

The impact of digital inequality in achieving sustainable development: a systematic literature review

Digital
disparity on
sustainable
development

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Abstract

Purpose – Digital inequality is considered one of the leading causes of socioeconomic disparities nowadays and a barrier to sustainable development. However, a dearth of empirical research has examined the impact of digital inequality in attaining sustainable development. This study aims to systematically review the scientific publications on the impact of digital inequality in achieving sustainable development.

Design/methodology/approach – The preferred reporting items for systematic reviews and meta-analyses (PRISMA, 2020) guidelines were followed to carry out the systematic literature review (SLR) using Scopus, Web of Science, ProQuest and Google Scholar electronic databases. Numerous inclusion/exclusion criteria were employed to obtain the most relevant literature. Finally, 54 articles were included to prepare the final database and qualitative synthesis was performed using 12 variables.

Findings – While the findings show that there has been a substantial expansion of scientific publications on the focused area in recent years, there is still a lack of empirical and comparative studies; less focus on the offline benefits of online activities were also demonstrated by the results. Moreover, SDGs 04 and 05 were identified as the predominant goals in the literature. Findings further highlighted the importance of an accurate conceptualization of digital inequality.

Originality/value – In general, this study investigates the level of impact of digital inequality on the United Nations' Sustainable Development Goals. Moreover, it shows the evolution of scientific publications on digital inequality in terms of its contribution when achieving sustainable development.

Keywords Digital inequality, Digital divide, Sustainable development goals, 2030 agenda, PRISMA 2020, Systematic literature review

Paper type Literature review

Introduction

Digital disparities have become a flourishing concern in modern life. These disparities are related to differences in access to digital resources, actual usage and the level of offline benefits achieved from the Internet and other types of access. Minimizing the gap of digital inequalities is critical for the long-term survival of a digital society. The phrase “Digital divide” relates to inequalities in proper access to information and communication technology (ICT), between people, businesses, households and geographic locations (Vassilakopoulou and Hustad, 2021). While some researchers use the terms “Digital divide” and “Digital inequality” interchangeably, some other researchers have highlighted the difference between these concepts (Islam and Inan, 2021; Oyedemi, 2012).



The term digital divide has been defined by [Islam and Inan \(2021\)](#) from the access perspective, and [Oyedemi \(2012\)](#) defined digital inequality from the digital skills and competency (usage) perspective. However, most of the recent studies segregated the term digital divide into three distinct levels: (1) access divide, (2) usage divide (skills gap) and (3) tangible offline benefits of using the Internet ([Gómez, 2018](#); [Ragnedda and Muschert, 2017](#); [Ragnedda and Kreitem, 2018](#); [Aissaoui, 2021](#)). Digital differences in terms of access seem to be narrowing in technologically and economically sophisticated and advanced social clusters, but inequalities that hinder people's ability to make effective use of digital resources persist. At the same time, significant access barriers remain obvious in low-resource social contexts ([Vassilakopoulou and Hustad, 2021](#)).

The digital divide on a global level is having an increasing influence on socioeconomic inequality and career possibilities. Economic inequality may be exacerbated by digital inequality, particularly for younger people with fewer educational options, resulting in exclusion from the labor market. This fact will certainly have a noticeable impact on a country's degree of sustainable development ([Hidalgo et al., 2020](#)). Sustainability or sustainable development is one of the main short-term as well as long-term goals of any company or country. Many researchers have defined the concept of sustainability/sustainable development in their studies ([Wichaisri and Sopadang, 2018](#); [Halisçelik and Soytaş, 2019](#)). According to [Halisçelik and Soytaş \(2019\)](#), sustainable development can be defined as "meeting the needs of the present generation without compromising the ability of future generations to meet their own needs" (p. 546). This can be achieved through three crucial pillars, economic growth, environmental protection and social inclusion ([Wichaisri and Sopadang, 2018](#)). Achieving healthy levels of these three pillars is undoubtedly very important for any country but measuring the outcomes and achievement levels is challenging.

The 2030 agenda for sustainable development comprises 169 targets and 232 indicators that must be achieved by 2030 and applies to all countries, irrespective of the development level (2030 Agenda). The goals and targets of the 2030 agenda, which builds on the millennium development goals (MDGs), help measure the achievement levels of the sustainable development of any country. The ultimate objective of SDGs is to improve human well-being and ensure all people enjoy peace and prosperity.

The purpose of conducting this study is to explore the impact of digital inequality in achieving sustainable development. Despite the differences in their economic strength, any country is trying to achieve the maximum levels of sustainable development. Due to the fourth industrial revolution and the proliferation of the Internet, the requirement for ICT has rapidly increased. This requirement created a novel form of disparity called digital inequality, which has been making a significant impact on the day-to-day lives of people. However, a dearth of empirical research has examined the impact of digital inequality in attaining sustainable development. Hence, this study explores the different levels of digital inequalities in terms of disparities in access, usage and offline benefits and how these can impact the sustainable development of a country. The key contribution of this study is the exploration of scientific production on the impact of digital inequality on sustainable development over the past decade, as none of the previous systematic literature surveys on the area of digital inequality were focused on the impact on sustainable development. Furthermore, this study investigates the possible main areas and directions of future research on the focused topic.

Research questions

Objective and research questions

The ultimate objective of the present review is to:

Explore the impact of different levels of ICTs in terms of inequalities in access, usage and offline benefits and how these can impact the sustainable development of a country.

To achieve the above-mentioned objective, we search for answers to the following research questions (RQs).

- RQ1.* What is the general state of research on the impact of digital inequality in achieving sustainable development?
- RQ2.* What methodologies were used in the relevant literature to explore the impact of digital inequality in achieving sustainable development?
- RQ3.* What are the determinants of digital inequality that affect sustainable development?
- RQ4.* What general conclusions can be drawn from the literature on the impact of digital inequality in achieving sustainable development?
- RQ5.* What is the level of impact of digital inequality on the United Nations' Sustainable Development Goals (SDGs)?
- RQ6.* What are the potential areas for future research in relation to digital inequality in achieving SDGs?

