

Digital Divide in Achieving Equitable Education Access in the Digital Transformation Era

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ABSTRACT

Digital transformation has created significant opportunities to improve the quality and accessibility of education while also generating challenges related to the digital divide that may reinforce educational inequalities. This article aims to analyze the phenomenon of the digital divide in education and identify strategies for achieving equitable education access in the digital transformation era. This study employed a literature review method by analyzing scientific publications and international institutional reports published over the last five years. The findings indicate that the digital divide in education is a multidimensional issue involving disparities in digital infrastructure, technological devices, digital competencies, technology utilization, and learning outcomes. Addressing these challenges requires a comprehensive approach through strengthening digital infrastructure, improving educators' and students' digital competencies, enhancing digital literacy, providing quality digital learning resources, and implementing inclusive educational policies. Digital transformation in education should not merely focus on increasing technology adoption but must prioritize the development of an equitable, sustainable, and inclusive education system that ensures equal learning opportunities for all students. Therefore, digital equity becomes a fundamental principle in achieving meaningful educational transformation in the contemporary digital era.

Keywords: *Digital Divide, Digital Education, Digital Literacy, Digital Transformation, Education Access.*

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1. | INTRODUCTION

Digital transformation has brought significant changes to the delivery of education at various levels. The use of digital technology is no longer seen as a complement to the learning process, but has become an integral part of supporting teaching and learning activities, education management, and competency development of 21st century students. The development of information and communication technology allows the creation of more flexible, collaborative, and student-centered learning through the use of various digital platforms, open learning resources, and interactive learning media. On the other hand, this transformation also shows a new challenge in the form of a digital divide that has the potential to widen the inequality of access to education if it is not balanced with inclusive and sustainable policies (UNESCO, 2021; OECD, 2021; UNESCO, 2023).

The acceleration of education digitalization is increasingly evident after the COVID-19 pandemic which has encouraged educational institutions around the world to adopt technology-based learning in a relatively short time. These changes show that technology has a strategic role in maintaining the continuity of the learning process when face-to-face learning cannot be implemented. However, this experience also shows that not all students, educators, and educational institutions have the same level of digital readiness. Differences in device availability, internet access, digital competence, and learning environment support cause the benefits of digital transformation to not be felt equally by all community groups (World Bank, 2021; UNICEF, 2021; UNESCO, 2021).

The digital divide in the education sector is no longer understood only as a problem of limited access to internet networks or technological devices. Recent research shows that the digital divide has more complex dimensions, including the ability of individuals to use technology effectively, the quality of technology use to support the learning process, and the ability to derive real benefits from the use of technology. Thus, individuals who have access to digital devices do not necessarily get equal learning opportunities if digital competence and the quality of their use are still low. This perspective expands the understanding that the equitable distribution of digital education must include the dimensions of access, skills, use, and outcomes obtained from the use of educational technology (van de Werfhorst et al., 2022; Norman et al., 2022; ITU, 2023).

In the context of 21st century education, equal access to education is one of the important prerequisites in realizing an inclusive and equitable education system. Equal access to digital technology provides opportunities for students to obtain wider learning resources, improve learning interactions, develop critical thinking skills, and build digital competencies needed in the future. On the other hand, the digital divide has the potential to create inequality in the quality of learning, widen the gap in academic achievement, and hinder the achievement of educational development goals that are

oriented towards equitable distribution of learning opportunities for all students (OECD, 2023; UNESCO, 2023; World Bank, 2021).

Various international organizations place equal access to educational technology as one of the priority agendas in the transformation of global education. UNESCO (2023) emphasized that the use of technology must be oriented towards improving the quality of learning and equitable access to education, not just expanding the use of digital devices. In line with that, the OECD (2023) emphasizes that the effectiveness of digital transformation is greatly influenced by the readiness of the education system in building educators' digital competencies, providing adequate infrastructure support, and ensuring that all students have the same opportunity to utilize technology in the learning process. Meanwhile, ITU (2023) shows that the improvement of digital connectivity is still faced with gaps in access and service quality that have implications for the equitable use of educational technology.

