting the adoption and utilisation of the internet.

Affordability

In South Africa, the digital divide can be attributed mainly to the high cost of data, which has been a topic of discussion and media attention for the past three years. Sathiaseelan et al. (2015) argued that the reluctance of operators to cover additional operational expenses associated with lower-cost data plans is a key factor contributing to excessive data prices in many countries. Research in Uganda also emphasises the impact of data or broadband prices on internet adoption and utilisation (Grossman et al., 2014). In the study referred to in this chapter, affordability was identified as a significant driver of the digital divide in South Africa, with participants ranking it second only to infrastructure. They consistently expressed that high data costs are a major barrier to internet access, perpetuating the digital divide. Affordability is critical in enabling internet access, and the current high costs make it difficult for individuals with limited financial resources to afford regular usage. The study participants emphasised the urgent need to address cost barriers and make internet access accessible to all

segments of society, acknowledging the influence of affordability on individuals' daily lives, particularly in the face of high unemployment levels in South Africa.

> "First, data is very expensive. I mean… it is expensive, and the gadgets, you know, are expensive, and the government is trying to provide some of the tablets to school learners as some intervention [to try and address the inequality of access] because the children from poor backgrounds get prejudiced by lack of access." – **Participant 12**

> "As I said, if you look at the huge inequalities of this country, where people live below the poverty line, you know. Thus, people constantly have to choose between buying food and maybe having access to data. But also, because people are unemployed, they do not have the resources to buy a cell phone or a laptop. So that creates that space and that gap within our society." – **Participant 2**

Emerging economies often face limited access to data and broadband services, hindering internet usage (Martínez-Domínguez & Mora-Rivera, 2020; Umezuruike et al., 2015). Tayo et al. (2016) emphasised the importance of making computer and internet access more affordable. While providing data and zero-rated services to university students has helped bridge the access gap, these efforts may not have fully addressed the user issues and concrete outcomes of the digital divide; simply reducing data prices and enhancing internet accessibility tackle only one aspect of the problem. The affordability of information and communication technology (ICT) is significantly affected by income level, as demonstrated by Ali et al. (2019) in Australia. Due to financial limitations, individuals from low-income households may not have the same level of access to ICT services as those from higher-income households. Participants in this study concurred that internet access has become a fundamental necessity for South African households, particularly those living below the poverty line. Other studies have also established a connection between ICT and the reduction of poverty (Yilmaz & Koyuncu, 2018). Ensuring equal internet access for all South Africans is crucial in addressing the country's high poverty rate.

Electricity – load-shedding

The participants highlighted electricity as a pivotal factor contributing to the digital divide in South Africa, with load-shedding exacerbating this issue. Reliable access to electricity is essential for utilising digital technologies, and challenges in infrastructure significantly

impact individuals' ability to bridge the divide. Therefore, addressing electricity infrastructure issues and ensuring a reliable and uninterrupted power supply is crucial to supporting digital connectivity for all individuals, regardless of location or background. Access to electricity is a fundamental prerequisite for digital inclusion, enabling individuals to power their devices, access the internet, and engage in online activities. Similarly, participants noted that the problems of unstable electricity and lack of spectrum also contribute to the digital divide. A study conducted by Magida (2022) across multiple countries in sub-Saharan Africa found a strong correlation between internet usage and electricity access, further highlighting the impact of electricity on the digital divide.

> "And in some areas, what you call this thing now, this or this load-shedding, or load reduction – so those things do not work, because there is no electricity."
> – **Participant 12**

> "The more I have thought about it, it is like… but certain things drive digital. As I mentioned, it is driven by electricity and fibre being everywhere. It is driven by an ability to have the information and ability to use digital tools and things."
> – **Participant 3**

Load-shedding has made it more difficult for South Africans to use ICT. The interviewees were of the view that decreased electrical supply has an impact on network and home infrastructure, which in turn has an impact on internet access. Consistent with the findings of this study, research has shown that low-income countries' restricted access to energy results in decreased ICT adoption and usage. The digital divide in South Africa, a country experiencing an energy crisis, is further exacerbated by the correlation between increasing ICT usage and higher electricity consumption in rising nations.

