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Research Article

The Factors, Forms, Causes, Positive and Negative Impacts of the Digital Divide on Educational Practices from Both Educators' and Learners' Perspectives: A Systematic Review

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ABSTRACT

Purpose of the study: The infusion of technology into education has transformed teaching and learning worldwide, offering numerous benefits to learners, educators, and institutions. However, unequal access to technological and educational resources has created two distinct groups: the privileged, who enjoy abundant access and benefits, and the deprived, who lack essential tools and opportunities. This disparity constitutes the digital divide, which creates significant negative effects on learning outcomes and equity.

Methodology: This systematic literature review investigates three key aspects of the digital divide in education, which are contributing factors, advantages, and negative impacts. A total of 34 studies were analyzed, representing data and perspectives from 40,548 participants across 25 countries spanning five continents.

Main Findings: The findings of this study reveal multiple causes of the digital divide in the educational sector, including limited access to technology, poor internet connectivity and digital literacy, lack of educational tools and financial resources, insufficient institutional infrastructure, as well as negative attitudes and poor communication skills. These deficiencies collectively lead to substantial pedagogical, technical, and social consequences.

Novelty/Originality of this study: Notable impacts include widened socio-economic disparities, achievement gaps, reduced interaction and engagement, poor knowledge retention, higher dropout rates, weak digital skills, and diminished relationships between teachers and students. Thus, ultimately, the digital divide fosters a persistent negative perception of technology integration, as many learners and educators view technological use as a frustrating challenge rather than an empowering tool.

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1. INTRODUCTION

The emergence, infusion, and application of technologies have impacted every sphere of human civilization, either in positive or negative ways [1]. The field of teaching and learning has also been experiencing a stable and continuous inclusion, adaptation, integration, amalgamation, and adoption of technologies in practice [2]. The access to the essential technologies involved in education has helped the students to develop the

required skills and competence for the job market, who can afford the essential technologies and can utilize the best use of those technologies [3]. On the other hand, those who can neither afford those technologies nor can utilize those tools for their professional purposes lag behind compared to their counterparts [4]. While access to technologies and their utilization lead one group to be more privileged and another group as deprived, it means a gap between them, meaning the divide in their access, capability, skills, and perceptions of technologies [5].

The term 'digital divide' (DD) is currently one of the interchangeably disputed and academically discussed topics in the field of educational technology and digitalization of education worldwide in this age of globalization and virtualization of education [6]. It (DD) simply means a situation where a large number of people have access to educational technologies, tools, and digital resources, and some of them do not even have access to the essential tools, technologies, and resources; hence, that creates inequity and disparity among individuals while practicing educational activities requiring the fundamental support of technologies [7]. It happens in a number of ways, such as the gap in the socioeconomic condition is one of the biggest reasons for it to happen in place [8]. Apart from the financial difference, some other factors also lead to create DD, such as ignorance, lack of motivation, resources, digital technologies, and internet connection [9].

DiMaggio et al [10] associated the digital divide with the unequal opportunities to access educational technologies, information and communication technologies (ICTs), usage of the Internet, the lack of skills to manage technological media and similar technological and educational resources for a wide range of teaching and learning activities of individuals caused by many reasons such as poor knowledge of families, geographical regions, et cetera. Another significant study has also defined DD as the existence of differences between the level of opportunities of access to technologies, resources, and information and communication technologies (ICT) and those with greater access opportunities and those without it [11], [12]. Similarly, Van Deursen and van Dijk [13] consider DD as the unequal access to the material, skills, and usage of essential technologies, the Internet, and digitally available educational resources that create some people more benefits than their counterparts who do not have equal access to the mentioned resources.

Therefore, one of the root causes of the digital divide lies in the difference between the financial capacity of the teachers, learners, educators, and involved stakeholders, meaning the widened gap between the financially capable and financially challenged group of stakeholders involved in the educational sector as the affluent stakeholders can benefit from the emerging technologies while the challenged people cannot [14]-[16]. The outcome of this DD is one of the worst barriers to enjoying the benefits of e-learning and skill development, particularly in developing countries throughout the world, such as African, Asian, and Latin American countries [17]. Hence, the digital divide leads to the widened gap in terms of technical abilities, skills, educational achievement, socioeconomic conditions, and so on between the privileged and challenged groups of people [18]-[20].

The lack of access to essential technologies and resources for the purpose of educational purposes leads to the increased gap between the capability, skills, and opportunity to play an important role in a society and leads to social inequality, disparity, and collective frustration among the deprived group [21]. The existing literature shows that the majority of the deprived group of people are from developing countries and lower-middle-income countries, whereas the majority of the privileged group are from financially developed countries [22]. Therefore, the digital divide not only impacts the educational practice but also creates a process of creating a bigger gap in terms of socioeconomic conditions in a society [23]-[26].

The impact of DD has been significantly understood in the field of educational practice worldwide. A number of factors create and lead to the widened gap between the privileged group and the deprived group of learners; the current study aimed to delve into the deep roots of the factors or causes of the digital divide in the field of education and its impacts on the learners, teachers, educators, and stakeholders involved in education, research, and policymaking. The current study targeted three driving academic inquiries, i.e., factors, advantages (if any), and the negative impacts of the digital divide on the learners, teachers, educators, researchers, and involved stakeholders. Consequently, this study developed three research questions that are as follows: 1). What are the factors, forms, and causes of occurring the digital divide in educational practice from both educators' and learners' perspectives?; 2). What are the positive impacts of the digital divide in teaching-learning practices based on the overall perceptions and circumstances of the stakeholders?; 3). What are the negative impacts of the digital divide on the stakeholders and educational practices?

2. RESEARCH METHOD

This study utilized the PRISMA protocol from the beginning to the end of the study to maintain the standards of a quality systematic study. PRISMA statements were followed for the literature search, conceptualization and formation, data extraction, results and analysis, et cetera. The researcher was neutral throughout the study, and the whole study was driven by academic inquiry through the research questions. The researcher considered the task of searching for appropriate literature to be one of the most important tasks. Therefore, I selected the most related and leading databases that are highly compatible with the current field of

study (educational and learning technologies and pedagogies), and I conducted the Boolean searches on Web of Science, Sage Journals, ScienceDirect, ProQuest, EBSCO, Taylor & Francis, Eric, Springer Journals, Google Scholar and ResearchGate to find the appropriate literature for including in this study.

The literature search was conducted by the end of August in the year 2023 and tried to find the literature from January 2020 to August 2023. This study utilized many different strings in the databases so that the most appropriate literature could be reached and retrieved from the database and included in the current study (as shown in Table 1). As different databases are built with certain unique characteristics such as algorithms, styles, search systems, et cetera, they function uniquely, too. Therefore, I took these issues seriously and devised the search strings with extra care and caution, and academically aligned with the research questions and the title.

Table 1. The applied strings for the literature search

Databases	The applied strings for the search
Web of Science	The causes of creating divide in education AND advantages AND disadvantages AND challenges of digital divide in educational practice
Sage Journals	The forms or ways or causes of creating divide in education AND advantages AND disadvantages AND challenges of digital divide in education
ScienceDirect	The forms or ways or causes of creating divide in education AND challenges of digital divide in educational practice
ProQuest	The forms or ways or causes of creating divide in education AND advantages AND disadvantages AND challenges of digital divide in education
EBSCO	The forms or ways or causes of digital divide in education AND positive and negative impacts of the digital divide on educational practices throughout the world AND challenges of digital divide in education AND digital divide in developing countries
Taylor & Francis	The forms or ways or causes of creating divide in education AND challenges of digital divide in education
Eric	The forms or ways or causes of creating divide in education AND positive AND negative impacts of the digital divide on educational practices AND challenges of digital divide in education
Springer Journals	The forms AND ways AND causes of digital divide in education AND positive AND negative impacts of the digital divide on educational practices throughout the world AND challenges of digital divide in education

Though these mentioned platforms were highly given importance, Google Scholar and ResearchGate were also given an equal emphasis to find more appropriate literature to make the current study more sound and legitimate. Apart from the strings mentioned here, there were many alternative terms and phrases that were used interchangeably, which helped this study find the appropriate resources.