Empirical findings also show that the digital divide is influenced by various interrelated factors, including socioeconomic conditions, the availability of technological infrastructure, ownership of digital devices, digital literacy competencies, and the support of educational institutions. Research by Gu (2021) shows that family conditions also affect students' ability to access online learning optimally. In addition, research on the digital readiness of students and schools indicates that differences in the level of technological readiness are one of the factors that determine the quality of digital-based learning experiences (van de Werfhorst et al., 2022). Therefore, efforts to reduce the digital divide cannot be done only through the provision of infrastructure, but also require strengthening the capacity of human resources, developing digital literacy, and education policies that are able to ensure the sustainability of digital transformation inclusively.

Sustainable digital transformation also requires a paradigm shift in the implementation of education. The main focus is no longer only on the provision of technology, but on how it is able to improve the quality of learning, expand learning opportunities, and support the achievement of better learning outcomes. In this context, the concept of digital equity is becoming increasingly important because it emphasizes that every student must have the same opportunity to access, use, and benefit from educational technology without being influenced by social, economic, or other characteristics. Therefore, the success of digital transformation cannot be measured only by the level of technology adoption, but also by the extent to which technology is able to reduce educational inequality and create a more inclusive learning experience (Msila et al., 2021; UNESCO, 2021; OECD, 2021).

In addition to the access aspect, the digital competence of educators and students is a fundamental factor in realizing the equitable distribution of technology-based education. Mastery of digital literacy allows educators to design innovative, interactive, and student-centered learning, while learners can use technology critically, creatively, and responsibly. Digital competency frameworks such as the Digital Competence of

Educators (DigCompEdu) have been widely used as a reference in increasing the capacity of educators to integrate technology into learning practices effectively. The development of these competencies is becoming increasingly relevant because the challenge of digital education is not only related to the ability to operate devices, but also the ability to select, evaluate, and utilize digital information appropriately to support a meaningful learning process (Redecker, 2017; DigCompEdu Expert Group, 2020; UNESCO, 2023).

In addition to individual competencies, the success of equitable access to digital education is also influenced by institutional support and adaptive education policies. Educational institutions need to build a digital ecosystem that supports collaboration, innovation, and sustainable use of technology. Equity-oriented policies need to integrate the provision of infrastructure, strengthening the capacity of educators, developing digital learning resources, and an evaluation system that is able to identify groups of students who are still experiencing obstacles in accessing educational services. A comparative analysis conducted by Msila et al. (2021) shows that various international organizations have different approaches to encouraging the digitalization of education, but all of them place equitable access and strengthening the quality of learning as the main goals of digital transformation.

A number of studies also show that the digital divide has long-term implications for the quality of human resources. Norman et al. (2022) emphasized that groups of students who are in vulnerable conditions tend to experience greater obstacles in obtaining benefits from digital learning if they are not supported by inclusive policies. These findings are reinforced by Akpan et al. (2024) who explain that gaps in technology access, quality of digital learning systems, and readiness of educational institutions are still major challenges in various developing countries. In fact, a study published in PLOS ONE shows that the digital divide in education can strengthen social inequality if not followed by a comprehensive equity strategy, so access to technology needs to be seen as part of efforts to create educational justice in a sustainable manner (PLOS ONE, 2023).

The rapid development of digital technology, including the emergence of artificial intelligence, learning analytics, and open learning resources, basically provides a great opportunity to expand access to education. However, these opportunities also present new challenges related to human resource readiness, technology utilization ethics, data protection, and digital competency gaps. UNESCO (2023) through the guidelines for the use of Generative Artificial Intelligence in education emphasizes that the implementation of technology must remain oriented towards the principles of inclusivity, equity, and improving the quality of learning. Thus, technological innovation should be an instrument to strengthen the equitable distribution of education, not create new forms of inequality in the education system.

