










# Exploring the Measurement of Digital Inclusion: A Review of Literature

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**Abstract.** Digital inclusion is a socio-technological process that enables individuals and communities to have access and digital skills to use information and communication technologies. Digital inclusion helps individuals and communities to be able to participate and benefit from today's growing information society. It also influences improve livelihood through the revolution of online work, online socialization, online learning, and all that on the remote. To ensure the successful implementation of digital inclusion, it is important to be able to measure it using a set of tools or measurement indexes. Currently, there is no accepted standard measurement that can comprehensively assess digital inclusion. Even while some measurement has been established, it only includes measurement for a select few domains. Realizing the criticality of measuring digital inclusion, this study aims to review and synthesize the rapidly growing literature on digital inclusion and how to measure it. It addresses the following questions: 1) What are digital inclusion and its advantages? 2) How can digital inclusion be measured? This study employed a systematic review methodology to investigate the areas where digital inclusion is measured. A systematic literature review is a methodical, transparent, and repeatable literature review that tries to find, select, evaluate, and synthesize research evidence on a given study issue comprehensively and systematically. In this study, 21 documents were analyzed and reviewed. Through this rapid review, the most recent understanding of digital inclusion measurement is presented. This could, later, be used by the government to measure digital inclusion and ensure the successful implementation of digital inclusivity in the country.

**Keywords:** Digital Inclusion · Digital Divide · Digital Literacy · Measurement · Systematic Literature Review

## 1 Introduction

Today's world is becoming more and more digital, from how people interact with each other to how businesses run, to how public services deliver their services. The immense speed and reach of digitalisation worldwide in recent years are unprecedented. During 2017, the digital economy was projected to grow, and the world gross domestic product (GDP) is estimated to increase from 4.5% to 15.5% worth US\$3.6 trillion to US\$12.3 trillion [1]. According to research, there were 4.5 billion internet users worldwide in 2020, an increase of 3.4 billion users from 2016. In addition, there were 3.8 billion social media users worldwide in 2020, which is an increase from 1.7 billion in 2017 (Dwivedi et al., 2021). This is seen as an increase in opportunities due to the increases in internet usage in a variety of sectors, including business, healthcare, and education. The digital economy is already being embraced by many businesses. This can be seen as the statistics show that the spending made on digital marketing is higher than the spending made on offline marketing. For instance, between 2018 and 2019, digital advertising accounted for 51% of all advertising spending in the United States of America. Global eCommerce sales are anticipated to reach US\$4.2 trillion in 2020 and US\$6.5 trillion by 2023 [2]. Governments all over the world are digitising their public services rapidly in response to citizen demands for greater efficiency and transparency. The United Nations E-Government Development Index (UN-EGDI), which shows that more than 84% of countries currently provide online transactional services, reflects the efficiency improvements from digitalization.

In late 2019, the world was shaken by the introduction of the COVID-19 pandemic. Numerous facets of people's lives have changed because of the coronavirus. It closed companies, schools, and workplaces, forcing millions of people to spend a lot of time at home. To try to slow the spread of the virus, public health officials have put on curfews and mandated physical distancing, and quarantine measures. These rules drastically changed how people worked, ran their businesses, learnt, connected with loved ones, went about their everyday lives, celebrated, and mourned. During this period, many people have sort to use technology, especially the Internet to continue their life [3]. Results from a survey of U.S. adults conducted in April 2021 reveal the extent to which people's use of the internet has changed in terms of how they carry out their life routines such as learning, communicating with each other and running their businesses. They also mentioned how helpful technology has been for them and the struggles some have faced in engaging with technology [4].

For some people, experiences with technology have not been that smooth or easy during the pandemic. The pandemic brought attention to digital disparities especially related to internet access and affordability. For those who relied on screens throughout the pandemic, connection quality was crucial for academic work, business meetings, and online social interactions. According to research carried out by [5], nearly half of those who use a high-speed internet connection at home (48%) say they frequently or occasionally experience issues with the speed, dependability, or quality of their connection. Beyond that, affordability remained a persistent worry for some users of digital technology as the pandemic persisted. According to the survey, about a quarter of home broadband users (26%) and smartphone owners (24%) expressed concern about paying their internet and cellphone bills in the coming months. People with lower incomes have

been more likely to struggle, from parents of kids who are dealing with the “homework gap” to people who are having trouble paying for home internet. Additionally, some people with higher salaries have also been impacted. When education is the biggest concern, providing students with access to laptops or computers or home broadband connectivity is necessary for the delivery of high-quality education [6].