Predetermined criteria were set and followed for the inclusion and exclusion of the included articles for this study. The following criteria were followed in order to decide which particular articles were supposed to be included in the current systematic review. The following inclusion criteria were maintained during the process of selecting the articles: 1) The study was conducted focusing on the phenomena involved in creating or leading the digital divide and its impacts on education; 2) The study was conducted from the point of view of educational perspective and educational research; 3) The article was a completed work and was published in internationally recognized journals; 4) The study was published in English; 5) The status of the article was active and online. The following criteria were maintained during the exclusion of the selection process: 1) The study did not contain the fundamental level of research on the digital divide and education; 2) The study was conducted in a language other than English; 3) The full article was not available while this study was being conducted; 4) The study that was not published in a peer-reviewed journal with proper indexing.

Data extraction is one of the most important jobs for systematic review and meta-analysis, and it requires a rigorous and systematic technique, strategy, and tool for extracting the detailed information and insights from the included studies for a specific systematic review or meta-analysis. Therefore, the current study also considered the data extraction style and followed the attached form (see Table. 2).

Table 2. The items and descriptions of the data extraction technique

Extraction items	Descriptions
Title	Title of the paper
Author (s)	Authors' names
Publication date	Publishing year
Country of Origin	The origin country of the research
Type	Type of academic work (article, proceeding)
Forms/causes	The ways or forms of the digital divide
Advantages	The advantages of it, if there were any.
Challenges	Disadvantages and challenges of it in education
Comments and future	Analytical comments and future work indicated

The quality of the included papers is one of the pivotal criteria for making a review as an important output from certain research. Therefore, this study considered it seriously and adopted a quality assessment technique (appraisal tool) developed by Ashraf et al [27] and applied this technique for assessing the quality of the included articles for this study (see S1). This is a critical appraisal tool (technique) that is a combination of quantitative, qualitative, and mixed-method critical appraisal that assesses the quality of the key characteristics of an article, such as the theoretical background, research design, data collection, data analysis, interpretations, and conclusions [27].

The tool considered those five characteristics of an article separately and allocated a score of 1 if it met the criteria, or it awarded a score of 0 if a certain part of an article did not meet the quality criteria. The authors (s) performed the quality assessment first, and then the supplementary materials, articles, and performed work were evaluated by two expert reviewers in the field who were also experts in the fashion of systematic review and meta-analysis writing. Afterward, the author and reviewers held several meetings and discussed the issues of the quality assessment of the included articles until they understood and agreed on the quality and legitimacy of the studies included in this study. It is also worth to note that no article was excluded based on the quality assessment phase, as it was meant to give deeper insights and meaning through exposing the different parts and features of the included studies to the current analysis.

The mentioned appraisal tool was used for the assessment of the included articles, which consisted of five items in the tool according to the checklist developed by Ashraf et al [27] All the studies included were proven to be sound enough (as shown in Table 3). Among 34 articles, 21 articles received a full score of 5 out of 5, which means that they met all of the five quality assessment criteria set by the appraisal tool. 9 (nine) studies met four out of five criteria, three studies received a score of 3, and only 1 article received a score of meeting two criteria.

Table 3. Scores of the included studies in this study

The number of criteria met	Number of articles
Five	21
Four	9
Three	3
Two	1

Among the included studies, the background (literature review) of the included studies lacked the details and proper approach to support and give the profundity of the studies, not meeting the criteria in six studies, while four studies lacked either a sufficient number of samples or the lack of proper selection of sampling techniques. In addition, methodology and conclusion were insufficient in 3 studies, respectively, while outcome measures were not met in two studies. The quality assessment protocol shows that four studies have relatively severe quality issues: meeting only three assessment criteria in three articles, and only two criteria were met in one article. Altogether, most of the included studies, except for a few studies, showed soundness in major parts of the articles (see Table 4).

Table 4. Scores of the included studies based on assessment criteria

Criteria	Met criterion	Did not meet
Outcome measures	32	2
Background/literature	28	6
Sample	30	4
Study design/ methodology	31	3
Conclusion	31	3

The included articles were studied, keeping the focus on the predetermined search following the research questions. The data extraction form (see Table 2) was used to extract the data from the included studies as the qualitative data. Based on the obtained data from the articles, we established several themes under each research question and organized the data based on the research questions and then on the themes. The concurrent themes were the factors that caused the digital divide in education and its impacts on the teachers and students. After completion of the reading and extraction, we analyzed the obtained data manually and compared or contrasted where it was relevant.

3. RESULTS AND DISCUSSION

The selected databases are leading ones in educational science and resulted in 2796 articles in total after an extensive search through Boolean search. Additionally, more than three hundred articles were retrieved from Google Scholar and ResearchGate. A number of articles were excluded based on the inclusion and exclusion criteria, and 34 articles were selected for the current study for coding and analysis (as shown in Figure 1).

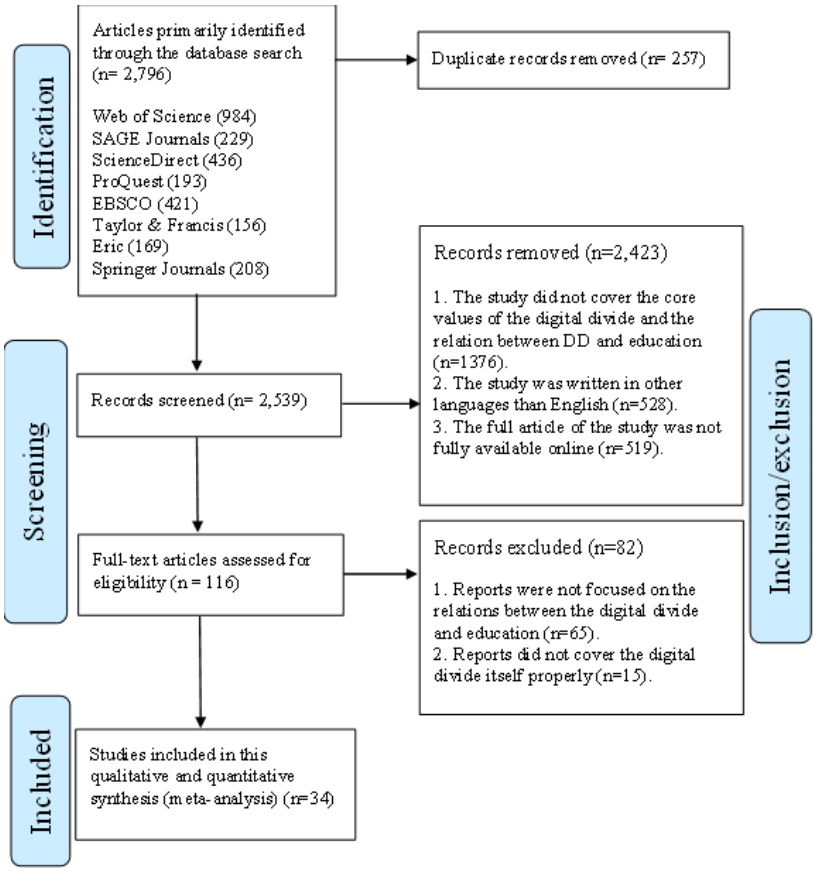
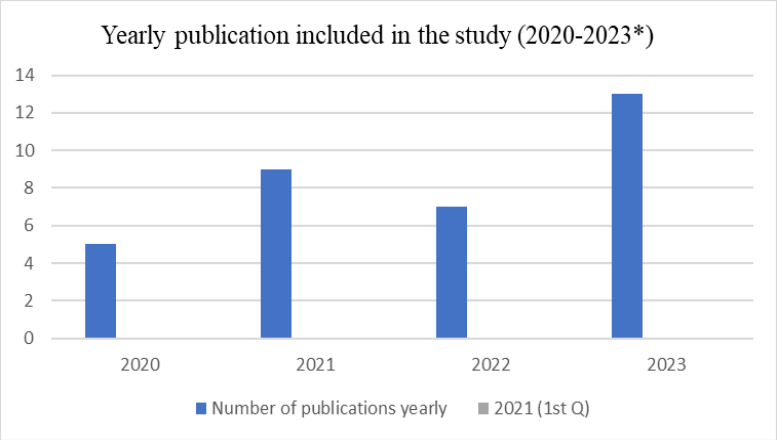


Figure 1. Flowchart of the systematic search of the included literature

Publication year of the included articles



* The current study included the articles from January 2020 to the 1st half of 2023.

Figure 2. Publication years of the included articles

The included articles of this study were searched, selected, and retrieved from January 2020 to the first half of the year 2023. Thirty-four articles in total were selected, including thirteen from 2023, seven from 2022, nine from 2021, and five from 2020 (see Figure 2). The number of studies included increased gradually from the past to the recent years.