Conclusion

Research suggests that various socio-economic factors such as age, gender, geographical location, population group, level of education and economic activity impact internet access and usage. However, recent findings indicate that age, geographic location, population group, economic activity, and education level are the primary socioeconomic factors influencing the digital divide. This study offers valuable insights into both individual and larger-scale drivers of the digital divide. The results demonstrate that while internet access is influenced by age

group and education level, internet usage is affected by population group, geographical location, education level, and economic activity. Notably, there was no significant correlation between age, gender and the secondary digital divide. Furthermore, quantitative findings reveal that infrastructure, data affordability, and electricity are macro-level factors influencing the digital divide. These findings align with similar studies conducted in developing countries. The cost of mobile data, infrastructure availability and electricity all perpetuate the digital divide issue. In countries such as South Africa, where socio-economic structural factors intersect with poverty, unemployment and inequality, the digital divide persists as a significant challenge.

The digital divide is a multifaceted issue influenced by various factors, such as socio-economic status, race, culture, and historical context. Socio-economic factors such as age, geographic location, population group, economic activity and education level illustrate the intricate nature of the digital divide, and the demographic and economic variables contributing to it. Different age groups may have varying levels of access to technology, with younger generations being more digitally competent than older individuals who may struggle to adapt to new technologies. Geographic location also significantly impacts access to digital infrastructure, with urban areas generally having better internet connectivity and technological resources than remote or rural locations. South Africa's historical context, including issues of racial segregation and inequality, is also likely to affect digital access and opportunities for certain population groups. Economic activities in which individuals or communities are engaged can also influence their access to digital resources, as certain industries or economic sectors may be more technologically advanced, affecting the digital capabilities of those involved. Education is a key determinant of digital literacy, with higher education levels generally associated with better understanding and use of digital technologies. Therefore, it is crucial for government and for private-sector companies, especially in telecommunications, to foster digital inclusion that does not exclude individuals from internet access and usage based on their socio-economic status. It is important to ensure the availability of infrastructure to guarantee universal, efficient and affordable internet access, which will encourage usage and address the digital divide without perpetuating existing levels of inequality.

The study's findings offer valuable insights into the factors contributing to the digital divide. However, the sample size used limits how much we can generalise these findings to the

broader South African context. Policymakers and stakeholders must consider these socio-economic factors when formulating digital inclusion policies and programmes. Bridging the digital divide is essential for creating a more inclusive society, in which individuals from all socio-economic backgrounds benefit from digital technologies. The study's focus on both individual-level determinants and systemic issues is essential for developing effective strategies and policies to address the digital gap in South Africa.

References

Abu-Shanab, E. & Al-Jamal, N. (2015). Exploring the gender digital divide in Jordan. *Gender, Technology and Development, 19*(1), 91-113.

Adeleke, R. (2021). Digital divide in Nigeria: The role of regional differentials. *African Journal of Science, Technology, Innovation and Development, 13*(3), 333-346.

Ahmed, R. R., Hanif, M. & Meenai, Y. A. (2015). Relationship between demographic and internet usage. *Journal of Information Engineering and Applications, 5*(10), 32-38.

Afzal, M. N. I. & Gow, J. (2016). Electricity consumption and information and communication technology (ICT) in the n-11 emerging economies. *International Journal of Energy Economics and Policy*, *6*(3), 381-388.

Ali, M. A., Alam, K., Taylor, B. & Rafiq, S. (2019). Do income distribution and socio-economic inequality affect ICT affordability? Evidence from Australian household panel data. *Economic Analysis and Policy, 64*, 317-328.

Al-Saggaf, Y., Shariati, S. & Morrison, M. (2017). Women in Iran: The effect of marital status and the presence of family dependents at home on their use of the Internet. *The Journal of Community Informatics, 13*(3).