In Malaysia, realizing the criticality of accelerating Malaysia as a technologically advanced economy, on 19 February 2021, the government launched an initiative called MyDigital to ensure that no Malaysian is left behind to catch the wave of digitalisation. The MyDigital initiative has laid the foundations for the country’s transformation towards an advanced digital economy. This foundation entails developing the necessary infrastructure, fostering innovation, and establishing an ecosystem so that everybody may contribute to raising living standards, the benefits of which will be shared by all Malaysians. Among the thrust of MyDigital that is being highlighted is creating an inclusive digital society by increasing the inclusivity of all Malaysians in digital activities [2]. To achieve this thrust, it is crucial to understand the concept of digital inclusion and how it can be measured to ensure its successful implementation.

To date, there has been no standard measurement that can measure digital inclusion holistically. Even though there has been some measurement developed, it only contains measurement that covers some domains such as access and affordability [7, 8]. Realizing the criticality of measuring digital inclusion, this study aims to review and synthesize the rapidly growing literature on digital inclusion and how to measure it. It addresses the following questions: 1) What are digital inclusion and its advantages? 2) How can digital inclusion be measured? Through this rapid review, the most recent understanding of digital inclusion measurement is presented. This could, later, be used by the government to measure digital inclusion and ensure the successful implementation of digital inclusivity in the country.

## 2 Methodology

### 2.1 The Review Protocol

This study adopted the PRISMA 2020 Statement approach proposed by [9] as a guide to searching the relevant articles in online databases. PRISMA Statement was designed to help systematic reviewers transparently report why the review was done, what the authors did, and what they found. The PRISMA 2020 statement replaces the 2009 statement and includes new reporting guidance that reflects advances in methods to identify, select, appraise, and synthesize studies. Over the past decade, advances in systematic review methodology and terminology have necessitated an update to the guideline. The author began the systematic literature review (SLR) process by formulating an appropriate research question for the review. The author then describes a systematic search strategy consisting of three main subprocesses of identification, screening (inclusion and exclusion criteria), and eligibility. The authors then assess the quality of the selected articles and describe the strategies used to ensure the quality of the articles under review. Finally, the authors describe how the data were abstracted for the review and how the abstracted data were analyzed and presented.

## 2.2 Formulation of Research Questions

The research question formulation for this study was based on the PICO. PICO is a tool that helps authors formulate research questions suitable for review. PICO is based on three main concepts: population or problem, interest and context. Based on these concepts, this study included three main aspects in the review: people (population), digital inclusion measurement (interest), and the world (context). Based on this, the research question for this study was developed which is – What is the measurement (domains) that can be used to measure digital inclusion across the world?

## 2.3 Systematic Searching Strategies

The systematic literature review process as proposed by [10] involves four processes which are keyword(s) identification, screening, eligibility and review of the result. The search on the Scopus online database in the field of information technology and social sciences was performed in December 2022. The Scopus database was chosen as it is the largest electronic database available with currently 22,794 active titles and 13,583 inactive titles. Journal articles, novels, book chapters, and conference papers were all included in the search to ensure a broad range of document categories for the review. Following this process, first, the author identified keywords used for the search process which is digital inclusion measurement. Relying on previous studies and thesaurus, keywords similar and related to measurement which is measure and measuring were also included in the search. Table 1 shows the search string used in this study.

Using the search string above, a total of 269 documents appeared as a result of the keyword searches in Scopus online databases. The search retrieved peer-reviewed papers as well as journals, conference proceedings, research reports and books section that could provide the author with insights into the research topic.

The second process is screening where articles that appeared in the results were either included or excluded from the study based on a specific set of criteria. This study limited the screening process to only include the articles published in the past five years which is between 2017 and 2022. This timeline was chosen to ensure the study carried out can capture the recent and current articles published related to the topic. Additionally, the number of published studies during this period was sufficient to perform a representative review. Table 2 summarizes the inclusion and exclusion criteria used in this study.

Based on the criteria above, the title and abstract were skimmed through and 69 documents that looked relevant to this study were downloaded.