The summary and details of the included studies

This study focused intensively on the academic and demographic details of the included articles simultaneously (see Table 5). It shows that the included 34 studies were conducted in 25 different countries spreading over five continents that ensure the diversity and inclusiveness of the data and insights found and explained throughout the current study. Also, it demonstrates the strengths of this systematic literature and meta-analysis that also helped this study to stand strong with a lot of details that give nuances and details related to the digital divide in educational practice to the readers. The attached table includes the details of authors, titles, the methods and instruments applied, samples, origins of studies, and continents of them.

Table 5. Summary and information of the included studies

Authors	Titles of the articles	Methods & Instruments	Samples	Origin of the Studies	Continents
Golden et al., 2023 [5]	What was a gap is now a chasm: Remote schooling, the digital divide, and educational inequities resulting from the COVID-19 pandemic	Review Paper	Not applicable	USA	North America
Giavrimis, 2023 [8]	The digital divide: Greek primary teachers' conceptualizations	Qualitative: interview Quantitative: survey	58	Greece	Europe
Jafar et al., 2023 [28]	Digital divide and access to online education: new evidence from Tamil Nadu, India	Quantitative: Computer-Assisted Telephonic Interviews	12,741	India	Asia
García Zare et al., 2023 [7]	Technological Devices and Digital Competences: A Look into the Digital Divides for University Continuity during the COVID-19 Pandemic	Quantitative: Survey & documentary analysis	9,326	Peru	South America
Odularu et al., 2023 [30]	Exploring COVID-19 Pandemic Impact, Online Engagement, and Digital Divide on Disadvantaged Undergraduate Students in South African Universities	systematic review	56	South Africa	Africa
Yajie et	Widening Digital Divide: Family	Quantitative:	1,982	China	Asia

Authors	Titles of the articles	Methods & Instruments	Samples	Origin of the Studies	Continents
al., 2023 [45]	Investment, Digital Learning, and Educational Performance of Chinese High School Students During the COVID-19 Pandemic School Closures	Survey questionnaire			
Nkoala, 2023 [35]	The influence of the digital divide on emergency remote student-centred learning during the COVID-19 pandemic: a case study of journalism education	Qualitative: analysis of video data	113	South Africa	Africa
Nanthakorn et al., 2023 [40]	Double burden: Exploring the digital divide in the Burmese educational system following the 2021 coup d' etat and the COVID-19 pandemic	Qualitative: case study, in-depth interviews Quantitative: Questionnaire	131	Myanmar	Asia
Choudhury et al., 2023 [31]	Management education in technology-mediated ODL platform – implications for educators in context of shifting learning path and digital divide	Qualitative: in-depth interviews Quantitative: Questionnaire	101	India	Asia
Baidoo-Anu et al., 2023 [32]	Digital divide in higher education in Sub-[52]ran Africa: evidence from online learning during the COVID-19 pandemic	Quantitative: Questionnaire	304	Sub-[52]ran Africa	Africa
Amirova et al., 2023 [9]	The impact of the digital divide on synchronous online teaching in Kazakhstan during COVID-19 school closures	Quantitative: Questionnaire	4,000 (approx.)	Kazakhstan	*Asia*
Kormos & Wisdom, 2023 [44]	Digital divide and teaching modality: It's role in technology and instructional strategies	Quantitative: Questionnaire	423	Mid-Atlantic countries	North America
Woldegiorgis, 2022 [46]	Mitigating the digital divide in the South African higher education system in the face of the Covid-19 pandemic	Qualitative: analysis of government statistics, reports, databases	Unspecified	South Africa	Africa
Kuhn, A., et al, 2022 [47]	Who gets lost? How digital academic reading impacts equal opportunity in higher education	Quantitative: Questionnaire, open-ended questions	3560	Germany, Austria, Switzerland	Europe
Ben Youssef et al., 2022 [34]	ICT Use, Digital Skills and Students' Academic Performance: Exploring the Digital Divide	Quantitative: Questionnaire	1469	France	Europe
Gulain et al., 2022 [48]	The Impact of the Digital Divide on Higher and University Education Sector Performance	Quantitative: Questionnaire	150	The Democratic Republic of Congo	Africa
Makumane & Mpungose, 2022 [42]	Digital Divide: Secondary School Learners' Experiences of Using Educational Technologies	Quantitative: Questionnaire Qualitative: semi-structured interviews, case study	35	South Africa and Lesotho	Africa

Authors	Titles of the articles	Methods & Instruments	Samples	Origin of the Studies	Continents
Baral, 2022 [33]	The Digital Divide in Online Learning: A Case Study of University Students in Nepal	Qualitative: semi-structured interviews and observations	20	Nepal	Asia
Norman et al., 2022 [49]	The Educational Digital Divide for Vulnerable Students in the Pandemic: Towards the New Agenda 2030	Quantitative: Questionnaire	518	Malaysia	Asia
Devisakti et al., 2023 [25]	Digital divide among B40 students in Malaysian higher education institutions	Quantitative: Questionnaire	511	Malaysia	Asia
Azubuike et al., 2021 [14]	Who gets to learn in a pandemic? Exploring the digital divide in remote learning during the COVID-19 pandemic in Nigeria	Quantitative: Questionnaire Qualitative: Interview over phone	1,183	Nigeria	Africa
Badiuzzaman et al., 2021 [4]	The Latent Digital Divides and Its Drivers in E-Learning: Among Bangladeshi Students During COVID-19 Pandemic	Quantitative: cross-sectional survey with questionnaire	123	Bangladesh	Asia
Faloye al al., 2021 [50]	Understanding the impact of the digital divide on South African students in higher educational institutions	Quantitative: Questionnaire	370	South Africa	Africa
Suriansha h, 2021 [51]	Digital Divide in Education during COVID-19 Pandemic (Jurang Digital dalam Pendidikan semasa Pandemik COVID-19)	Quantitative: Questionnaire	233	Malaysia	Asia
Saha et al., 2021 [52]	The mental impact of digital divide due to COVID-19 pandemic induced emergency online learning at undergraduate level: Evidence from undergraduate students from Dhaka City	Quantitative: Questionnaire Qualitative: In-depth interview	180	Bangladesh	Asia
Anuradha et al., 2021 [36]	Digital divide framework: online learning in developing countries during the COVID-19 lockdown	Quantitative: Questionnaire	827	India, Pakistan, Bangladesh, Nepal, Afghanistan	Asia
Chisango et al., 2021 [38]	The digital divide at three disadvantaged secondary schools in Gauteng, South Africa	Qualitative: case study, semi-structured in-depth interviews (face-to-face), focus group discussions	51	South Africa	Africa
López-Montero et al., 2021 [37]	DIGITAL BORDERS: THE IMPACT OF THE DIGITAL DIVIDE IN THE EDUCATIONAL PROCESS OF MINOR MIGRANTS LIVING IN MARGINALIZED URBAN AREAS	Review	Not applicable	Spain	Europe

Authors	Titles of the articles	Methods & Instruments	Samples	Origin of the Studies	Continents
Azionya et al., 2021 [41]	THE DIGITAL DIVIDE AND HIGHER EDUCATION CHALLENGE WITH EMERGENCY ONLINE LEARNING: ANALYSIS OF TWEETS IN THE WAKE OF THE COVID-19 LOCKDOWN	Qualitative: content analysis	658	South Africa	Africa
Leshkevich, 2020 [43]	The "Digital Divide" as a Feature of the Modern Educational Process: Ambivalent Assessments	Review	Not applicable	Russia	Europe
Soomro et al., 2020 [29]	Digital divide among higher education faculty	Quantitative: Questionnaire	322	Pakistan	Asia
Hosszu, & Rughiniș, 2020 [53]	DIGITAL DIVIDES IN EDUCATION. AN ANALYSIS OF THE ROMANIAN PUBLIC DISCOURSE ON DISTANCE AND ONLINE EDUCATION DURING THE COVID-19 PANDEMIC	Thematic content analysis of core articles	152	Romania	Europe
Wordu, 2020 [54]	Digital Divide among Teachers in Urban and Rural Secondary Schools in Rivers State, Nigeria	Quantitative: Questionnaire	721	Nigeria	Africa
Lembani et al., 2020 [39]	The same course, different access: the digital divide between urban and rural distance education students in South Africa	Quantitative: Questionnaire Qualitative: Interviews	230	South Africa	Africa
Total	34 articles		40,548	25	5

The factors, forms, and causes of occurring digital divide in education

The first research question of this study inquired about the phenomena such as factors, reasons, and forms involved in creating the digital divide in education due to internal and external factors. The included studies were studied, scrutinized, extracted thematically, and coded carefully to find the academic answers to the first research question throughout the attached table (see Table 6). The themes identified in the included articles have been supported by the mentioned articles throughout the table to show the frequency and significance of the propelling factors of the digital divide in teaching and learning activities.