Methodology

A systematic literature review (SLR) on studies that focus on the impact of digital inequalities on sustainable development has been performed to achieve the primary objective of the study. An SLR follows a methodical, transparent process based on predefined eligibility criteria to answer RQs rather than a traditional narrative review (Shamseer *et al.*, 2015). This systematic, iterative process enhances the quality of the selection and evaluation of the literature. It enhances the validity of the entire procedure, owing to the replicability of the process followed through the review. Moreover, this scientific process minimizes any bias on the part of the researcher when selecting literature for the study (Shamseer *et al.*, 2015).

The present SLR followed the preferred reporting items for systematic reviews and meta-analyses (PRISMA) 2020 updated guidelines provided in the study by Page *et al.* (2021a, b) and also the 15-step process suggested by Pickering and Byrne (2013) for SLRs. After formulating the specific RQs, in order to find answers to the RQs, the search process was started using Scopus, Web of Science (WoS) and ProQuest electronic databases. The reason for selecting these databases was due to their extensive coverage of social science journals. Furthermore, to add more relevant research studies to the present study from other sources, the authors used the Google Scholar electronic database. All databases provide advanced search options and filtration tools, which allow for a more effective and accurate search process.

Search strategy

One of the vital steps of the SLR is developing a structured search string. The final search string of the present study was developed using a few steps. Since the main research focus of the study is digital inequality and the digital divide, all closely related keywords of these two primary concepts were included in the search string as the first step. Supporting keywords were incorporated into the main string step by step, using advanced search options of selected electronic databases. In order to enhance the accuracy level of the search results, different truncations, wild cards and proximity operators (such as NEAR, WITHIN) were also used in the search string. Table 1 shows the final boolean search strings used in the present study to search the relevant literature.

The database search process was conducted in August 2021 (but considered studies conducted from January 2011 to July 2021) [1] using two iterations. The first iteration was

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Table 1.
Final boolean search
strings

Concept 1 – digital inequality/digital divide
Search 1 digital W/2 (inequality OR divide OR exclusion OR inclusion OR competence* OR skill* OR literac*)
Search 2 (Internet OR online) W/2 (use OR usage OR activit* OR access)
Search 3 ICT W/2 (skill* OR outcome* OR benefit* OR effect*)
Search 4 e-skill* OR “technology W/2 access”
Search 5 e-Commerce OR e-Business OR Online W/2 (Business OR Commerce)
Concept 2 – sustainable development “Sustainable development” OR “sustainable goal*” OR “sustainable development goal*” OR “sustainability” OR “social inequalit*”
Source(s): Authors’ own research

conducted in WoS, Scopus and ProQuest databases using Phase 01 inclusion/exclusion criteria as stated in Table 2. This search resulted in a total of 3,162 (=934 + 901+1,327) articles. The Google Scholar database was used as the second iteration of the search process. Since the advanced search option in Google Scholar is not as comprehensive as other databases, a different search string was performed using essential keywords: “Digital Inequality,” “Digital Divide,” “Digital Inclusion,” “Digital Exclusion” and “Sustainable Development,” with a few other important keywords for the same period (2011–2021). The Google Scholar search results were screened based on the relevance of the search results. Accordingly, the first 500 records were screened. Out of 500 articles, 115 were refined and included in the Phase 01 evaluation based on the research focus. Altogether, 3,277 (=3,162 + 115) articles were identified. These articles were added to one of the reference management software, EndNote. Initially, the duplicate articles were removed using the EndNote software and then manually for the remaining duplicates. During the duplicate removal process, 1,075 duplicates were removed. Thus, 2,202 (= 3,277 – 1,075) articles were identified for the title-abstract-keywords screening. The keywords defined in the final search strategy had to be included in the title, abstract and keywords of the document.

Inclusion/exclusion criteria – Phase 01 (database search)

- Peer-reviewed journal articles
- Articles that were written in the English language
- Studies conducted from January 2011 to July 2021

Inclusion/exclusion criteria – Phase 02 (screening keywords in the title-abstract-keywords of the articles)

- The research focus of the study should be digital inequality (or the digital divide) in achieving sustainable development. (The concepts digital inequality/digital divide should be discussed directly or indirectly)
- Articles should not be focused on a separate profession. The overall impact of digital inequality/digital divide, which can be generalized, should be considered
- The terms “sustainable development” or “sustainable development goals” must have been used in the study. In other words, authors should discuss the impact of the digital divide/digital inequality on sustainable development
- Articles that only focused on the sustainability of a specific subject area were removed, excluding general education, as education can be applied to any profession and generalized
- Articles that mentioned the word “Sustainability” in the abstract but had different research focus were excluded

Table 2.
Selection criteria

Source(s): Authors’ own research

Selection criteria

Table 2 below states numerous inclusion and exclusion criteria developed for the Phase 01 and Phase 02 selection process to obtain the most relevant literature for the present study. These criteria were adopted in different stages of the study, as discussed below.

Study selection

The next stage of the screening process was performed based on the inclusion/exclusion Phase 2 criteria described in Table 2 by reading the title and abstract of the study. After the initial screening process (title-abstract-keywords screening), 1,892 articles were discarded and 310 ($= 2,202 - 1,892$) were selected for the Phase 02 screening process. After completing the selection process using the inclusion/exclusion criteria described in Table 2, the reference lists of the most relevant and most cited top ten articles among 310 were reviewed to ensure a comprehensive selection process. Figure 1 below shows the PRISMA (2020) flowchart. The authors of the present study also used other methods to identify further relevant articles. As can be seen on the right-hand side of Figure 1, the authors have found another eight studies from the reference list review process [2] combined with the Phase 02 screening process. Two articles were removed using Phase 02 inclusion/exclusion criteria from these eight articles identified through the reference lists evaluation, and six articles were included in the full-text screening and assessment process, giving a total of 316 ($= 310 + 6$).