The third process is eligibility. Here, the authors manually screen the retrieved articles to ensure that all remaining articles (after the screening process) meet the criteria. This process was done by reading the article titles and abstracts. After a thorough evaluation,

**Table 1.** Search string used in the selected database.

Database	String
Scopus	TITLE-ABS-KEY (“digital inclusion” AND measurement OR measure OR measuring) AND PUBYEAR > 2017 AND PUBYEAR < 2023

**Table 2.** Inclusion and exclusion criteria

Criterion	Inclusion	Exclusion
Timeline	2017–2023	2016 and earlier
Document type	Article, review article, chapter in a book, book, conference proceeding	None
Language	English	Non-English
Subject area	Information technology and social science	Engineering, medicine, energy, environmental science and other non-social science studies

21 documents that are related to this study were retained for further review and used for the qualitative analysis. The last process is the reviewing process where the selected articles were reviewed and analysed based on the research question developed earlier. Figure 1 depicted the flow diagram of the search strategy used in this study. The results of the review are written in subsequent sections as domains to be considered in measuring digital inclusion.

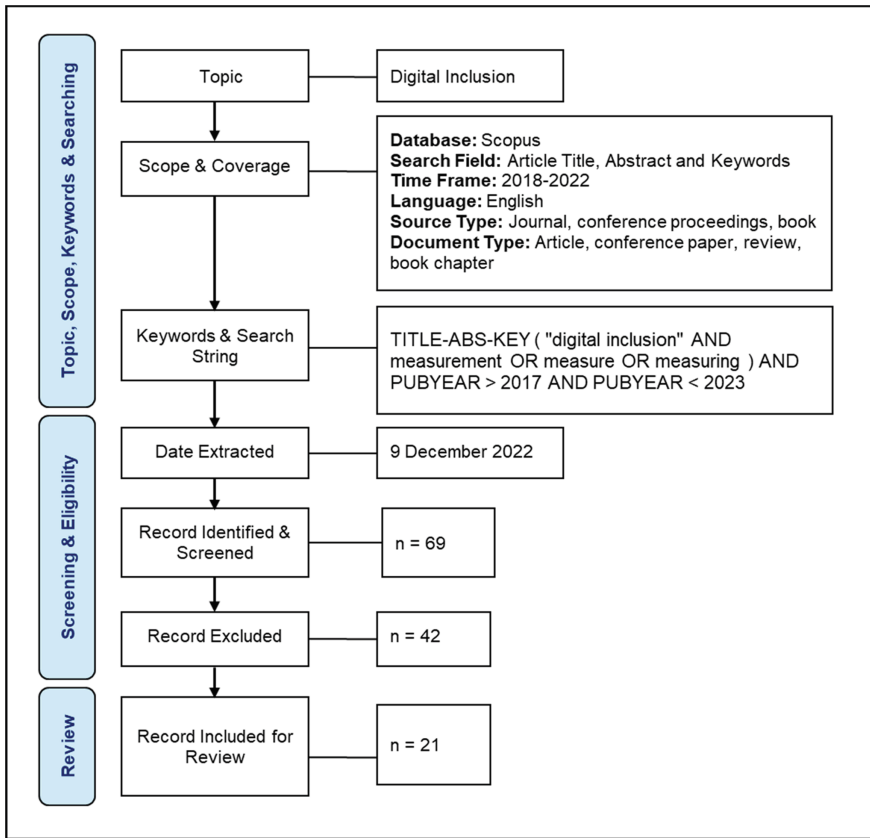
### 3 Results and Discussions

Based on the review carried out, a deeper meaning of digital inclusion and the domain(s) used to measure digital inclusion were explored. The result surprisingly shows the lack of literature and research carried out concerning measuring digital inclusion. Most literature and research found only discuss the concept of digital inclusion. Others reported some activities carried out on a certain group of people that they considered as the implementation of digital inclusion. Only a few research and reports are available on the internet that present details about measurement and indexes used to measure digital inclusion which is carried out by [7, 8, 11–15]. This study attempts to summarize the findings from the literature review concerning the measurement of digital inclusion. The results are presented in the following section.

#### 3.1 Overview of Digital Inclusion

Digital inclusion is defined as the “ability of individuals and groups to access and use information and communication technology (ICT). Digital inclusion includes not only internet access, but also hardware and software availability, related content and services, and training in the digital literacy skills required to use ICT effectively” [16]. Unequal access to the Internet and online content and services has been the subject of political, social, economic, and educational policy debates since the mid-1990s. While terms like “digital divide” and “digital literacy” have become popular, the term “digital inclusion” has received less attention.