Based on various empirical findings and policy developments, it can be understood that the digital divide is a multidimensional issue that requires a comprehensive

approach through synergy between the provision of infrastructure, strengthening digital competence, developing digital literacy, supporting educational institutions, and public policies oriented towards equitable access to education. Therefore, this article aims to comprehensively analyze the relationship between the digital divide and equitable access to education in the perspective of digital transformation. The analysis is focused on identifying the factors that influence the occurrence of the digital divide, its impact on the equitable distribution of learning opportunities, and various strategies that can be applied to realize a more inclusive, adaptive, and sustainable education system in the digital era. The results of this study are expected to make a conceptual contribution to the development of educational policies and practices that support the creation of equitable access to education through the effective and equitable use of digital technology.

2. | RESEARCH METHOD

This research uses a library research method with a descriptive-qualitative approach to obtain a comprehensive understanding of the digital divide and equitable access to education in the era of digital transformation. Literature studies were chosen because they allow researchers to collect, review, compare, and synthesize various scientific findings that have been published, so that a complete picture of the development of concepts, causal factors, impacts, and strategies in overcoming the digital divide in the field of education is obtained. This approach is also appropriate for identifying trends in the results of cutting-edge research while crafting conceptual arguments based on credible scientific evidence. Through the analysis of various literature sources, this study seeks to produce a systematic understanding of the relationship between digital transformation and equitable access to education without collecting direct field data.

The source of research data is in the form of secondary data derived from scientific articles, books, proceedings, reports of international organizations, and policy documents relevant to the focus of the research. All references used are limited to publications from the last five years to align with the latest developments in educational digitalization and remain relevant to the context of scientific publications. The literature was obtained through searching on scientific databases indexed in Google Scholar using keywords such as digital divide, digital equity, digital education, educational technology, digital literacy, education access, and education transformation. In addition, this study also utilizes official reports from UNESCO, OECD, World Bank, ITU, and UNICEF as the main reference sources because these institutions consistently publish empirical reports on the development of digital transformation and equitable education at the global level.

The literature selection process is carried out through several stages, namely identification, screening, feasibility assessment, and determination of sources to be analyzed. At the identification stage, all literature that corresponds to the research

keywords is collected. The next stage is screening based on the suitability of the title, abstract, scope of discussion, and year of publication. Furthermore, an assessment of the quality of sources is carried out by considering the reputation of the journal, relevance of substance, credibility of the author, and direct relevance to the issue of digital divide and equal access to education. Literature that has no direct relationship to the research objectives or is outside the established age range is not included in the analysis process. Through this stage, reference sources that have high validity and relevance are obtained so that they can support the preparation of comprehensive discussions.

Data analysis is carried out using content analysis techniques through the process of critical reading, grouping information based on themes, comparing research results, identifying patterns of interdependency between variables, and synthesizing various findings into a complete conceptual framework. The analysis focuses on four main aspects, namely the concept of digital divide in education, factors that affect equitable access to education, the impact of digital divide on learning quality, and strategies that can be applied to realize inclusive and equitable digital education. Furthermore, the results of the synthesis of various references are analyzed descriptively to find similarities, differences, and thought developments from various previous studies so that conclusions based on the latest scientific evidence are obtained. With this approach, this research is expected to be able to provide a comprehensive conceptual overview of the importance of strengthening equitable access to education through digital transformation that is oriented towards improving the quality of learning, developing digital competencies, and the sustainability of the education system in the digital era.

3. | RESULTS AND DISCUSSION

Digital transformation has changed the paradigm of education delivery from a classroom-centered learning system to a more flexible, adaptive, and supported learning by digital technology. These changes allow the learning process to take place without being limited by space and time through the use of various learning platforms, digital learning resources, interactive media, and learning management systems that support collaboration between educators and students. Digitization of education also provides opportunities to improve the quality of learning through the presentation of more varied materials, personalization of the learning process, and expansion of access to various sources of knowledge. However, these benefits cannot be felt equally because there are still gaps in access, competence, and use of technology in the educational environment. This condition shows that digital transformation is not only a matter of technology adoption, but also related to the ability of the education system to ensure equal distribution of learning opportunities for all students (UNESCO, 2023; OECD, 2021; World Bank, 2021).