Table 6. The factors, causes, and forms of the digital divide in education

The factors and forms of occurring digital divide	Supporting articles
Inadequate and inequitable access to educational technologies and devices (laptops, computers, smartphones, digital facilities)	[5]; [29]; [35]; [9]; [8]; [7]; [30]; [40]; [32]; [44]; [28]; [47]; [49]; [33]; [46]; [42]; [14]; [51]; [37]; [36]; [38]; [4]; [41]; [39]; [53]; [54]; [52]; [25]
Insufficient Internet connection and low broadband coverage	[5]; [29]; [35]; [9]; [7]; [31]; [30]; [32]; [44]; [28]; [45]; [49]; [33]; [42]; [46]; [14]; [41]; [53]; [37]; [54]; [39]; [43]; [38]; [4]; [51]; [36]; [52]; [25]
Poor digital skills and lack of training for teachers and students	[5]; [29]; [9]; [8]; [7]; [30]; [40]; [32]; [44]; [47]; [49]; [33]; [14]; [4]; [41]; [36]; [38]; [37]; [46]; [34]; [42]; [43]; [53]; [54]; [48]; [52]; [25]
Financial incapability of family members for the required support (space, devices, Internet)	[5]; [30]; [32]; [44]; [28]; [45]; [47]; [49]; [33]; [46]; [14]; [38]; [41]; [51]; [4]; [37]; [42]; [39]; [53]; [52]; [30]; [25]

The factors and forms of occurring digital divide	Supporting articles
Lack of digital literacy & knowledge in cyberlearning	[5]; [8]; [7]; [30]; [40]; [32]; [44]; [28]; [33]; [46]; [34]; [41]; [51]; [36]; [38]; [4]; [54]; [37]; [39]; [52]
The gap between urban and rural practitioners due to geographical differences (rural, remote, and adverse)	[9]; [8]; [30]; [32]; [44]; [49]; [33]; [46]; [14]; [36]; [4]; [51]; [39]; [53]; [54]; [44]; [25]
Lack of inclusive digital infrastructure	[33]; [34]; [14]; [38]; [41]; [4]; [39]; [53]; [36]; [54]
Unavailable electricity (shortage of power supply)	[35]; [31]; [32]; [28]; [33]; [46]; [14]; [36]; [52]
Unwillingness, fear, and reluctance of senior people (i.e., teachers, parents) to adopt new technologies	[8]; [30]; [40]; [38]; [53]; [36]
Lack of government regulations (technological support, training, and data usage policy)	[31]; [32]; [33]; [41]; [4]; [51]; [52]
Lack of physical presence and interaction	[5]; [35]; [30]; [4]; [36]; [52]
Insufficient access to appropriate academic educational resources (software, books, platforms, websites, digital libraries)	[5]; [35]; [9]; [8]; [41]; [32]
Unavailability of a dedicated (personal) space and electronic devices	[5]; [35]; [45]; [41]; [52]
Lack of motivation to participate actively (passive attendance)	[35]; [30]; [40]; [42]
Fear of learning and using digital technologies	[33]; [42]; [37]; [39]
Lack of technological and digital knowledge and skills of family members	[28]; [14]; [4]; [36]
Lack of accessibility to the digital spaces (virtual environment, virtual services, subscriptions)	[5]; [8]; [7]; [32]
Lack of motivation for using ICT tools	[4]; [53]; [38]; [41]
High data price	[4]; [36]; [54]; [52]
Lack of support from family members	[5]; [40]; [53]
Insufficient infrastructure and resources for physically and mentally vulnerable learners	[5]; [8]; [14]
Difficulties of communication between teachers and learners	[5]; [35]; [31]
Improper channels and systems for the diffusion and infusion of technologies	[36]; [39]
Gender discrimination	[37]; [36]
Technological issues and troubleshooting	[5]; [31]

The factors and forms of occurring digital divide	Supporting articles
Limited deliverables and new content	[5]; [48]
Ignorance of the use and benefits of the latest technologies	[8]; [37]
Negative attitude of the university authority	[41]
Controlled and censored by government authorities	[40]
Extra workload and stress of teachers	[5]
Theft of electronic devices (resources)	[38]
Lack of time to master the latest technologies	[43]
Absence from class due to lack of resources	[35]

Among the 34 articles, 29 (85.289%) included studies that contained or mentioned the insufficiency of access to educational technologies, resources, and devices (laptops, computers, smartphones) and other digital facilities for facilitating their education. Similarly, another lion share of included articles, 85.289% (29), found that insufficient Internet connection or very low broadband coverage of the Internet that is one of the biggest barriers to enjoying their education over the Internet or distance education mode. 28 articles (82.348%) of the included studies indicated to the low digital skills and training among both the students and teachers for utilizing the digital means and benefiting their educational activities for the distance learning. Even they cannot get proper training or learning facilities to develop their skills in essential digital technologies. Financial incapability of family members stood as the fourth biggest reason for creating DD, with the findings of 23 articles (67.643%), and do not let them provide their children with the essential technologies required for developing digital skills and educational purposes. Additionally, 21 articles (61.761%) found that the lack of digital illiteracy was prevalent among teachers, learners, and administrative bodies. Finally, it was found that the location of stakeholders (52.938%, 18 articles) became a factor for creating the difference among the stakeholders such as the students and teachers who live in remote or adverse areas showed a lot of struggles and disadvantages compared to their counterparts who live in urban areas and enjoy all the facilities.

10 (29.41%) of the included studies found the lack of digital infrastructure for inclusive education as one of the most frequently faced problems when the stakeholders (teachers and learners) want to practice the required resources and materials. Surprisingly, the unavailability of electricity was found in 9 (26.469%) articles, which is one of the unbelievable factors to create DD found in this study. Next, 20.587% (7) articles found the lack of government regulations relating to the essential fields to address, such as technological support, training, and data usage policy, etc., and lead to unequal access to the facilities and creating the digital divide among the users. In addition, a few other factors that were found to the same degree throughout this study include the lack of access to appropriate academic educational resources (6 articles, 17.646%), unwillingness and the reluctance of senior people (6 articles, 17.646%), lack of physical presence (6 articles, 17.646%), and unavailability of a dedicated personal space and electronic devices (6 articles, 17.646%). Finally, 5 articles (14.705 %) included in this study found that the users do not feel motivated to participate actively in the teaching and learning activities.

The rest of the factors that lead to the increased digital divide were relatively less frequently found in the included studies compared to the above-mentioned ones. Those factors include the lack of digital spaces (virtual environment), highly expensive internet, lack of motivation for using ICT tools, and fear of learning and using digital technologies, constituting 11.764% (4 articles) in each of these factors. Similarly, three factors have been found in 3 articles (8.823%): the lack of family support, insufficient infrastructure and resources for physically and mentally challenged people, and the communication gap between teacher and student. In addition, there are five other factors, each of which was found in a couple of studies (5.882%), namely, the technological issues and troubleshooting, limitation of deliverable content, ignorance about the use and benefits of using educational technologies, the gap between gender, and the improper channel and system of diffusion and infusion of essential technologies among the stakeholders. Finally, the rest of the six factors are extra workload and stress of teachers, absence from class due to lack of resources, negative attitude of the university authority toward technologies, lack of time to learn about technologies, control, and censoring imposed by government authorities, and the theft case of electronic devices (resources) and each of these factors was at least (2.941%) found in an article.

Positive impacts of the digital divide in education

The current study also investigated whether there were any positive sides to the digital divide in education through the research question two in this study. Unfortunately, it was found that there were not many positive sides of DD in education, as only one positive aspect was reported in only one study among all 34 included articles in this study (see Table 7). In contrast, this same study has found a variety of negative impacts of DD on learners, teachers, researchers, stakeholders, policymakers, etc. It proves that the digital divide does not bring positivity to be mentioned while it brings uncountable negative impacts that create a wall between the privileged and deprived groups, creating disparity, inequity, and many other negative impacts on the stakeholders, unfortunately, worldwide.