To better understand the concept of digital inclusion, it is also important to understand the terms digital divide and digital literacy. The digital divide refers to the gap between



**Fig. 1.** Flow diagram of the search strategy

demographics and regions that have access to modern information and communications technology and those that do not. Additionally, the digital divide is also closely related to factors such as age, gender, language literacy, socioeconomic status, geography, and other factors. Though the term now encompasses the technical and financial ability to utilize available technology, along with access or a lack of access to the internet, the gap it refers to is constantly shifting with the development of technology [8, 17]. Additionally, digital literacy is defined as the skills and abilities necessary to access and use digital devices and content safely, reliably and effectively. This includes the minimal understanding of hardware and software required to properly control a given technology. It also requires an understanding of the languages in which content is available (reading, writing and math skills) and critical and analytical skills to navigate digital content such as misinformation, cyberbullying and online scams [7].

Access to ICT and digital competence are abstract concepts and prerequisites for digital inclusion [18]. Digital inclusion is therefore further defined as bridging the digital divide by ensuring that people have the access, skills, and ability to use digital devices and content confidently, safely and effectively. Digital inclusion also, on the other hand,

considers the activities which are necessary to enable all individuals and communities, including the most disadvantaged, to have access to and use ICTs [19, 20]. The significance of digital inclusion is increased as technology, particularly the internet, becomes an ever-more-essential component of modern life. The availability and use of technology impacts how everybody participates in society. It also significantly impacts access to public services, career opportunities, civic engagement, and even social networks. Faced with the responsibility of maximizing the benefits of technology while mitigating its negative impacts, governments need to measure progress, implement appropriate policies and initiatives, and address traditionally underserved and digital. They are also obliged to provide the funds necessary to facilitate the participation of marginalized communities [17].

### 3.2 Digital Inclusion and Its Advantages

Digital inclusion means using ICTs in a comprehensive fashion that encourages employment, a higher standard of living, social participation, and social integration. It includes a variety of digital social integrations, such as digital social inclusion, digital citizenship, and digital social fusion. Among the many advantages that digital inclusion may bring are cost savings in the delivery of public services and the ability to secure more sophisticated policies for social advancement. Studies on the use of ICTs frequently discuss improvements in the accomplishment levels of individuals, corporations, and communities because it also improves the opportunities of both individuals and organisations [11]. At the individual level, students will probably gain personal achievement from using ICTs for learning and academic success. At the corporate level, businesses and organizations may help clients by reducing the costs of providing public services. In the public sector, digital inclusion is not only potentially cost-saving but also applicable to the digitization of health services. On the social level, digital inclusion may improve community engagement and integration as it enables people to express themselves and communicate with one another [21].

Digital inclusion does not only take into account access to information and communications through infrastructure and technological advancements but also emphasizes enhancing the complete range of human experience. Even though the global access and use of ICTs are impacted by differences in income, location, educational attainment, nation, gender, and age, digital inclusion does not only focus on these disparities but also beyond. Digital inclusion policies connect to social welfare, including job creation and social involvement, compared to information-related policies that only relate to apparatus and education. Digital inclusion strategies aim to produce digital citizens who are not only well-informed but also socially and physically integrated. Enhancing ICT utilisation capabilities aims to produce digital citizens capable of leading happy and healthy lives. This emphasis on social integration is starting to influence how people use technology [21].

Additionally, research carried out on digital inclusion in Wales reported that households who did not use online in their daily transaction missed out on savings of £560 per year from shopping and paying bills online. This amounted to nearly £1 billion in annual savings being lost by 3.6 million low-income households because they do not shop and pay their bills online. On top of that, she also reported that children can improve

their performance in education if they are provided with access to a computer and the internet at home. If 1.6 million kids in households had access to the internet at home, they could increase their lifetime earnings by £10 billion. Additionally, each time the general public interacts with a service provider and completes a transaction online that had not previously done so, the service provider may save between £3 and £12 on each transaction. Furthermore, people with good ICT skills earn between 3–10 per cent more than people without such skills [11].