Selection bias

Selection bias in a systematic quantitative literature review can occur during the inclusion/exclusion process. Thus, it is vital to minimize the selection bias to enhance the study's accuracy and reliability. Among 316 articles, 10% were screened randomly by an independent researcher using the selection criteria to overcome this problem. These screened articles were employed to measure the inter-rater reliability using Cohen's Kappa coefficient. Cohen's Kappa coefficient measures the degree of agreement between two or more independent coders to check the research validity of the selection process and reduce the researcher bias (McHugh, 2012). Altogether 31 articles were used for the independent screening process. The resulting Cohen's Kappa value of 0.81 indicates an almost perfect agreement between the researcher and the independent screener (Landis and Koch, 1977).

Full-text evaluation

During the Phase 02 screening process, 236 out of 310 articles were removed, resulting in 74 articles for further analysis. Altogether 80 studies were qualified for the full-text screening and assessment process, 74 papers, from the "Identification of studies via databases and registers" and 06 papers were entitled from the "Identification of studies via other methods." These papers were assessed for further eligibility, and 26 papers were excluded based on the full-text availability, quality, generalizability and focus of the entire study. Ultimately, a total of 54 ($= 80 - 26$) articles were used to prepare the final excel database for the qualitative synthesis.

Structuring the database is an iterative process. The categories and subcategories of the database were developed, considering the main focus of the study. Considering the main focus of the study, a total of 29 main categories and corresponding 105 subcategories of the database were developed in several iterations. These categories were used to record all relevant information of the literature for an accurate and comprehensive study. The final database included information on the general state of research (main keywords used, the country of the study, key themes of the study, etc.), the journal of the publication, the primary discipline of the journal where the research was published and the continent where the

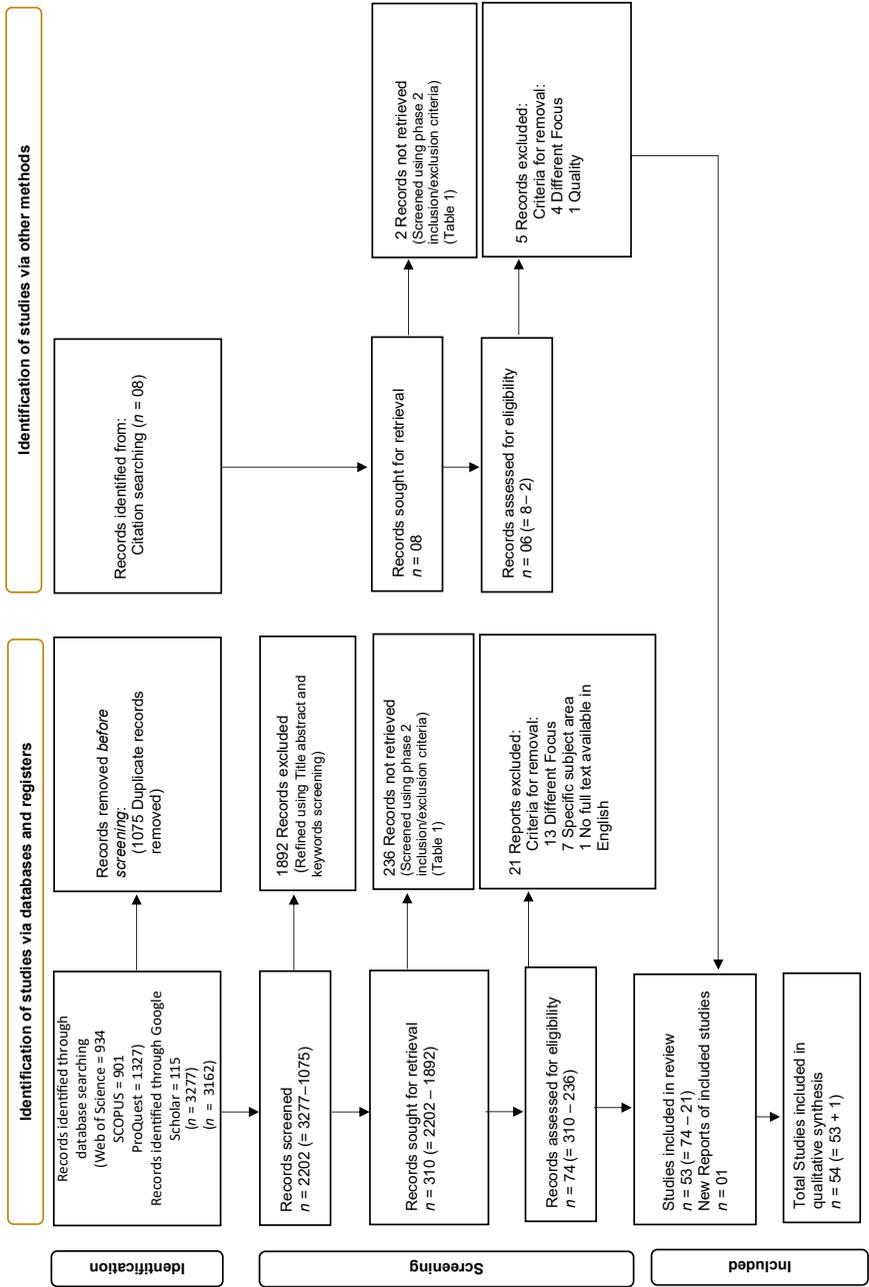


Figure 1. PRISMA (2020) flowchart

research was conducted. Apart from that, separate categories were included in reporting the main focus of the study, such as “Digital Divide/Digital Inequality,” “Sustainable Development/Sustainable Development Goals,” “Impact of Digital Inequality on Sustainable Development,” etc.