Table 7. positive impacts of the digital divide in education

Positive impacts of DD	Supporting articles
Autonomy and independence in learning ability	[44] & Wisdom, 2023

The negative impacts of the digital divide on education

The third research question of this study looked for the negative impacts created by the digital divide in educational activities, practices, learning processes, stakeholders, et cetera. The negative impacts or problems brought about by the DD have been explored throughout the attached table (see Table 8).

Table 8. Negative impacts of the digital divide on education

Negative impacts of the digital divide	Supporting articles
Increased inequality, inequity, and disparity	[5]; [35]; [9]; [8]; [7]; [31]; [40]; [32]; [45]; [49]; [33]; [46]; [46]; [14]; [34]; [42]; [44]; [47]; [41]; [4]; [38]; [36]; [51]; [37]; [39]; [43]; [25]
Increased socioeconomic disparity and inequality	[5]; [35]; [9]; [30]; [32]; [47]; [41]; [51]; [39]; [42]; [37]; [25]
Achievement gaps from an educational perspective	[5]; [35]; [9]; [45]; [7]; [48]; [25]
The increased gap between teachers and learners	[5]; [7]; [31]; [40]; [52]; [53]
Increased racial gap and disparity	[5]; [28]; [37]; [41]; [39]
Increased gap between urban and rural stakeholders (deprived of equal access opportunity)	[31]; [30]; [40]; [32]; [28]; [42]
Economic gap and disparity	[5]; [9]; [8]; [41]; [36]; [42]
Poor retention rate of knowledge and student-enrollment	[5]; [30]; [28]; [49]; [41]; [52]
Pushing psychological inferiority complex among disadvantaged learners	[5]; [8]; [31]; [42]; [25]
Increased gap in professional and technical skill	[29]; [9]; [8]; [36]; [4]
Lack of bondage among learners and teachers	[5]; [44]; [33]; [53]
Insufficient development of communication skills	[5]; [33]; [53]; [41]
Procrastination and demotivation	[35]; [40]; [32]; [47]
Feeling unnecessary, imposed, and irritated	[8]; [30]
Difficulties for disabled learners (academically, psychologically, socially)	[5]; [8]
Lack of student-engagement	[5]; [35]
Poor professional networking skills	[9]
Adolescent lifestyle affected negatively	[45]

There are numerous negative outcomes of the digital divide in the educational practice from both perspectives: teacher and student. Among those impacts, the most frequently found and severe impact is the

increased inequality and disparity between the privileged and deprived groups, which is apparently reported in 82.348% of articles (28) among 34 articles included in this study. Secondly, 35.292% of the included articles (12) reported increased socioeconomic gap, disparity, and inequality due to the factors and digital divide in the activities in educational practices. The third highest impact of the digital divide in education is the gap in academic achievement that has been reported in 20.587% of articles included in this study. The poor retention rate of knowledge and studentship and the increased gap between teachers and learners have been reported in six articles (17.646%), respectively, which lead to less possibility of successful delivery of education and a bigger gap between the students and teachers. Likewise, six articles (17.646%) have reported about the increased racial gap and disparity among the stakeholders.

Six studies (17.646%) reported that DD increases the gap between urban and rural stakeholders due to the lack of equal access to technologies and resources, increasing economic gap and disparity (17.646%). Five studies (14.705 %) have reported that the digital divide leads disadvantaged stakeholders (teachers, learners, educators, researchers, etc.) to feel psychologically inferior to the privileged stakeholders, and it increases the gap in professional and technical skills between these mentioned groups of stakeholders. DD leads to the insufficient development of communication skills, poor bondage among learners and teachers, procrastination, and demotivation, as reported by four articles (11.764%) in each impact, respectively. Furthermore, other negative impacts of DD include difficulties associated with inclusive education, poor student engagement, irritation for some learners, failure to build professional networks, and the impact on the adolescent lifestyle, et cetera.

The emergence and infusion of technologies in educational practice have immensely impacted every way of dealing involved in education and research today. As all the people involved in education do not have equal access to the essential and appropriate technologies, resources, and tools, it creates a wall between two groups of people: those who have the affordability and those who do not have it due to one or more reasons [28].

The factors, forms, and causes of occurring digital divide in education

The first research question of the current study was aimed at the root causes, reasons, forms, and factors that lead to the increased gap between the groups of stakeholders in terms of access to electronic and educational resources for using in education and lead to the widening of the digital divide. The current study has found a number of factors and forms of the gap among the users. Root causes lie in both ways, externally and internally, depending on the situation and in a number of ways. The external reasons include the lack of physical infrastructure, technical unavailability, technical deficiency, extreme circumstances, and the causes that either do not allow continuously to learn and use the technologies for educational purposes or they (stakeholders) do not have those affordances at all. Some external factors include the lack of access to fundamental technologies [29]. Unavailable access to virtual resources, unavailable broadband connection, low speed of internet [5], financial incapability of the family, et cetera [30].

The government is one of the core regulatory bodies in each country; however, this study has found that there is no proper government regulation in most developing countries about data policy or plans for educational purposes, such as mobile data plans, broadband connection, and price, etc., for either institutional purposes or individual purposes. As a result, stakeholders and institutions cannot afford essential technological equipment, support, and training facilities [31], [32]. Similarly, they do not have access to the digital infrastructure or platform for practicing inclusive education for disabled learners [33], [34]. The other factors include the unavailable electricity supply [35], difficulties in accessing appropriate academic educational resources (software, books, platforms, websites, digital libraries), personal spaces and electronic devices for attending online lessons [5], [35].

Some additional challenges and barriers associated with the digital divide are inadequate access to the virtual environment, poor digital skills, and limited authorization and subscriptions [5], [8]. Furthermore, there are other challenges such as high data price [4], [36], underrepresentation of women [37], theft of digital infrastructure and devices [38] and improper channel and system of technology diffusion et cetera which create digital divide [39]. Sometimes, the digital divide can also be triggered due to government intervention or control and censorship [40]. In addition, most of the family members do not have sufficient technological and digital skills and knowledge, which bars the guardians from educating their children [5], [40]. Finally, the studies also showed the insufficiency in infrastructure and resources for physically and mentally vulnerable and disabled learners [5], lack of resources [35], various technological issues and troubleshooting [31].

Though there are many external factors and forms of creating digital divide among the learners and other stakeholders, there are some internal factors as well that are the reasons from within the users. For example, many teachers and learners have low digital skills and they develop demotivation [4] to utilize the technologies [29], to participate actively in online education [30] and many senior teachers expressed their unwillingness and fear to adopt new technologies in their teaching [30] whereas the geographical adversity bars many teachers and learners to learn, use, and benefit from these technologies meaning widened gap in skillset,

learning and teaching skills [9]. Additionally, the reported internal factors include physical absence from the learning venue, meaning a widened gap in interacting with other learners and teachers [35].

Many teachers and administrators have a negative attitude [41] towards the latest technology; they also consider it as an extra workload and source of stress [5], are afraid of learning and using digital technologies [42] and finally, they also think that they do not have sufficient time for learning the latest technologies [43]. The teachers also reported the limited scope of deliverable content [5] while the learners found difficulties communicating with teachers, leading them toward the low level of confidence in their skills, and capacity [35].

The negative impacts of the digital divide on education

The digital divide is itself one kind of wall between the privileged and deprived groups of stakeholders in educational sectors and practice. There are many negative effects of the digital divide on teaching and learning activities directly, indirectly, socially, emotionally, personally, and academically. The current study aimed to draw the factors and negative impacts of the digital divide on the stakeholders as subtly as possible. The extensive analysis and synthesis of the included studies led to the finding of numerous factors, causes, and forms of the digital divide directly or indirectly in the field of teaching and learning. Similarly, this study also found negative impacts of DD on the educational practice as a whole and on the individuals involved in the education sector personally, such as teachers and students.

The biggest negative impact of the digital divide is that it creates increased inequality, inequity, and disparity among the stakeholders from different aspects [55]-[61]. Similarly, it further increases the gap and leads to more inequality and disparity between people of different socioeconomic statuses [5]. The current study also found that the people who live outside of urban areas suffer from various problems, from the lack of required devices to the Internet, which leads to a big gap between urban stakeholders and remote dwellers in terms of skills, competence, confidence, etc. [30], [31]. It creates an even more significant gap in terms of socioeconomic consideration, leading to disparity [9], racial disparity [5], gap in academic achievement [35], increases the interaction gap [5] and increases gap in achieving professional and technical skill [29].