Based on various studies analyzed, the digital divide is a multidimensional phenomenon that includes more than just limited access to the internet or digital devices. The development of the concept of digital divide shows that there are four

main dimensions that are interrelated, namely access divide, skills divide, usage divide, and outcome divide. In the early stages, individuals or educational institutions may experience limitations in obtaining technological devices and internet connectivity. Once access is available, the next challenge is the ability to use technology effectively to support the learning process. Furthermore, the quality of technology utilization will determine the benefits obtained by students, both in the form of improving learning outcomes, critical thinking skills, and mastery of 21st century competencies. Thus, the equitable distribution of digital education must be understood as an effort to reduce all forms of disparities simultaneously so that every student has equal learning opportunities (van de Werfhorst et al., 2022; Norman et al., 2022; ITU, 2023).

The results of the synthesis of various studies show that digital infrastructure is still a fundamental factor that affects the equitable distribution of access to education. The availability of a stable internet network, adequate learning tools, and information technology support are prerequisites for the effective implementation of digital learning. Although the development of digital infrastructure has increased in recent years, its distribution has not been completely evenly distributed, so there are still groups of students who experience obstacles in accessing technology-based education services. This condition not only affects the continuity of learning, but also limits the opportunity for students to take advantage of the various digital learning resources that are widely available. Therefore, digital infrastructure development needs to be seen as a long-term investment in supporting equitable distribution of education and improving the quality of human resources (ITU, 2023; OECD, 2023; World Bank, 2021).

In addition to infrastructure, the ownership and availability of digital devices also determine the success of the implementation of technology-based learning. Devices such as computers, laptops, tablets, and smartphones are the main media that allow students to access learning materials, communicate with educators, and participate in various academic activities online. However, device ownership does not always guarantee effective learning if device quality, user capabilities, and learning environment support are still limited. Research by Gu (2021) shows that family conditions, including the availability of devices and learning environments at home, have an influence on the accessibility of digital learning. The findings show that the digital divide is also influenced by socioeconomic factors that have implications for students' ability to utilize technology optimally. Therefore, efforts to equalize access to education require an approach that considers economic, social, and pedagogical aspects in an integrated manner.

Another factor that has a very important role is the digital competence of educators and students. Digital transformation will not result in an improvement in the quality of learning if technology users do not have adequate skills to integrate technology into teaching and learning activities. Digital competence includes the ability to search, evaluate, manage, create, and communicate information through digital media effectively, ethically, and responsibly. In the context of education, these competencies

are the basis for educators to design innovative learning strategies while guiding students in utilizing technology as a means of learning. The DigCompEdu framework emphasizes that the development of educators' digital competencies must include pedagogical, professional, evaluative, and student empowerment aspects so that the use of technology is truly able to improve the quality of learning (DigCompEdu Expert Group, 2020; Redecker, 2017; UNESCO, 2023).

Furthermore, various studies show that digital literacy has a close relationship with equal distribution of learning opportunities. Digital literacy is not only related to technical abilities in operating devices, but also includes the ability to think critically, evaluate the credibility of information, maintain digital security, and use technology creatively to solve problems. Students who have a good level of digital literacy tend to be better able to utilize various digital learning resources independently, collaborate in online learning environments, and develop lifelong learning skills. On the other hand, low digital literacy can cause students to have difficulties in accessing valid information, utilizing learning platforms effectively, and adapting to changing technological developments. Therefore, the development of digital literacy needs to be an integral part of the education equity strategy because it directly contributes to improving the quality of learning and strengthening the capacity of students in facing the challenges of the digital era (UNICEF, 2021; UNESCO, 2021; Alamprese, 2024).