Blank, G. (2017). The digital divide among Twitter users and its implications for social research. *Social Science Computer Review, 35*(6), 679-697.

Creswell, J. W. & Clark, V. L. P. (2017). *Designing and conducting mixed methods research*. Sage publications.

Cruz-Jesus, F., Oliveira, T. & Bacao, F. (2018). The global digital divide: Evidence and drivers. *Journal of Global Information Management (JGIM), 26*(2), 1-26.

DiMaggio, P., Hargittai, E., Celeste, C. & Shafer, S. (2004). Digital inequality: From unequal access to differentiated use. In K. Neckerman (Ed.), *Social inequality,* pp. 355-400. New York, Russell Sage Foundation.

Dupagne, M. & Salwen, M. B. (2005). Communication technology adoption and ethnicity. *The Howard Journal of Communications, 16*(1), 21-32.

Elena-Bucea, A., Cruz-Jesus, F., Oliveira, T. & Coelho, P. S. (2020). Assessing the role of age, education, gender and income on the digital divide: Evidence for the European Union. *Information Systems Frontiers*, 1-15.

Ferro, E., Helbig, N. C. & Gil-Garcia, J. R. (2011). The role of IT literacy in defining digital divide policy needs. *Government Information Quarterly, 28*(1), 3-10.

Field, A. (2013). *Discovering statistics using IBM SPSS statistics*. Sage.

Gillwald, A. (2017). *Beyond access: Addressing digital inequality in Africa.* Centre for International Governance Innovation (CIGI). https://www.cigionline.org/publications/beyond-access-addressing-digital-inequality-africa/

Gillwald, A., Mothobi, O. & Rademan, B. (2018). The state of ICT in South Africa. *Research ICT Africa.* South Africa.

Gong, R. (2020). Digital inclusion: Assessing meaningful internet connectivity in Malaysia. In *#NetworkedNation: Navigating challenges, realising opportunities of digital transformation*, Chapter 1, pp. 5-38. Khazanah Research Institute.

Gray, T. J., Gainous, J. & Wagner, K. M. (2017). Gender and the digital divide in Latin America. *Social Science Quarterly, 98*(1), 326-340.

Grossman, G., Humphreys, M. & Sacramone-Lutz, G. (2014). "I wld like u WMP to extend electricity 2 our village": On information technology and interest articulation. *American Political Science Review, 108*(3), 688-705.

Hadi, A. (2018). Bridging Indonesia's digital divide: Rural-urban linkages. *Jurnal Ilmu Sosial dan Ilmu Politik, 22*(1), 17-33.

Haight, M., Quan-Haase, A. & Corbett, B. A. (2014). Revisiting the digital divide in Canada: The impact of demographic factors on access to the internet, level of online activity, and social networking site usage. In *Current research on information technologies and society,* pp. 113-129. Routledge.

Hargittai, E. (2002). Second-level digital divide: Differences in people's online skills. *First Monday, 7*(4).

Hargittai, E. (2003). The digital divide and what to do about it. In Jones, D.C. (Ed.), *New economy handbook,* Chapter 35, pp. 821-839. San Diego: Academic Press.

Hargittai, E. & Hinnant, A. (2008). Digital inequality: Differences in young adults' use of the internet. *Communication Research, 35*(5), 602-621.

Hargittai, E., Piper, A. M. & Morris, M. R. (2019). From internet access to internet skills: Digital inequality among older adults. *Universal Access in the Information Society, 18*(4), 881-890.

Helsper, E. J. & Van Deursen, A. (2015). Digital skills in Europe: Research and policy. *Digital Divides: The New Challenges and Opportunities of e-Inclusion, 195*, 125.

Hilbert, M. (2016). The bad news is that the digital access divide is here to stay: Domestically installed bandwidths among 172 countries for 1986-2014. *Telecommunications Policy, 40*(6), 567-581.