As a result, many vulnerable learners face extreme levels of difficulty in continuing their education with a lot of technical problems and deprived conditions; hence, they also feel psychologically down and lose their hope and energy, leading them finally to drop out of the course [30]. As the engagement gets broken due to unequal access to lessons and educational activities, it increases the gap in communication skills [33] and professional networking [9] and leads to poor relations between students and teachers among students themselves [62]-[67]. DD makes inclusive education almost impossible for disabled people as they cannot function themselves, and most of the online platforms are not suitable for inclusive education [5]. Additionally, the students and teachers feel unnecessarily imposed and irritated with something that they do not want to adopt and learn [30], which leads to demotivation in using digital devices [35]. Even though they want to adopt, they procrastinate using these latest technologies [68]-[71].

The current study has tried to maintain all the possible criteria according to the PRISMA protocols, regulations, academic fashion, integrity, technique, and tools throughout all the stages from the beginning to the end of the study. The endeavor of finding more sound literature was constant, and one of the stringent focuses following the PRISMA Statements, protocols, and academic inquiries underpinned in the study. However, there still might be the least possibility of bias in the literature selection due to multiple reasons, such as the inclusion and exclusion criteria of literature and databases. Additionally, the studies included might have some weaknesses, such as technical and pedagogical shortcomings and the absence of representations of actual data from all the geographical and demographic backgrounds, leading to a difficult stance to generalize the conclusions based on the studied articles and extracted data and insights.

Furthermore, the coding technique applied in this study was manual, based on the themes that evolved from the academic pursuits (research questions) through analysis and synthesis of the included studies. As a result, there might still be some biasedness and a lack of the fullest understanding of the synthesized studies, which means themes and data might be more concrete, numerically accurate, and academically sound compared to the current form of the manuscript, as the human beings are still not beyond biasedness, even the least. Other than the mentioned possible weaknesses, the current study has many strong aspects that should be expected to meet the academic standards to provide academically sound, insightful, thought-provoking, and sufficiently detailed information and guidelines to the readers regarding this field of research. Finally, the current study can be one of the methodologically conducted systematic literature and meta-analyses on the forms, benefits, and negative impacts of the digital divide in educational practice that show the research gaps, recommendations, and future research direction.

4. CONCLUSION

This study concludes that while the rapid integration of digital and communication technologies has transformed educational practices and opened wide opportunities for innovation in teaching and learning, the

digital divide remains a major barrier that limits the equitable realization of these benefits. The findings reveal that the digital divide in education is shaped by a complex interaction of external and internal factors. External factors—such as limited access to digital devices, unstable internet connectivity, poor socio-economic conditions, inadequate infrastructure, geographical constraints, and insufficient institutional and governmental support—largely lie beyond the immediate control of learners and educators. At the same time, internal factors—including limited digital skills, low technological confidence, negative attitudes toward technology, increased workload, lack of time, and resistance to change—further deepen disparities in technology use and learning participation. Together, these factors create a persistent gap between stakeholders who can effectively utilize educational technologies and those who remain excluded. The study also confirms that the digital divide offers almost no meaningful advantages in educational contexts, while its negative impacts are extensive and multidimensional. These impacts include widening achievement gaps, reduced student engagement, weak teacher–student interaction, poor knowledge retention, increased dropout rates, limited development of digital competencies, and growing socio-economic inequalities at both local and global levels. Over time, these conditions foster frustration, psychological resistance, and negative perceptions of technology among disadvantaged groups, reinforcing a cycle of exclusion and underutilization of digital learning opportunities.

The implications of these findings are significant for educational policy and practice. Governments and educational authorities must prioritize inclusive digital policies that ensure equitable access to infrastructure, affordable internet, and learning resources, particularly for marginalized communities. Schools and institutions should invest in systematic capacity-building programs to strengthen digital skills, confidence, and pedagogical competence among teachers and learners. At the classroom level, educators need to adopt flexible, supportive, and context-sensitive approaches that reduce technological anxiety and encourage gradual, meaningful engagement with digital tools. Families and communities also play a crucial role in supporting learners' access and motivation. Overall, addressing the digital divide requires coordinated, multi-stakeholder efforts that go beyond technological provision to include social, psychological, and pedagogical dimensions. By actively reducing these barriers, education systems can better harness technology as a tool for inclusion, quality improvement, and sustainable educational development.

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CONFLICTS OF INTEREST

The author(s) declare no conflict of interest.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

The authors declare that no artificial intelligence (AI) tools were used in the generation, analysis, or writing of this manuscript. All aspects of the research, including data collection, interpretation, and manuscript preparation, were carried out entirely by the authors without the assistance of AI-based technologies.

REFERENCES

[1] K. Ratheeswari, "Information communication technology in education," *Journal of Applied and Advanced research*, vol. 3, no. 1, pp. 45-47, 2018, doi: 10.21839/jaar.2018.v3S1.169.

[2] T. Tanti, D. A. Kurniawan, K. Kuswanto, W. Utami, and I. Wardhana, "Science process skills and critical thinking in science: Urban and rural disparity," *Jurnal Pendidikan IPA Indonesia*, vol. 9, no. 4, pp. 489-498, 2020, doi: 10.15294/jpii.v9i4.24139.

[3] L. I. González-Pérez, and M. S. Ramírez-Montoya, "Components of education 4.0 in 21st century skills frameworks: Systematic review," *Sustainability*, vol. 14, no. 3, pp. 1493, 2022, doi: 10.3390/su14031493.

[4] M. Badiuzzaman, M. Rafiquzzaman, M. I. I. Rabby, and M. M. Rahman, "The latent digital divide and its drivers in e-learning among Bangladeshi students during the COVID-19 pandemic," *Information*, vol. 12, no. 8, pp. 287, 2021, doi: 10.3390/info12080287.

[5] A. R. Golden, E. N. Srisarajivakul, A. J. Hasselle, R. A. Pfund, and J. Knox, "What was a gap is now a chasm: Remote schooling, the digital divide, and educational inequities resulting from the COVID-19 pandemic," *Current Opinion in Psychology*, vol. 52, 2023, doi: 10.1016/j.copsyc.2023.101632.

[6] D. Tiene, "Addressing the global digital divide and its impact on educational opportunity," *Educational Media International*, vol. 39, no. 3-4, pp. 212-222, 2002, doi: 10.1080/09523980210166440.

[7] E. J. García Zare, S. E. Soto Abanto, N. P. Rodriguez Paredes, T. D. R. Merino Salazar, S. E. Pagador Flores, J. L. Baldárrago Baldárrago, and P. I. Mejía Pardo, "Technological devices and digital competences: A look into the digital