The success of digital transformation in education is also greatly influenced by the ability of educational institutions to build a learning ecosystem that is adaptive to technological developments. The ecosystem includes not only the availability of hardware and software, but also educational leadership, organizational culture, educator professional development, technical support, and ongoing evaluation mechanisms. Educational institutions that are able to integrate all of these components tend to be better prepared to face changes and more effective in reducing barriers to technology implementation. On the other hand, institutions that do not have a structured digital planning often have difficulty in optimizing the use of technology so that the digital divide persists even though basic infrastructure is available. Thus, digital transformation requires systemic changes that involve all elements of education providers, not just the procurement of technological devices (OECD, 2021; Msila et al., 2021; UNESCO, 2023).

The results of the study also show that education policy has a strategic role in determining the success of equitable access to digital education. Effective policies must be able to integrate infrastructure development, improving human resource competencies, developing adaptive curriculum, and providing quality digital learning resources. Various international organizations affirm that the success of education digitalization requires a cross-sectoral approach through collaboration between governments, educational institutions, communities, and the private sector. This synergy is needed to ensure that digital transformation not only improves the efficiency of education delivery, but is also able to reduce the gap in learning opportunities

between groups of students. Therefore, digital education policy formulation should be based on empirical evidence, learner needs, and the principle of fairness so that the benefits of technology can be widely felt (UNESCO, 2021; World Bank, 2021; Msila et al., 2021).

In addition to policy support, the collaboration of various stakeholders is an important factor in realizing equitable access to education. Educators have the responsibility to develop learning strategies that are able to accommodate the diversity of students' abilities in utilizing technology. On the other hand, educational institutions need to provide a learning environment that supports the development of digital competencies through training, mentoring, and the provision of adequate learning facilities. The role of the family also cannot be ignored because parental support for the positive use of technology will affect students' motivation, discipline, and learning independence. This collaboration creates a learning ecosystem that allows all parties to contribute to reducing barriers to access while improving the quality of the technology-based learning process (UNICEF, 2021; Gu, 2021; Norman et al., 2022).

The development of digital technology also opens up opportunities to develop a more flexible and student-centered learning model. The use of learning management systems, open educational resources, video-based learning, digital simulations, and artificial intelligence provides increasingly diverse alternatives to support the learning process. These innovations allow students to learn according to their needs, abilities, and speeds so that learning becomes more personalized. However, the increasingly complex use of technology also requires increasing the capacity of educators to be able to choose technology that suits learning objectives and student characteristics. Therefore, digital transformation needs to be accompanied by the development of digital pedagogical competencies so that technological innovation really provides added value to the quality of learning, not just replacing conventional learning methods (OECD, 2023; UNESCO, 2023; DigCompEdu Expert Group, 2020).

In addition to these various opportunities, the development of digital technology also presents new challenges that need to be anticipated. One of the main challenges is the increasing need for critical thinking skills in filtering information circulating in the digital space. Students are not only required to be able to access information, but also have the ability to evaluate the validity of sources, understand the ethics of using technology, maintain the security of personal data, and use digital media responsibly. This challenge has become increasingly important as artificial intelligence technology has developed that allows for the rapid production of information in various forms. UNESCO (2023) emphasizes that the implementation of technology, including Generative Artificial Intelligence, must be accompanied by strengthening digital literacy, digital ethics, and clear governance so that its use continues to support educational goals. Thus, the development of digital competencies needs to be directed not only at the technical aspect, but also at the formation of a responsible digital character.

Furthermore, the results of Akpan et al.'s (2024) research show that the digital divide is still a big challenge, especially in the education system that is experiencing an acceleration of digital transformation. The difference in the level of technology readiness, the quality of the digital learning system, and the ability of institutions to manage innovation cause the benefits of digitalization to not be optimally felt by all students. The findings are in line with research published in PLOS ONE (2023) which shows that the digital divide can strengthen social inequality if it is not balanced with comprehensive equity policies. Therefore, the digital education development strategy should not only be oriented towards increasing access to technology, but also ensure that all students have the same opportunity to obtain the benefits of quality education through the use of digital technology. This approach is an important foundation in realizing an inclusive, equitable, and sustainable education system in the midst of ongoing technological developments.