Quality assurance

To ensure the internal validity of the articles selected through the inclusive and exclusive screening, Critical Appraisal Skills Programme (CASP) checklists were used. CASP provides “Critical Appraisal Tools”, which can be used with different research styles, including systematic reviews (Checklist, 2018). There are ten questions included in the CASP appraisal tool to guide the researcher when conducting systematic reviews. According to the guidelines provided in the CASP checklists, answers were recorded to identify the internal validity and to ensure the quality assurance of the systematic review process. The authors of the present SLR have followed the guidelines described in the CASP checklist in order to ensure the validity, trustworthiness and relevance of the review results.

Results and discussion

In this section, the table of results and figures generated from the final Excel database that we developed as the final step of the selection process were organized into three groups. In the first group, we focused on the general state of the literature by generating various tables and figures. In the second group, the focus was given to the two main concepts, digital inequality and sustainable development. Finally, in the third group, the impact of digital inequality in achieving sustainable development was analyzed, focusing on different aspects, including future research lines and directions. The various types of information gathered from the 54 articles selected for qualitative synthesis have been categorized in the database under 15 groups and created graphs and tables for the analysis discussed below. The information on the first seven groups was used to answer RQ1: What is the general state of research on the impact of digital inequality in achieving sustainable development?

Distribution of the publications

As stated earlier, the authors of the present study considered only the publications during January 2011 and July 2021 for the analysis, as several ICT and digital education developments have taken place during the last decade. It should also be noted that a particular focus was given to the year 2015, as the 2030 UN Agenda for sustainable development was launched in that year. Figure 2 presents a time series plot of the 54 publications, disaggregated by each year, over the period 2011 to 2021. As can be seen, the number of scientific publications of the selected area has slightly declined during the initial period 2011 ($n = 1$) to 2014 ($n = 0$) and has a steady increase until 2018 ($n = 4$). A major increase was reported in 2019 ($n = 12$) and in 2020 ($n = 21$). It can be noted in Figure 2 that, after 2015 (the year in which the 2030 agenda was adopted), the number of publications in the area has increased significantly. The incomplete data for 2021 (which is not included in Figure 2) reveal that there were seven publications in the first seven months.

Country and the continent

The analysis of the country and the continent with the highest number of article publications was carried out to ascertain the publication distribution based on the geographic location. Table 3 demonstrates the global distribution of the 54 publications by affiliation of author’s country of origin. The analysis of the country was conducted based on the country of the first

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Figure 2.
Distribution of the
publications by year

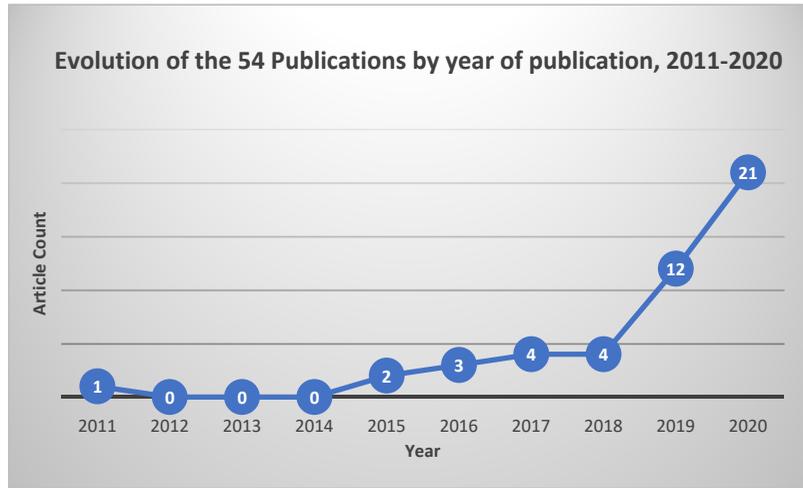


Table 3.
Global distribution of
publications by
affiliation of author's
country of origin

Country	No. of publications
Spain	7
The UK	6
Nigeria	4
The USA	4
Romania	2
Canada	2
India	2
Sweden	2
Portugal	2
Others	23

Source(s): Authors' own research

author of the article. As can be seen, the majority of the studies were carried out in Spain (n = 7), followed by the United Kingdom (n = 6), Nigeria (n = 4) and the USA (n = 4).

Similarly, the analysis of the continents was conducted based on the country of the data used for the particular study. The number of studies that discussed the impact of digital inequality in achieving sustainable development in general, without focusing on any continent, was 16, with the highest percentage (28%) followed closely by Europe with 15 publications (27%), Africa with 11 publications (20%), Asia with ten publications (18%) and North America with four publications (7%) that have focused on the impact of digital inequality in achieving sustainable development [3].

Most studies were carried out in Europe, reflecting an interest in and concern about sustainable development. Regarding the countries and continents of the authors, as well as that of the focused data, there is an uneven global distribution. The trend, which has increased its popularity since 2019, clearly indicates the importance of digital disparities when achieving sustainable development.

Keywords and themes

Keywords and themes' analysis is imperative to identify critical subject matters and clusters of the relevant literature. Table 4 shows the most frequently used keywords. For this study,

“Author Keywords” have been used to reflect the content of the publications by the authors of the present study.

Accordingly, the keywords “Sustainable Development,” “ICT” and “Sustainable Development Goal” were used by the majority of the authors, coinciding with the main focus of the study.

Table 5 displays the main themes identified through the full-text evaluation. The authors of the present study conducted the “Themes” analysis by referring to the full text. The key theme of the study has been identified and recorded.

The theme of the publication was identified based on the main focus area of the study. It should be noted that the keywords “Sustainability and Sustainable Development” were not considered for the theme analysis, as these keywords were part of the inclusion criteria of the review. According to the theme analysis, it was found that “Digital Literacy” (n = 14) and “ICT” (n = 14) were the primary research focus of the literature, followed by “Digital Inclusion” (n = 5). According to the results presented in Figure 3, it is apparent that selected previous studies were focused mainly on the set of competencies that needs to function in the digitalized society. In other words, from the 54 articles refined it can be determined that the focus of sustainable development in the previous studies was directed mainly into the fields of education (digital literacy, quality education, digital learning, higher education, digital skills, digital competency, etc.).