Hollman, A. K., Obermier, T. R. & Burger, P. R. (2021). Rural measures: A quantitative study of the rural digital divide. *Journal of Information Policy, 11,* 176-201.

Hudson, D. J. (2016). *On dark continents and digital divides: Information inequality and the reproduction of racial otherness in library and information studies.* University of Guelph, California. https://atrium.lib.uoguelph.ca/items/3da8cc76-df43-4cb4-8dc8-9c5471dee3f3

ICASA. (2023). *State of the ICT sector in South Africa – 2023 Report.* Independent Communications Authority of South Africa. https://www.icasa.org.za/legislation-and-regulations/state-of-ict-sector-report-2023-report

Kaila, H. (2023). Ethnic digital divide? Evidence on mobile phone adoption. *Applied Economics 55*(22), 1-15.

Kalmus, V., Talves, K. & Pruulmann-Vengerfeldt, P. (2013). Behind the slogan of 'e-state': Digital stratification in Estonia. In M. Ragnedda and G. W. Muschert (Eds.), *The Digital Divide*, p. 193.

Kharlamova, G., Stavytskyy, A. & Zarotiadis, G. (2018). The impact of technological changes on income inequality: The EU states case study. *International Studies, 11*(2), 76-94.

Kleinbaum, D. G. & Klein, M. (2002). Analysis of matched data using logistic regression. Logistic regression: A self-learning text, 227-265.Lai, J. and Widmar, N. O. (2021). Revisiting the digital divide in the COVID-19 era. *Applied Economic Perspectives and Policy, 43*(1), 458-464.

Lembani, R., Gunter, A., Breines, M. & Dalu, M. T. B. (2020). The same course, different access: The digital divide between urban and rural distance education students in South Africa. *Journal of Geography in Higher Education, 44*(1), 70-84.

Magida, A. (2022). The second level, digital divide in sub-Saharan Africa: A cross-country analysis. In G. J. Lee and R. Dagada (Eds.), *Research in Southern African Digital Business,* pp. 431-446. Silk Route Press.

Martínez-Domínguez, M. & Mora-Rivera, J. (2020). Internet adoption and usage patterns in rural Mexico. *Technology in Society, 60*, 101226.

Mesch, G. S. & Talmud, I. (2011). Ethnic differences in internet access: The role of occupation and exposure. *Information, Communication & Society, 14*(4), 445-471.

Min, S.-J. (2010). From the digital divide to the democratic divide: Internet skills, political interest, and the second-level digital divide in political internet use. *Journal of Information Technology & Politics, 7*(1), 22-35.

Montagnier, P. & Wirthmann, A. (2011). Digital divide: From computer access to online activities – a microdata analysis. *OECD Digital Economy Papers No. 189.*

Mossberger, K., Tolbert, C. J. & Stansbury, M. (2003). *Virtual inequality: Beyond the digital divide*. Georgetown University Press.

Ogbo, E., Brown, T., Gant, J. & Sicker, D. (2021). When being connected is not enough: An analysis of the second and third levels of the digital divide in a developing country. *Journal of Information Policy, 11*, 104-146.

Perrin, A. (2019). Digital gap between rural and nonrural America persists. In *Proceedings of the 12th International Conference on Education Technology and Computers*, pp. 215-222.

Salajan, F. D., Schönwetter, D. J. & Cleghorn, B. M. (2010). Student and faculty inter-generational digital divide: Fact or fiction? Computers & Education, 55(3), 1393-1403.

Sathiaseelan, A., Tyson, G. & Sen, S. (2015). *Exploring the role of smart data pricing in enabling affordable internet access* [Conference paper]. 2015 IEEE Conference on Computer Communications Workshops. DOI: 10.1109/INFCOMW.2015.7179444

Selwyn, N. (2004). Reconsidering political and popular understandings of the digital divide. *New Media & Society*, *6*(3), 341-362.