### 3.3 The Measurement of Digital Inclusion

[22] and [23] stated that measuring digital inclusion is so complex and to develop a standard measurement is unworkable. On contrary, [15] argue that measuring digital inclusion consistently and in a way that allows for the disaggregation of data is very important. While it may be difficult to capture all possible aspects of digital inclusion, some initiatives need to be taken, especially by relevant authorities, to establish standard instruments that are broadly applicable in most developing countries. Today, literature shows that there is still a lack of a standard measurement established to measure digital inclusion holistically [7, 13, 15]. Most of the measures only focus on the quality of access [18, 20, 24–26] and affordability of the infrastructure [7, 15, 18]. Another important area of very limited focus is the evaluation of supportive environments. Additionally, metrics for tracking legal identification, financial inclusion, trust and security in both the digital and physical spheres are also missing, which are essential elements of digital inclusion metrics [7, 12, 15]. Apart from what is mentioned above, the measure of gender equality is also becoming a debate in measuring digital inclusion as the current assessments on gender equality do not distinguish between different user categories. Thus, the digital inclusion of marginalized communities cannot be measured over time, allowing decision-makers to refine initiatives and allocate resources to specific communities without disaggregated data on gender, age, income, and education. Besides, the lack of data on these areas, especially at regional and local levels, makes it more difficult for the government to direct activities toward people and groups that are digitally excluded in particular regions. Thus, the government should develop a framework for measuring digital inclusion based on each country's resources and capability, collecting data for missing indicators where necessary. This is necessary if these measurement gaps are to be closed.

The review of literature carried out in this study also shows a lack of research carried out in relation to domains to measure digital inclusion. A report by [12] is the only study that highlighted nine international indexes which track digital inclusion in various parts of the world. Unfortunately, these nine indexes are said to be focused on certain areas only and are unable to measure digital inclusion holistically. However, these indexes could be used as a guideline for the government in measuring digital inclusion. To measure digital inclusion effectively, data related to the measurement areas must be collected regularly and segmented. Table 3 summarizes the nine international indexes as reported by [12].

After analysing the nine indexes stated above, [12] reported that even though the nine indexes tracked various elements of digital inclusion, they do not cover the world equally. Low- and middle-income countries in North Central Africa, Central Eurasia, and the Middle East are the least persecuted. Ironically, these are the largest regions in



**Table 3.** Nine International Indexes for Measuring Digital Inclusion

No.	Index Name	Areas/Domains
1.	ICT Development Index (ITU-IDI) International Telecommunications Union (ITU)	Infrastructure access, affordability and quality of infrastructure, skills, and actual usage of ICTs, specifically telephony and internet.
2.	Global Competitiveness Index (WEF-GCI) World Economic Forum	Measures technological readiness using seven indicators: availability of latest technologies, firm-level technology absorption, foreign direct investment and technology transfer, internet users, fixed-broadband internet subscriptions per 100, internet bandwidth per capita, and mobile-broadband subscription per 100 inhabitants.
3.	Inclusive Internet Index (EIU-III) Facebook and Economist Intelligence Unit	Assessing the availability, affordability, and relevance of the internet. The index also measures “readiness”, defined as citizens’ capacity to access the internet, as well as cultural acceptance of the internet and supporting policy.
4.	Digital Economy and Society Index (EC-DESI) European Commission and Eurostat	Indicators such as access, skills and usage are broken down based on access points (home vs work), technologies (eg fixed vs mobile internet and telephony), different forms of usage (eg computer vs internet, eCommerce, digital banking, eGovernment services, types of software usage), and frequency of use (daily, quarterly, annually). With respect to digital inclusion, several metrics are disaggregated by country, gender, age, income, educational attainment level, and even type of work.
5.	eGovernment Development Index (UNDESA-EGDI) United Nations Department for Economic and Social Affairs (UNDESA)	Measures general digital inclusion with its subindexes tracking access to telecommunication infrastructure, human capacities and skills, and digital public services.

*(continued)*

**Table 3.** (continued)

No.	Index Name	Areas/Domains
6.	State of Mobile Internet Connectivity Index (GSMAMIC) GSMA	Indicators such as access, quality and affordability of access, technology types, skills, gender equality, eGovernment and cyber-security readiness of the public sector.
7.	Global Innovation Index (WIPO-GII) World Intellectual Property Organization (WIPO), INSEAD and Cornell University	Analyses over 120 countries in relation to the human aspects of innovation and policy creation. The two subindexes covering infrastructure, and human capital and research are especially relevant when measuring digital.
8.	Affordability Drivers Index (A4AI-ADI) Web Foundation Alliance for Affordable Internet	Availability and affordability of internet access.
9.	Australian Digital Inclusion Index (AUS-ADI) Supported by Telstra and conducted by Roy Morgan Research, RMIT and Swinburne University	Focused solely on access to technology, including fixed and mobile telephony and internet, with no segmentation by user group.

the world, with proportionately more digitally excluded communities and the greatest gaps that separate them from the world's most digitally inclusive societies. Apart from that, they also found that most indexes have a high emphasis on access, especially in terms of internet connectivity and content. This can be seen as access dimensions are given the highest weights in the proportion of indicators in most indexes.