Nature of the research evidence

Research approach

According to the type of approaches used by the authors who conducted the selected 54 studies, the majority of the studies (n = 22, 41%) adopted a quantitative approach, while 16 studies (n = 16, 29%) used a mixed-methods approach, followed by reviews’ approach (n = 9, 17%) and qualitative approach (n = 7, 13%).

Author keyword	Frequency
Sustainable development	23
ICT	15
Sustainable development goal	12
Digital divide	8
Sustainability	8
Digital literacy	6

Note(s): The numbers do not add up to 54 as some author keywords were used in more than one article

Source(s): Authors’ own research

Table 4.
Keywords analysis

Key theme	Frequency
Digital literacy	14
ICT	14
Digital inclusion	5
Digital divide	4
Quality education	3

Note(s): The numbers do not add up to 54, as there was more than one paper with the same theme

Source(s): Authors’ own research

Table 5.
Themes analysis

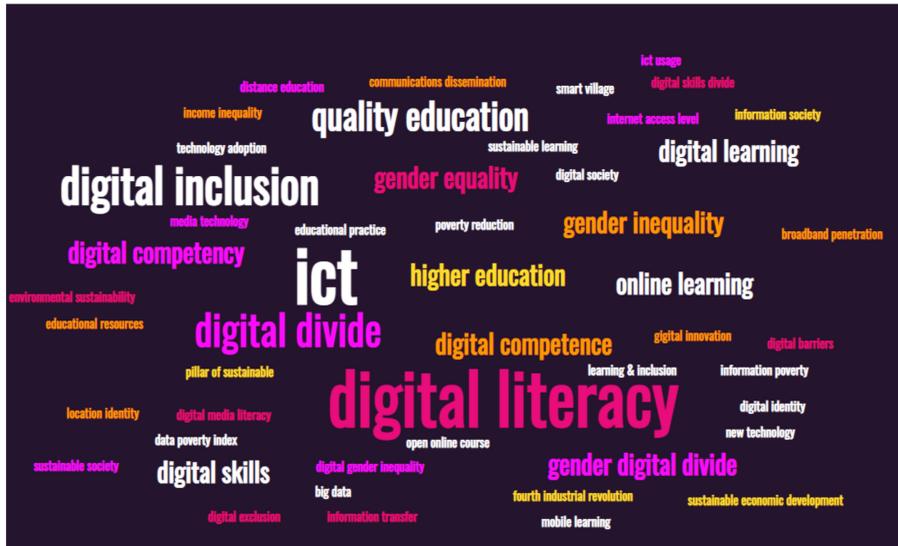


Figure 3.
Themes' analysis

Research methods used

In relation to the analysis of the research methods used by the previous authors, the survey method was employed in most studies (22, 29%), followed by the secondary data analysis method (15, 20%), and the reviews method (09, 12%). In addition to these three primary methods, several other methods were also applied, such as interviews, case studies and action research.

The above two analyses provide answers to RQ2: What methodologies were used in the relevant literature to explore the impact of digital inequality in achieving sustainable development? The results indicate a lack of qualitative studies in the focused area.

Digital inequality determinants

Digital inequality is a multidimensional phenomenon. Thus, digital inequalities can be caused by an assortment of factors. Significantly, these variables can vary from one society to another and country to country. Thus, identifying the underlying determinants of digital inequalities is essential for any country or community in the quest of addressing the root causes of disparities.

Table 6 shows the determinants of digital inequality. The information in Table 6 provides answers to RQ3: What are the determinants of digital inequality that affect sustainable development? Accordingly, “ICT Infrastructure” was considered as the primary determinant (n = 21) of digital inequality, followed by “Digital Literacy” (n = 14) and “Gender” (n = 12). Apart from the aforementioned factors, there are a number of other elements that contribute to digital inequality. It is worth stating that numerous studies (n = 39) identified more than one determinant of digital inequality.

A total of 36 determinants of digital inequality were uncovered by the current study based on the 54 selected publications; 21 studies out of 54 identified “ICT Infrastructure” as the main dominance, which suggests that it plays a key role in accelerating digital inequality. The lack of ICT infrastructure has been a primary driver of digital inequality for years. Those with the appropriate devices and skills, for example, may nonetheless have poor Internet access owing to infrastructure issues. Further to this, digital literacy and gender have also been crucial

Table 6.
Determinants of digital
inequality

Determinants of digital inequality	Frequency
ICT infrastructure	21
Digital literacy	14
Gender	12
Digital skills	10
Device	9
Digital competency	6
Socio	6
Age	6
Educational level	5

Note(s): Frequencies do not add up to 54 as some determinants of digital inequality were mentioned/discussed in more than one paper
Source(s): Authors' own research

factors for digital disparities (Vega Montiel, 2018). Similar findings were also reported by Febro *et al.* (2020) and Wamuyu (2017). Many studies discussed the importance of improving the ICT/digital skills among rural communities to grasp more opportunities through ICT interventions (Khalid *et al.*, 2019), which suggests digital skills as the main determinant of digital inequality (Dawood *et al.*, 2019; Sá *et al.*, 2021). This intervention will raise living standards and ensure sustainable development in the long run (Sharma *et al.*, 2016). However, “Device” was separately reported as one of the main determinants on many occasions ($n = 9$), though it is a component of “ICT Infrastructure,” due to its significant impact on the disparities among individuals with a different socioeconomic status.

Levels of digital inequality

Simplistically, digital inequality is the disparity between those who have access to and the ability to use ICT and those who do not (Aissaoui, 2021; Hidalgo *et al.*, 2020). Previous studies in the digital divide literature focused on this subject categorized digital inequality into three distinct levels, namely, the access divide (first level), skills divide (second level) and the offline tangible benefits gained through the Internet (third level) (Ragnedda and Muschert, 2017; Gómez, 2018; Ragnedda and Kreitem, 2018).