divides for university continuity during the COVID-19 Pandemic," *Sustainability*, vol. 15, no. 11, pp. 8494, 2023, doi: 10.3390/su1511849.
[8] P. Giavrimis, "The digital divide: Greek primary teachers' conceptualizations," *Journal of Digital Educational Technology,* vol. 3, no. 2, 2023, doi: 10.30935/jdet/13350.
[9] A. Amirova, K. Nurumov, R. Kasa, A. Akhmetzhanova, and A. Kuzekova, "The impact of the digital divide on synchronous online teaching in Kazakhstan during COVID-19 school closures," In *Frontiers in Education* (Vol. 7, p. 1083651). Frontiers, 2023, doi: 10.3389/feduc.2022.1083651.
[10] P. DiMaggio, E. Hargittai, W. R. Neuman, and J. P. Robinson, "Social implications of the Internet. *Annual Review of Sociology*, vol. 27, no. 1, pp. 307-336, 2001, doi: 10.1146/annurev.soc.27.1.307.
[11] T. Tanti, D. Darmaji, A. Astalini, D. A. Kurniawan, and M. Iqbal, "Analysis of user responses to the application of web-based assessment on character assessment," *Journal of education technology*, vol. 5, no. 3, pp. 356-364, 2021, doi: 10.23887/jet.v5i3.33590.
[12] UNESCO, *COVID-19 Impact on Education*, 2022. https://en.unesco.org/themes/education-emergencies/ coronavirus-school-closures. Accessed 20 May 2020
[13] A. J. Van Deursen, and J. A. van Dijk, "IQ and digital inequality: An empirical investigation," *new media & society*, vol. 25, no. 6, pp. 1248-1270, 2023, doi: 10.1177/14614448211024012.
[14] O. B. Azubuike, O. Adegboye, and H. Quadri, "Who gets to learn in a pandemic? Exploring the digital divide in remote learning during the COVID-19 pandemic in Nigeria," *International Journal of Educational Research Open*, vol. 2, pp. 100022, 2021, doi: 10.1016/j.ijedro.2020.100022.
[15] S. M. González-Betancor, A. J. López-Puig, and M. E. Cardenal, "Digital inequality at home. The school as compensatory agent," *Computers & Education*, vol. 168, pp. 104195, 2021, doi: 10.1016/j. compedu.2021.104195.
[16] S. Jamil, "From digital divide to digital inclusion: Challenges for wide-ranging digitalization in Pakistan," *Telecommunications Policy*, vol. 45, pp. 102206, 2021, doi: 10.1016/j.telpol.2021.102206.
[17] M. J. Koehler, T. S. Shin and P. Mishra "How do we measure TPACK? Let me Count the Ways," *Educational Technology, Teacher Knowledge, and Classroom Impact: A Research Handbook on Frameworks and Approaches*: IGI Global, 2012, doi: 10.4018/978-1-60960-750- 0.ch002.
[18] G. Hartviksen, S. Akselsen, and A. K. Eidsvik, "MICTS: municipal ICT schools – a means for bridging the digital divide between rural and urban communities," *Educ. Inf. Technol*, vol. 7, pp. 93–109, 2022, doi: 10.1023/A:1020349509331.
[19] J. A. G. M. Van Dijk, "Digital divide: Research, achievements and shortcomings. *Poetics*, vol. 34, pp. 221–235, 2006, doi: 10.1016/j.poetic.2006.05.004.
[20] M. Ragnedda, and H. Kreitem, "The three levels of digital divide in east EU countries," *J. Russ. Med. J. Stud*, vol. 5, pp. 5–26, 2018, doi: 10.30547/worldofmedia.4.2018.1.
[21] K. Ercikan, M. Asil, and R. Grover, "Digital divide: A critical context for digitally based assessments," *Education Policy Analysis Archives*, vol. 26, no. 51, pp. 1-24, 2018, doi: 10.14507/epaa.26.3817.
[22] S. Agyapong, S. Asare, P. Essah, L. Heady, and G. Munday, "Learning in crisis: COVID-19 pandemic response and lessons for students, faculty, and Vice Chancellors in sub-Saharan Africa," *Education sub-Saharan Africa (ESSA)*, 2020.
[23] F. Ballesta Pagán, J. Lozano Martínez, and M. Cerezo Máiquez, "Internet use by secondary school students: A digital divide in sustainable societies?," *Sustainability*, vol. 10, no. 10, pp. 3703, 2018, doi: 10.3390/su10103703.
[24] K. Barzilai-Nahon, "Gaps and bits: Conceptualizing measurements for digital divide/s," *The Information Society*, vol. 22, no. 5, pp. 269-278, 2006, doi: 10.1080/019722406009039_53.
[25] Devisakti, A., Muftahu, M., & Xiaoling, H. (2023). Digital divide among B40 students in Malaysian higher education institutions. *Education and Information Technologies*, vol. 29, no. 2, pp. 1857-1883, 2023, doi: 10.1007/s10639-023-11847-w
[26] C. K. Sanders and E. Scanlon, "The digital divide is a human rights issue: Advancing social inclusion through social work advocacy," *Journal of Human Rights and Social Work*, vol. 6, no. 2, pp. 130–143, 2021, doi: 10.1007/s41134-020-00147-9.
[27] M. A. Ashraf, S. Mollah, S. Perveen, N. Shabnam, and L. Nahar, "Pedagogical applications, prospects, and challenges of blended learning in Chinese higher education: A systematic review," *Frontiers in psychology*, vol. 12, pp. 772322, 2022, doi: 10.3389/fpsyg.2021.772322.
[28] K. Jafar, K. Ananthpur, and L. Venkatachalam, "Digital divide and access to online education: new evidence from Tamil Nadu, India," *Journal of Social and Economic Development*, vol. 25, no. 2, pp. 313-333, 2023, doi: 10.1007/s40847-023-00236-1.
[29] K. A. Soomro, U. Kale, R. Curtis, M. Akcaoglu, and M. Bernstein, "Digital divide among higher education faculty," *International Journal of Educational Technology in Higher Education*, vol. 17, pp. 1-16, 2020, doi: 10.1186/s41239-020-00191-5.
[30] A. T. Odularu, X. Khalo, N. F. Mashiyi, and M. B. Nkohla, "Exploring COVID-19 Pandemic Impact, Online Engagement, and Digital Divide on Disadvantaged Undergraduate Students in South African Universities, 2023, doi: 10.20944/preprints202305.0573.v1.
[31] S. Choudhury, C. Senapati, and N. N. Sarma, "Management education in technology-mediated ODL platform–implications for educators in context of shifting learning path and digital divide," *Asian Association of Open Universities Journal*, vol. 18, no. 2, pp. 144-159, 2022, doi: 10.1108/AAOUJ-08-2022-0117.
[32] D. Baidoo-Anu, K. Gyamerah, and M. Munezhi, "Digital divide in higher education in Sub-Saharan Africa: evidence from online learning during the COVID-19 pandemic," *SN Social Sciences*, vol. 3, no. 8, pp. 122, 2023, doi: 10.1007/s43545-023-00717-4.