To have a more holistic measurement index to measure digital inclusion, [12] proposed a new framework which was inspired by the none-international indexes discussed above. In this framework, four key dimensions are proposed, namely access, skills, use and supportive environment. The first dimension, access, consists of components that include access to electricity, access to telephony, access to devices, and access to the Internet. In addition, it also refers to the quality of the connection and access point. According to their report, access to power is critical for powering devices, and Internet infrastructure, including networking devices and access points. These are indicators most easily found in various benchmarks and statistical sources such as the International Energy Agency or the World Bank. The types and quality of access are also indicators which are also well-developed. Thus, access to the Internet and ICT devices should be maintained within the digital inclusion indicator.

The second dimension proposed to measure digital inclusion is skills. It refers to adult literacy, academic life expectancy and digital skills. The United Nations Educational, Scientific and Cultural Organization (UNESCO) define literacy as understanding, evaluating, using and engaging with written text to participate in society, achieve one's goals and develop one's knowledge and potential. It also measures adults' proficiency

in key information processing, skills literacy and numeracy. Most current global assessments of digital inclusion focus on indicators of traditional skills such as literacy and mathematics, with less emphasis on digital literacy, consumption of essential content and entrepreneurship [27, 28]. In today's world, digital literacy is needed more for those who use online content and ICT to create new services and products than for those who only passively consume online materials, services and products. It is a collection of expertise, skills, and attitudes that are needed when using ICT and digital media to accomplish tasks; solve problems; communicate; manage information; create; collaborate; and share content; and develop knowledge effectively, efficiently, correctly, objectively, creatively, independently, ethically, flexibly, reflectively, for work, learning, society [24]. Traditional literacy is internationally relevant and well-documented and should be retained within the framework of the digital inclusion indicator. However, the skills and competencies aspect should be complemented by additional indicators of digital proficiency and online safety [12].

The third dimension proposed is the use. It consists of several elements such as the use of the Internet, basic activities, use of eCommerce, use of eBanking, eWork/entrepreneurship, use of social media as well as eParticipation. The use of the Internet refers to the number of individuals using the Internet and how frequently they use them [19]. Additionally, it also measures the purpose of people using the Internet. Digital inclusion and the use of digital services and products bring value not only to the marginalized but also to public and private service providers. As governments, businesses, and third-sector organizations strive to improve the delivery of digital services, there is a need to enable target audiences to access and use new digital services. These metrics are therefore a key factor in understanding the level of digital inclusion in marginalized communities and their readiness for digital transformation. Indicators for this dimension go beyond the Internet and technologies used and include the use of public and private sector services, the use of ICT in the workplace, social activities, and public engagement [12].

The fourth and last proposed dimension in measuring digital inclusion is a supportive environment. It refers to an element such as affordability, legally valid identification, banking and financial inclusion, trust as well as security. Affordability is defined in terms of the relative burden of paying for digital services with a given income, for a given set of benefits derived from access. Thus, digital affordability can be increased in three different, non-mutually exclusive ways: by increasing income, by lowering prices (especially entry-level prices) or by increasing the utility derived from digital access (Leung, 2014). Affordability is an expanding driver of the digital divide and digital exclusion. While people may have access, they might not have the affordability of internet access and digital services and products. Additionally, legally valid identity is an integral part of everyday life in both the physical and digital worlds. When it comes to digital identity, the challenges facing globally, and traditionally marginalized communities are even more acute. Most emerging markets have some form of digital identity system in place, but it is limited to specific purposes or has limited use. Today, Internet access is a problem that often leaves marginalized communities behind. Awareness and analysis of their digital identities provide the necessary metrics to address full digital inclusion in the virtual arena, based on how they digitize their daily lives [29].