This answers RQ4: What general conclusions can be drawn from the literature on the impact of digital inequality in achieving sustainable development? First, the authors concentrated on the concept of digital inequality. As per the results, certain studies focused on at least one level or more than one level of digital inequality, while others focused solely on the general digital inequality without focusing on any specific level. Accordingly, the second-level digital divide (skills gap) was widely researched ($n = 40$) during the last decade, followed by the first-level digital divide (access gap) ($n = 38$). This may be due to the requirement for high-tech equipment and the proliferation of the Internet with the inception of the fourth industrial revolution and also several technological disruptions (Habanik *et al.*, 2019). Thus, the access and skills gap have increased throughout the last decade and still prevail as the fourth industrial revolution leads to its next level. (For example, see (Bag *et al.*, 2021; Ingaldi and Ulewicz, 2020; Mishra and Maheshwari, 2020; Piątkowski, 2020)).

Another level of the digital divide arose based on the tangible and offline benefits (third level) that can be gained through the Internet and digital technologies. For example, see Robles *et al.* (2011) and Van Deursen and Helsper (2015). The focus of the first and second-level digital divide is access to the digital infrastructure and the usage of the Internet and related technologies, respectively. Recent research into the digital divide and digital inequalities changed the direction of the focus more on the outcomes of Internet usage (Van Deursen *et al.*, 2014; Scheerder *et al.*, 2017; Van Deursen and Helsper, 2015; Yu, 2018). It is

apparent that a myriad of outcomes can be obtained from the Internet and related digital technologies in the modern world (Vincent, 2016). Researchers have categorized these outcomes of Internet usage into different categories. Jan and van Dijk (2005) classified outcomes of Internet usage from the perspective of the conception of resources and further explained it using societal fields. A more comprehensive categorization of the outcomes of Internet usage has been presented by van Deursen *et al.* (2014), who identified five main components of Internet outcomes: economic outcomes, social outcomes, political outcomes, institutional outcomes and cultural (or educational) outcomes. Therefore, the third-level digital divide is based on the level of offline benefits/outcomes that can be obtained from online participation. Hence, the concept of the third-level digital divide (known as the utility gap) can be defined as *the gaps in individuals' capacity to translate their Internet access and use into favorable offline outcomes* (Van Deursen and Helsper, 2015). The results highlighted the significantly smaller number of studies conducted on the third-level digital divide (n = 2). Therefore, there is an apparent research gap on the impact of the third-level digital divide on sustainable development. The overall digital inequality was discussed on five occasions.

Similarly, "Gender Digital Divide/Gender Inequality" was another common issue discussed in the digital divide literature (n = 7). According to the literature, this has been mostly due to the promotion of gender stereotypes that can prevent women from being recruited to technical or ICT-based careers (Kerras *et al.*, 2020). Some authors argue this is due to social intervention and the person's socioeconomic level (Ballesta Pagán *et al.*, 2018; Kashyap *et al.*, 2020). Nevertheless, the literature suggests that the most effective mechanism to reduce any form of inequality, including the gender digital divide, is education (Perryman and De Los Arcos, 2016, Febro *et al.*, 2020; Alotaibi *et al.*, 2020; Francisco Javier Ballesta *et al.*, 2018; Lembani *et al.*, 2020; Michelle Schira, 2019; Oboh, 2020).

Inter-country and intra-country focus

Another intriguing component of digital inequality research is its inter-country and intra-country focus. Because digital disparities might occur across nations and among communities within a country, intra-country and inter-country studies were employed to analyze the trends in the literature. Existing research on digital inequality has been conducted, emphasizing data from within and across nations. Put differently, several studies used data from a single country, while others conducted comparative studies.

Furthermore, analysis of the 54 selected above studies reveals that most of the research (n = 28 or 52%) performed intra-country analysis to study digital inequities within the country, whereas n = 23 or 43% of the studies were comparative studies. Previous authors of the selected studies undertook comparative analyses for respective geographic areas and subcontinents but did not classify countries into developing and developed grouping. In addition, 5% of the studies conducted their analysis without focusing on a specific country (no country focused).

Focused sustainable development goals

The second key concept in this present study was "Sustainability/Sustainable Development". Table 7 below illustrates the distribution of the 54 studies by various SDGs. As can be seen, the majority of the selected 54 articles at least focused on one of the SDGs. Accordingly, 15 out of 17 SDGs were focused at least once in the selected papers. As can be seen, Goal 04: Quality Education (n = 20) was the most prominent SDG, followed by Goal 05: Gender Equality (n = 12), and the studies focused on overall SDGs (n = 12).

Taking into account RQ5: What is the level of impact of digital inequality on the United Nations' SDGs?, the majority of the studies (n = 39) highlighted at least one SDG, which is noteworthy as it shows growing global interest in the topic. Literature that focuses on the

Focused SDGs	Frequency
GOAL 4: Quality Education	20
GOAL 5: Gender Equality	12
Overall	12
GOAL 3: Good Health and Well-being	5
GOAL 10: Reduced Inequality	5
GOAL 8: Decent Work and Economic Growth	3
GOAL 9: Industry, Innovation and Infrastructure	3
GOAL 11: Sustainable Cities and Communities	3
GOAL 2: Zero Hunger	2
GOAL 13: Climate Action	2
GOAL 1: No Poverty	1
GOAL 6: Clean Water and Sanitation	1
GOAL 7: Affordable and Clean Energy	1
GOAL 12: Responsible Consumption and Production	1
GOAL 16: Peace and Justice Strong Institutions	1
GOAL 17: Partnerships to achieve the Goal	1
GOAL 14: Life Below Water	0
GOAL 15: Life on Land	0

Note(s): The frequencies do not add up to 54 as some articles highlighted more than one SDG

Source(s): Authors' own research

Table 7.
Frequency of the SDGs

impact of digital disparities on quality education suggests a wide variety of technological tools and methods, such as massive open online courses, virtual learning environments and blended learning tools, and it further emphasizes the importance of online or distance education to achieve sustainable education by reducing digital disparities (Alcardo *et al.*, 2019; Gomez-Zermeno, 2020; Ortega-Sanchez and Gomez-Trigueros, 2019; González-Zamar *et al.*, 2020; Kim, 2018; Kim *et al.*, 2020).