[33] R. P. Baral, "The digital divide in online learning: A case study of university students in Nepal," *Prithvi Academic Journal*, pp. 88-99, 2022, doi: 10.3126/paj.v5i1.45043.
[34] A. Ben Youssef, M. Dahmani, and L. Ragni, "ICT use, digital skills and students' academic performance: Exploring the digital divide," *Information*, vol. 13, no. 3, pp. 129, 2022, doi: 10.3390/info13030129.
[35] S. Nkoala, and T. Matsilele, "The influence of the digital divide on emergency remote student-centred learning during the COVID-19 pandemic: a case study of journalism education," *SN Social Sciences*, vol. 3, no. 3, pp. 47, 2023, doi: 10.1007/s43545-023-00626-6.
[36] A. Mathrani, T. Sarvesh, and R. Umer, "Digital divide framework: online learning in developing countries during the COVID-19 lockdown," *Globalisation, Societies and Education*, vol. 20, no. 5, pp. 625-640, 2022, doi: 10.1080/14767724.2021.1981253.
[37] R. López-Montero, A. Delgado-Baena, R. Vela-Jiménez, and A. Sianes, "Digital Borders: The impact of the digital divide in the educational process of minor migrants living in marginalized urban areas," In *INTED2021 Proceedings* (pp. 5231-5239). IATED, 2021, doi: 10.21125/inted.2021.1071.
[38] G. Chisango, and N. Marongwe, "The digital divide at three disadvantaged secondary schools in Gauteng, South Africa," *Journal of Education (University of KwaZulu-Natal)*, vol. 82, pp. 149-165, 2021, doi: 10.17159/2520-9868/i82a09.
[39] R. Lembani, A. Gunter, M. Breines, and M. T. B. Dalu, "The same course, different access: the digital divide between urban and rural distance education students in South Africa," *Journal of geography in higher education*, vol. 44, no. 1, pp. 70-84, 2020, doi: 10.1080/03098265.2019.1694876.
[40] B. Nanthakorn, P. Ractham, and L. Kaewkitipong, "Double burden: Exploring the digital divide in the Burmese educational system following the 2021 coup d'etat and the COVID-19 pandemic," *Computers in Human Behavior Reports*, vol. 11, 2023, doi: 10.1016/j.chbr.2023.100310.
[41] C. M. Azionya, and A. Nhedzi, "The digital divide and higher education challenge with emergency online learning: Analysis of tweets in the wake of the COVID-19 lockdown," *Turkish Online Journal of Distance Education*, vol. 22, no. 4, pp. 164-182, 2021, doi: 10.17718/tojde.1002822.
[42] M. A. Makumane, and C. B. Mpungose, "Digital divide: Secondary school learners' experiences of using educational technologies," *Alternation*, vol. 39, 2022, doi: 10.29086/2519-5476/2022/sp39a10.
[43] T. Leshkevich, "The "Digital Divide" as a feature of the modern educational process: Ambivalent assessments. In *International Conference on Education Studies: Experience and Innovation (ICESEI 2020)* (pp. 1-4). Atlantis Press, 2022, doi: 10.2991/assehr.k.201128.001.
[44] E. Kormos, and K. Wisdom, "Digital divide and teaching modality: It's role in technology and instructional strategies," *Education and Information Technologies*, vol. 28, no. 8, pp. 9985-10003, 2023, doi: 10.1007/s10639-022-11488-5.
[45] L. Yajie, H. Liu, and M. Gaoming, "Widening digital divide: Family investment, digital learning, and educational performance of chinese high school students during the COVID-19 pandemic school closures," *Applied Research in Quality of Life*, vol. 18, no. 5, pp. 2397-2413, 2023, doi: 10.1007/s11482-023-10191-y.
[46] E. T. Woldegiorgis, "Mitigating the digital divide in the South African higher education system in the face of the Covid-19 pandemic," *Perspectives in Education*, vol. 40, no. 3, pp. 197-211, 2022, doi: 10.18820/2519593X/pie.v40.i3.13.
[47] A. Kuhn, A. Schwabe, H. Boomgarden, L. Brandl, G. Stocker, G. Lauer, ... and M. Krause-Wolters, "Who gets lost? How digital academic reading impacts equal opportunity in higher education," *New Media & Society*, vol. 26, no. 2, pp. 1034-1055, 2024, doi: 10.1177/14614448211072.
[48] M. B. Gulain, B. N. Justin, and S. W. Expedit, "The impact of the digital divide on higher and university education sector performance," *Open Journal of Social Sciences*, vol. 10, 22-30, 2022, doi: 10.4236/jss.2022.1010003.
[49] H. Norman, N. H. Adnan, N. Nordin, M. Ally, and A. Tsinakos, "The educational digital divide for vulnerable students in the pandemic: Towards the New Agenda 2030," *Sustainability*, vol. 14, no. 16, pp. 10332, 2022, doi: 10.3390/su141610332.
[50] S. T. Faloye, and N. Ajayi, "Understanding the impact of the digital divide on South African students in higher educational institutions," *African Journal of Science, Technology, Innovation and Development*, vol. 14, no. 7, pp. 1734-1744, 2022, doi: 10.1080/20421338.2021.1983118.
[51] S. Surianshah, "Digital divide in education during COVID-19 pandemic," *Jurnal Ekonomi Malaysia*, vol. 55, no. 4, pp. 103-112, 2021, doi: 10.17576/JEM-2021-5503-07.
[52] A. Saha, A. Dutta, R. I. Sifat, "The mental impact of digital divide due to COVID-19 pandemic induced emergency online learning at undergraduate level: Evidence from undergraduate students from Dhaka City," *Journal of Affective Disorders*, vol. 294, pp. 170-179, 2021, doi: 10.1016/j.jad.2021.07.045.
[53] A. Hosszu, and C. Rughiniș, "Digital divides in education. An analysis of the Romanian public discourse on distance and online education during the COVID-19 pandemic," *Sociologie Românească*, vol. 18, no. 2, pp. 11-39, 2020, doi: 10.33788/sr.18.2.1
[54] H. Wordu, "Digital divide among teachers in urban and rural secondary schools in Rivers State, Nigeria," *International Journal of Innovative Education Research*, vol. 8, no. 3, pp. 54-62, 2020.
[55] A. Imran, "Why addressing digital inequality should be a priority," *The Electronic Journal of Information Systems in Developing Countries*, vol. 89, no. 4, pp. 12255, 2023, doi: 10.1002/isd2.12255.
[56] P. Rydzewski, "Digital inequality and sustainable development," *Problemy Ekorozwoju*, vol. 20, no. 1, pp. 96-108, 2025, doi: 10.35784/preko.6691.
[57] V. M. Gallegos-Rejas, E. E. Thomas, J. T. Kelly, and A. C. Smith, "A multi-stakeholder approach is needed to reduce the digital divide and encourage equitable access to telehealth," *Journal of Telemedicine and Telecare*, vol. 29, no. 1, pp. 73-78, 2023, doi: 10.1177/1357633X221107995.

[58] S. Lythreatis, S. K. Singh, and A. N. El-Kassar, "The digital divide: A review and future research agenda," *Technological Forecasting and Social Change*, vol. 175, pp. 121359, 2022, doi: 10.1016/j.techfore.2021.121359.
[59] A. Cheshmehzangi, T. Zou, Z. Su, and T. Tang, "The growing digital divide in education among primary and secondary children during the COVID-19 pandemic: An overview of social exclusion and education equality issues," *Journal of Human Behavior in the Social Environment*, vol. 33, no. 3, pp. 434-449, 2023, doi: 10.1080/10911359.2022.2062515.
[60] A. Osonuga, A. A. Osonuga, S. C. Fidelis, G. C. Osonuga, J. Juckes, and D. B. Olawade, "Bridging the digital divide: artificial intelligence as a catalyst for health equity in primary care settings," *International Journal of Medical Informatics*, vol. 204, pp. 106051, 2025, doi: 10.1016/j.ijmedinf.2025.106051.
[61] A. S. George, "Bridging the digital divide: Understanding the human impacts of digital transformation," *Partners Universal International Innovation Journal*, vol. 2, no. 3, pp. 1-34, 2024, doi: 10.5281/zenodo.11287684.
[62] F. Huang, Y. Wang, and H. Zhang, "Modelling generative ai acceptance, perceived teachers' enthusiasm and self-efficacy to english as a foreign language learners' well-being in the digital era," *European Journal of Education*, vol. 59, no. 4, pp. 12770, 2024, doi: 10.1111/ejed.12770.
[63] T. D. Pham Thi, and N. T. Duong, "Investigating learning burnout and academic performance among management students: A longitudinal study in English courses," *BMC psychology*, vol. 12, no. 1, pp. 219, 2024, doi : 10.1186/s40359-024-01725-6.
[64] G. Lu, K. Xie, and Q. Liu, "What influences student situational engagement in smart classrooms: Perception of the learning environment and students' motivation," *British Journal of Educational Technology*, vol. 53, no. 6, pp. 1665-1687, 2022, doi: 10.1111/bjet.13204.
[65] L. Scheel, G. Vladova, and A. Ullrich, "The influence of digital competences, self-organization, and independent learning abilities on students' acceptance of digital learning," *International journal of educational technology in higher education*, vol. 19, no. 1, pp. 44, 2022, doi: 10.1186/s41239-022-00350-w.
[66] W. Lei, X. Wang, D. Y. Dai, X. Guo, S. Xiang, and W. Hu, "Academic self-efficacy and academic performance among high school students: A moderated mediation model of academic buoyancy and social support," *Psychology in the Schools*, vol. 59, no. 5, pp. 885-899, 2022, doi: 10.1002/pits.22653.
[67] C. D. Robinson, "A framework for motivating teacher-student relationships," *Educational Psychology Review*, vol. 34, no. 4, pp. 2061-2094, 2022, doi: 10.1007/s10648-022-09706-0.
[68] A. Johri, and A. Hingle, "Students' technological ambivalence toward online proctoring and the need for responsible use of educational technologies," *Journal of Engineering Education*, vol. 112, no. 1, pp. 221-242, 2023, doi: 10.1002/jee.20504
[69] S. Yao, J. Lu, H. Wang, J. J. W. Montgomery, T. Gorny, and C. Ogbonnaya, "Excessive technology use in the post-pandemic context: How work connectivity behavior increases procrastination at work," *Information Technology & People*, vol. 37, no. 2, pp. 583-604, 2024, doi: 10.1108/ITP-08-2022-0573.
[70] A. Przepiorka, A. Blachnio, and A. Cudo, "Procrastination and problematic new media use: the mediating role of future anxiety," *Current Psychology*, vol. 42, no. 7, pp. 5169-5177, 2023, doi: 10.1007/s12144-021-01773-w.
[71] D. Pérez-Jorge, A. C. Hernández-Henríquez, R. Melwani-Sadhwani, and A. F. Gallo-Mendoza, "Tomorrow never comes: the risks of procrastination for adolescent health," *European Journal of Investigation in Health, Psychology and Education*, vol. 14, no. 8, pp. 2140-2156, 2024, doi: 10.3390/ejihpe14080143.