Some developing countries have basic eID systems that can be used to access various online service offerings, while others do not have eID systems at all. As a result, more than a billion people around the world still struggle to prove their identities and are unable to access essential services such as health care, social protection, education and finance. Of these, 47% are younger than their country's national ID card age, and 63% of their children in low- and middle-income countries do not have formal identification. Without financial inclusion, individuals cannot actively participate in the global economy. Even though the number of adults with a bank or mobile money provider account has improved globally, reaching 69%, more than 1.7 billion people remain unbanked. Globally, most non-users live in low-income countries, and half of the unbanked adults live in the poorest 40% of households in the economy, 56% are women. Without access to financial services, marginalized groups have limited access to public and private services and limited opportunities to capitalize on the opportunities of the digital economy. Financial inclusion should therefore be added to the core metrics of digital inclusion [12]. Table 4 summarizes the dimensions of digital inclusion measurement as proposed by [12].

**Table 4.** Summary of dimensions of digital inclusion measurement as proposed by [12].

Dimensions	Indicators	Descriptions
Access	Access to electricity	<ul style="list-style-type: none"> <li>Percentage of the population having access to electricity in general/rural/urban areas.</li> </ul>
	Access to telephony	<ul style="list-style-type: none"> <li>The number of fixed-telephone subscriptions per 100 residents.</li> <li>The number of mobile phone subscriptions per 100 residents.</li> <li>Internet-enabled.</li> </ul>
	Access to device	<ul style="list-style-type: none"> <li>Percentage of households with desktop/laptop computers.</li> <li>Presence of personal computers or tablet computers in a household.</li> <li>Percentage of households with a mobile phone.</li> </ul>
	Access to the Internet	<ul style="list-style-type: none"> <li>The number of fixed Internet subscriptions per 100 residents.</li> <li>The number of active mobile broadband subscriptions per 100 residents.</li> </ul>
	Quality of connectivity	<ul style="list-style-type: none"> <li>Average mobile download speeds.</li> <li>Average mobile upload speeds.</li> <li>International Internet bandwidth (bit/s) per user.</li> </ul>

(continued)

**Table 4.** (continued)

Dimensions	Indicators	Descriptions
	Point of access	<ul style="list-style-type: none"> <li>• Percentage of households with internet access.</li> <li>• Percentage of homes with internet access.</li> <li>• Percentage of works with internet access.</li> <li>• Percentage of free public hotspots.</li> </ul>
Skills	Adult literacy	<ul style="list-style-type: none"> <li>• Percentage of adult literacy.</li> </ul>
	Academic life expectancy	<ul style="list-style-type: none"> <li>• Percentage of enrolment in primary education.</li> <li>• Percentage of gross graduation ratio from primary education.</li> <li>• Percentage of enrolment in secondary education.</li> <li>• Percentage of gross graduation ratio from upper and lower secondary education.</li> <li>• Percentage of enrolment in tertiary education.</li> <li>• Percentage of graduates from tertiary education.</li> <li>• Mean years of schooling.</li> </ul>
	Digital skills	<ul style="list-style-type: none"> <li>• Percentage of possession of “basic” or “above basic” digital skills (general).</li> <li>• In addition to having used basic software features such as word processing, used advanced spreadsheet functions, created, a presentation or document integrating text, pictures and tables or charts, or written code in a programming language.</li> <li>• Percentage of individuals with a degree in ICT.</li> <li>• Percentage of employed ICT specialists.</li> </ul>
Use	Internet use	<ul style="list-style-type: none"> <li>• Percentage of individuals using the Internet once in the last 3 months.</li> <li>• Percentage of individuals who use the Internet at least once a week.</li> </ul>
	Basic online activities	<ul style="list-style-type: none"> <li>• Percentage of individuals streamed, played, or downloaded content online.</li> <li>• Percentage of individuals communicating via the internet.</li> <li>• Percentage of individuals who created or managed a site or blog.</li> <li>• Percentage of individuals searched for advanced information.</li> </ul>

(continued)