Apart from the two foremost SDGs, Quality Education (SDG 04) and Gender Equality (SDG 05), SDG 10 and SDG 03 were also discussed on many occasions in the relevant literature (For example, see (Cioaca *et al.*, 2020; Hidalgo *et al.*, 2020; Ukachi and Anasi, 2019)). Interestingly, except for SDGs 14 and 15, all other goals were highlighted at least once in the selected papers. Similarly, another 12 studies have discussed the overall impact of the SDGs. Furthermore, it is clear that some important SDGs were not significantly discussed in the literature, such as SDG 01: No Poverty(n = 1) and SDG 12: Responsible Consumption and Production(n = 1).

Digital inequality vs sustainability concepts' discussion levels

To identify the level for the reporting of two primary focus areas relating to digital inequality and sustainable development, the metadata was analyzed using four distinct categories: "Defined," "Discussed," "Mentioned" and "Demonstrated."

When the definition of the concept was included in the study, it was classified as "Defined." When the authors discussed the main focus of the present study, digital inequality on sustainable development, those studies were classified as "Discussed," either with or without the keywords' digital divide/digital inequality, throughout the paper. Although the primary research focus of a particular study is focusing the impact of digital inequality on sustainable development, studies were classified as "Mentioned," when the authors only mentioned the keywords, digital divide/digital inequality and sustainability/sustainable development once or a few times in the paper without discussing the concepts broadly. Finally, when the concept was empirically evaluated to generate conclusions based on real

data, such studies were labeled as “Demonstrated.” Consequently, some studies were placed into more than one category since they featured definitions, a discussion and empirical findings of a concept.

The analysis on the concepts of digital inequality and sustainability indicates that nine articles defined the concept of digital inequality/digital divide. In comparison, 42 articles discussed the concept throughout their study, while three studies only mentioned the concept. Moreover, it is imperative to note that 14 articles demonstrated the concept using empirical evidence. Conversely, 13 studies have defined the term sustainability/sustainable development, whereas 42 articles discussed the sustainability/sustainable development concepts throughout the studies. In addition, while five articles just mentioned the concept, seven articles have empirically demonstrated its roles and relationships.

According to the findings, the level of reporting of two main concept areas of the review (digital inequality and sustainable development) indicates that most studies (n = 42) discussed both throughout. Nevertheless, a significantly smaller number of studies empirically demonstrated the impacts and relationships.

The impact of digital inequality in achieving sustainable development

The primary objective of the present study was divided into three main classifications based on the way of reporting, namely, “Mentioned” “Discussed” and “Demonstrated.” The term “Mentioned” refers to studies that mentioned (but not discussed in detail) the impact of digital inequality in attaining sustainable development. If the main focus of the study has been discussed throughout the selected study, either explicitly or implicitly, such studies were labeled as “Discussed.” Finally, studies that used real-world data to establish roles and relationships of digital inequality and sustainable development (empirical studies) were classified as “Demonstrated.” Some studies were placed into more than one classification based on their way of reporting. According to the results of the qualitative synthesis, the majority of the studies (n = 39) “Discussed” the impact of digital inequality in attaining sustainable development, whereas 14 other studies have only “Mentioned” the same. Nonetheless, only ten studies have empirically “Demonstrated” the relevant relationships.

As per the results, most of the studies discussed the impact of digital inequality, specifically focusing on sustainable development, similar to the concept meta-analysis. In contrast, a relatively small number of studies conducted empirical investigations. Among the 11 studies under the “Demonstrated” category, six applied regression and descriptive analysis as the analytical techniques, whereas another three studies employed the factor analysis/structural equation modeling (SEM) technique. Interestingly, in the present review, only one study employed machine learning tools as an analytical technique. This clearly shows the dearth of using advanced analytical techniques in the relevant literature. Additionally, three studies have conducted action research to demonstrate the impact of digital inequalities on sustainable development empirically.

Conclusions

This study aimed to review the existing literature on the impact of digital inequality in attaining sustainable development. Overall, this study demonstrates the persisting and increasing demand as well as the requirement for research on the impact of digital inequality in achieving sustainable development. The substantial expansion of scientific publications in recent years reflects the growing interest in this field. However, the lack of adoption of advanced methodological techniques such as machine learning tools is evident even in most of the recent studies.

Online activities have many offline benefits, such as finding more job opportunities, more social connections, lower prices from online purchases, e-money options and better

educational opportunities and resources. Therefore, two Internet users with the same level of access to the Internet and equal levels of digital skills may obtain different offline benefits from online participation. Moreover, Internet users who receive offline returns more often can use those returns to develop their digital skills further and acquire more advanced infrastructure facilities. For instance, someone who uses the Internet to find a good job or online business may use the financial return they obtain from such opportunities, which can be invested in better devices, stronger Internet connections and enhanced digital skills. This digital inequality replication can reproduce digital inequalities and further enhance the existing digital disparities. Hence, identification of the third-level digital divide is imperative to identify the correct level of digital inclusion. However, the findings of the present study indicated that there was little focus on past studies on the offline benefits that might be achieved through online activities (third-level digital divide). The authors determined the skills divide as the most evident digital discrepancy by evaluating the selected studies. Moreover, the skills divide may widen even further when the fourth industrial revolution and Society 5.0 bring significant technological advancements (Roblek *et al.*, 2020).