Shenglin, B., Simonelli, F., Ruidong, Z., Bosc, R. & Wenwei, L. (2017). Digital infrastructure: Overcoming the digital divide in emerging economies. *G20 Insights, 3*, 1-36.

Shirazi, F. (2012). Information and communication technology and women empowerment in Iran. *Telematics and Informatics, 29*(1), 45-55.

StatsSA. (2018). General household survey 2013, Statistics South Africa, Pretoria.

Stern, M. J., Adams, A. E. & Elsasser, S. (2009). Digital inequality and place: The effects of technological diffusion on internet proficiency and usage across rural, suburban, and urban counties. *Sociological Inquiry, 79*(4), 391-417.

Szeles, M. R. (2018). New insights from a multilevel approach to the regional digital divide in the European Union. *Telecommunications Policy, 42*(6), 452-463.

Tayo, O., Thompson, R. & Thompson, E. (2016). Impact of the digital divide on computer use and internet access on the poor in Nigeria. *Journal of Education and Learning, 5*(1), 1-6.

Tsetsi, E. & Rains, S. A. (2017). Smartphone internet access and use: Extending the digital divide and usage gap. *Mobile Media & Communication, 5*(3), 239-255.

Umezuruike, C., Oludele, A., Kuyoro, S. & Izang, A. (2015). Broadband internet penetration in Nigeria: A review. *International Journal of Research Studies in Computer Science and Engineering (IJRSCSE), 2*(1), 1-7.

Van Deursen, A. J. & Helsper, E. J. (2018). Collateral benefits of internet use: Explaining the diverse outcomes of engaging with the internet. *New Media & Society, 20*(7), 2333-2351.

Van Deursen, A., Helsper, E. J. & Eynon, R. (2014). *Measuring digital skills: From digital skills to tangible outcomes.* From digital skills to tangible outcomes project report.

Van Deursen, A. J. & Van Dijk, J. A. (2014). The digital divide shifts to differences in usage. *New Media & Society, 16*(3), 507-526.

Van Deursen, A. J. & Van Dijk, J. A. (2019). The first-level digital divide shifts from inequalities in physical access to inequalities in material access. *New Media & Society, 21*(2), 354-375.

Van Dijk, J. A. (2005). *The deepening divide: Inequality in the information society*. Sage Publications.

Van Dijk, J. & Hacker, K. (2003). The digital divide as a complex and dynamic phenomenon. *The Information Society, 19*(4), 315-326.

Várallyai, L., Herdon, M. & Botos, S. (2015). Statistical analyses of digital divide factors. *Procedia Economics and Finance, 19*, 364-372.

Viollaz, M. & Winkler, H. (2021). Does the internet reduce gender gaps? The case of Jordan. *Journal of Development Studies, 58*(3), 436-453.

Vogels, E. A. (2021). *Some digital divides persist between rural, urban and suburban America.* Pew Research Center. https://www.pewresearch.org/short-

reads/2021/08/19/some-digital-divides-persist-between-rural-urban-and-suburban-america/

Wang, J., Yin, Z. & Jiang, J. (2023). The effect of the digital divide on household consumption in China. *International Review of Financial Analysis, 87*, 102593.

West, D. M. (2015). *Digital divide: Improving internet access in the developing world through affordable services and diverse content.* Center for Technology Innovation at Brookings, 1, 30. https://www.brookings.edu/articles/digital-divide-improving-internet-access-in-the-developing-world-through-affordable-services-and-diverse-content/

Yilmaz, R. & Koyuncu, J. Y. (2018). The contribution of ICT to poverty reduction: A panel data evidence. *Sosyal Bilimler Araştırma Dergisi*, *7*(4), 63-75.

Yoon, H., Jang, Y., Vaughan, P. W. & Garcia, M. (2020). Older adults' internet use for health information: Digital divide by race/ethnicity and socioeconomic status. *Journal of Applied Gerontology, 39*(1), 105-110.