**Table 4.** (continued)

Dimensions	Indicators	Descriptions
	Used eCommerce	<ul style="list-style-type: none"> <li>• Searched for eCommerce information in the last 12 months.</li> <li>• Made a transaction in the last 12 months.</li> </ul>
	Used eBanking	<ul style="list-style-type: none"> <li>• Percentage of individuals searched for online banking information in the last 12 months.</li> <li>• Percentage of individuals who made a payment or transaction (including mobile money) in the last 12 months.</li> <li>• Percentage of individuals made or received digital payments in the past year (% ages 35–59).</li> <li>• Percentage of individuals used the internet to pay bills or buy online in the past year.</li> </ul>
	Used eGovernment	<p>Percentage of individuals searched for digital public service information in the last 12 months.</p> <ul style="list-style-type: none"> <li>• Percentage of individuals who made a digital public service transaction in the last 12 months.</li> </ul>
	eWork/entrepreneurship	<ul style="list-style-type: none"> <li>• Percentage of individuals who used the internet or a device for work in the last 12 months.</li> </ul>
	Social media	Percentage of individuals who used social media in the last 12 months.
	eParticipation	<ul style="list-style-type: none"> <li>• Percentage of individuals engaged in public discourse online in the last 12 months.</li> </ul>
Supportive	Affordability	<p>Cost of 100 MB of data.</p> <ul style="list-style-type: none"> <li>• Device price (cheapest mobile on the market).</li> </ul>

(continued)

**Table 4.** (continued)

Dimensions	Indicators	Descriptions
	Legally valid identification	<ul style="list-style-type: none"> <li>• Ability to apply for a personal identity card.</li> <li>• Presence of an eID or national digital identification system to access government services.</li> <li>• Evidence on government websites that the national ID is digitalized.</li> <li>• Nationally recognised eSignature.</li> </ul>
	Banking and financial inclusion	<ul style="list-style-type: none"> <li>• Individuals with access to financial services.</li> </ul>
	Trust and online privacy	<ul style="list-style-type: none"> <li>• Confidence in the privacy of online activities.</li> <li>• Presence of data protection law(s).</li> </ul>
	Security	<ul style="list-style-type: none"> <li>• Existence of legislation that specifically addresses sexual harassment.</li> <li>• Percentage of individuals victims of a crime.</li> </ul>

## 4 Conclusions

The 21st century has seen a tremendous increase in the number of ICTs users worldwide. Research has shown that the increase in World Wide Web (WWW) users could effectively tackle socio-economic inequalities, promoting the diffusion of information and creating more opportunities for people around the globe. However, despite the rising numbers recorded, there are arising concerns reported from new technologies have been distributed unevenly, missing the point of digital freedom being spread. In certain parts of the world, there are still a group of people who are excluded from having access to the use of ICTs and thus refrain from enjoying its benefits [23]. [30] stated that since the 1970s, the use of ICTs has spread unevenly, and many remain digitally excluded. Around 1.3 million people in Scotland are either not online or do not have the basic skills to use the internet. To eliminate the digital divide, the 2030 UN Sustainable Development Goals (SDGs) proposed the use of digital technologies that were identified to be the catalyst and can contribute significantly to the fulfilment of every SDG. To bridge the digital divide, the concept of digital inclusion is essential and a highly practical tool to measure the state of digital inclusion especially within traditionally marginalised and digitally excluded communities worldwide must be developed. Current global digital inclusion metrics and benchmarks now tend to focus on cross-country comparisons of access, skills, and some basic online activities. This focus should be expanded to include power, internet, end device access, and quality of access and access point metrics.

This paper aims to review the literature related to digital inclusion and its measurement. It adopted the systematic literature review approach to explore and understand digital inclusion and how it can be measured. The results show very limited research

on the measurement of digital inclusion. However, a few domains that could be considered when measuring digital inclusion have been identified and reported. The first domain for digital inclusion measurements is access which includes access to electricity, access to telephony, access to devices, access to the Internet, quality of connectivity and point of access. The second domain identified is skills which include adult literacy, academic life expectancy and lastly digital skills. The third domain is used which includes the use of the Internet, basic online activities, used eCommerce used eBanking, used eGovernment, eWork/entrepreneurship, social media and eParticipation. The last domain included is a supportive environment which includes affordability, legally valid identification, banking and financial inclusion, trust, and online privacy as well as security. The implementation of digital inclusion will enable individuals to participate and be part of society, or the extent to which ICTs enhance people's abilities to fulfil active roles in society. As such, measuring digital inclusion can help decision-makers take targeted action, improve their strategies and reach out to digitally excluded groups, thereby improving the United Nations' vision for 2030 and subsequently contributing to achieving the Sustainable Development Goals (SDGs) planned.

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