Overall, most of the authors discussed the challenges of achieving sustainable development due to digital inequalities. According to the findings of the present review, one of the focal reasons for digital inequality is that high-income level communities acquire most of the benefits of ICTs. Conversely, other low-income level communities are missing out on the benefits of ICTs (Gomes, 2019). Moreover, the ICT infrastructure difference between urban and rural communities is one of the biggest challenges for the sustainable development of rural areas (Guzhavina, 2021; Ko *et al.*, 2019). Thus, rural communities are not benefitting from the advantages of digital technologies (Zhang and Zhang, 2020). For example, despite having a smart device and a greater level of digital abilities, a person in a remote region may still have connection problems owing to a lack of adequate ICT infrastructure. Furthermore, digital inequalities always negatively affect both businesses, people in rural areas, and ultimately also sustainable development (Dawood *et al.*, 2019). This is also more prevalent in developing countries. Essentially, digital disparities cannot be resolved only by focusing on technology. Some other essential areas, such as political and socioeconomic issues, should also be considered while enhancing technological development (Armenta *et al.*, 2012).

A digitally literate community is vital for any developing or developed society. When people can apply ICTs in their day-to-day activities, they can achieve goals more efficiently and effectively, contributing to their country's economy. Furthermore, it is crucial to implement e-learning platforms and enhance their usage when it comes to education. Due to infrastructural concerns and a lack of digital skills among the communities, providing more inclusive education during the pandemic might be challenging (Sá and Serpa, 2020; Sun *et al.*, 2021; Toader *et al.*, 2021; Wang *et al.*, 2021). In addition, the resources required to integrate ICTs with the teaching and learning process may not be available for every individual which can create further disparities. Moreover, access to online resources will enhance digital competencies and ensure sustainable development through quality and inclusive education (Muñoz-Rodríguez *et al.*, 2020). The objective toward inclusive education will be backed by the adoption of m-learning technologies. This is also subject to the availability of solid network capacity and the skills of users (Ajayi *et al.*, 2019). In addition to that, digital disparities cause several socioeconomic distinctions, including discrepancies in the job market. Given the lack of digital skills and competencies, these discrepancies may lead to exclusions from the job market, particularly among younger people. This, in turn, will impact the sustainable development of a country (Radovanović *et al.*, 2020; Reddy *et al.*, 2020; Rotondi *et al.*, 2020).

The introduction of cutting-edge technological innovations and digital technologies can improve the quality of life. Still, it could also further enhance digital disparities if society cannot grab technological advancements. The most critical aspect of reducing digital

inequality is the further investment in ICT infrastructure and developing a digitally savvy population, including the rural areas, if a country wants to reduce disparities and promote sustainable development (Jayaprakash and Radhakrishna Pillai, 2021; Wu *et al.*, 2018).

The lack of empirical investigations on exploring the impact of digital inequality in achieving sustainable development was another conclusion in the present review. Moreover, the current study's findings have explicitly demonstrated the requirement of a sound ICT infrastructure and high levels of digital literacy to reduce digital inequalities. Interestingly, these two determinants play a significant role in shaping and determining digital disparities and eventually creating sustainable digital societies. When it comes to SDGs, the present review reveals that the majority of prior research is concentrated on quality education and gender equality. It is noteworthy that several critical SDGs, such as SDG 01 and SDG 12, have not been addressed much in the relevant literature.

Furthermore, there is a lack of comparative analysis between developed and developing countries, which examines the impact of digital disparities on the SDGs of each economy. Because the determinants of digital inequality in distinct economies might be quite diverse, it is also crucial to distinguish between different social clusters, such as urban–rural. For that reason, a comparative analysis would be ideal and beneficial in delivering more holistic insights for sustainable future societies. Moreover, it is critical to accurately conceptualize digital inequality in order to comprehend the phenomena and enable policymakers to address the real issue in order to attain sustainable development.

Limitations

Evaluating only peer-reviewed publications since 2011 has been one of the limitations of the present review. As a result, some crucial publications, including books, conference papers and Internet resources, may have been overlooked or ignored. In addition, the number of eligible publications for the study was decreased according to the authors' inclusion/exclusion criteria. These eligibility criteria were defined by the authors based on their expertise in the field. Therefore, the validity risk could be minimized. Additionally, articles that only focused on the sustainability of a specific subject area, excluding general education, were omitted. Moreover, the author's judgment and perspective were occasionally used to categorize studies depending on their degree of reporting. All other categories, with the exception of "Defined," were difficult to conceptualize, resulting in authors taking a judgmental approach based on their expertise.

Future research directions

As per the findings, there is a dearth of empirical research that examined the impact of digital inequality in attaining sustainable development. Consequently, future researchers and scholars will be able to conduct more empirical studies utilizing real-world data to obtain more accurate results. Furthermore, a handful of studies employed advanced methodological tools such as machine learning techniques. Thus, future researchers will be able to use sophisticated methodological techniques to increase the quality of the outputs. As the findings show, the number of both intercountry and intra-country analyses is almost the same. Nevertheless, no studies comparing the degrees of digital inequality in developed and developing countries were discovered in the selected publications. Therefore, future researchers can emphasize the influence of digital inequalities on sustainable development depending on the economic situation of the country (developed vs developing). Considering individual targets of SDGs is another possible direction for future research. There were no studies in the present SLR that looked at individual targets of SDGs rather than the impact on the overall goal. Therefore, this research gap can be addressed by future researchers. The targets and indicators of the 2030 agenda have been used to track the progress of the SDGs.

As a result, the individual assessment of 169 targets of 17 SDGs to analyze the impact on a specific goal will be pivotal for overall impact measurements as well as leveraging existing resources to successfully bridge digital inequities. Finally, future studies should also consider the influence of the COVID-19 pandemic on digital inequalities and, ultimately, sustainable development. Existing digital disparities have been exacerbated due to several implications of the COVID-19 pandemic, including social isolation and working from home. Hence, future researchers need to be further encouraged to more pragmatically detect the aggravating digital disparities encountered by various segments of society.

Notes

1. The distribution of publications during January 2011 and July 2021 was considered for the analysis as several ICT and digital education developments have taken place during the last decade.
2. The reference lists of the most relevant and most cited ten articles among 310 were reviewed to ensure that all relevant articles of the related literature were included into the study.
3. Two studies were placed into two continents as they used data from two different continents.

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