The sustainability of digital transformation in education ultimately depends on the ability of the education system to build equity that is not only physical, but also functional. Physical equity is related to the provision of adequate infrastructure, internet connectivity, and digital devices, while functional equity emphasizes the ability of all students and educators to utilize technology to improve the quality of learning. These two aspects must go hand in hand because the provision of technology without strengthening user capacity will not result in significant changes in the quality of education. On the other hand, good digital competence cannot develop optimally if it is not supported by access to adequate facilities and infrastructure. Therefore, the strategy for equitable access to education needs to be designed holistically in order to be able to respond to various dimensions of the digital divide simultaneously (UNESCO, 2021; OECD, 2023; ITU, 2023).

One of the strategies that is considered effective in reducing the digital divide is to strengthen the professional development of educators in a sustainable manner. Rapid technological changes require educators to continue to update their knowledge and skills in order to be able to integrate technology appropriately in the learning process. Professional development programs need to focus not only on the ability to operate digital devices, but also on innovative learning design, digital assessment, utilization of open learning resources, learning data analysis, and the application of technology that is oriented to the needs of students. In this context, the educators' digital competency framework is an important reference for designing a systematic capacity-building program so that educators are able to adapt to technological developments while maintaining the quality of the learning process (Redecker, 2017; DigCompEdu Expert Group, 2020; OECD, 2021).

In addition to increasing the capacity of educators, strengthening students' digital literacy needs to be an integral part of the educational curriculum. Digital literacy is no longer understood as the ability to use technological tools alone, but as a set of competencies that include the ability to search, evaluate, manage, create, and

communicate information responsibly. This ability is very important in forming students who are able to learn independently, think critically, collaborate, and adapt to dynamic technological developments. The UNICEF report (2021) emphasizes that strengthening digital competence from an early age will increase the readiness of the younger generation to face social and economic changes influenced by technological developments. In line with that, Alamprese (2024) explained that the development of digital literacy is one of the important instruments to expand learning opportunities and increase educational inclusion for various community groups.

Another aspect that is no less important is the optimization of the use of quality and easily accessible digital learning resources. Technological developments have made it possible to provide various forms of learning resources, such as digital books, learning videos, interactive simulations, virtual laboratories, massive open online courses (MOOCs), and open educational resources that can be used by educators and students. The availability of these learning resources provides opportunities to enrich the learning experience, increase learning flexibility, and support the application of lifelong learning. However, its use still requires information literacy skills so that students are able to choose sources that are valid, relevant, and in accordance with learning objectives. Therefore, educational institutions need to develop a mechanism for curating digital learning resources while guiding students in using various sources of information critically and ethically (UNESCO, 2023; World Bank, 2021; OECD, 2023).

Based on the overall results of the study, it can be understood that the digital divide is a multidimensional challenge that requires a cross-sectoral and sustainability-oriented approach. Efforts to equalize access to education are not enough to be carried out through the provision of infrastructure or technological devices, but must also be accompanied by strengthening digital competence, increasing digital literacy, developing the capacity of educational institutions, providing quality learning resources, and formulating policies based on the principles of justice and inclusivity. This approach is in line with the direction of global education transformation which places technology as a means to improve the quality of learning while expanding learning opportunities for all students regardless of social, economic, or other characteristics. Thus, equitable access to education in the digital era can only be realized if technological transformation is carried out in a planned, collaborative, and centered manner on the needs of students as the main goal of education development (UNESCO, 2021; UNESCO, 2023; World Bank, 2021).

4. | CONCLUSION

Digital transformation has become one of the main factors that change the paradigm of education delivery towards a more flexible, adaptive, and competency-oriented learning system in the 21st century. However, various studies show that the use of technology in education is still faced with the problem of a multidimensional digital

divide. The gap is not only related to limited access to digital infrastructure and devices, but also includes differences in digital competencies, the quality of technology utilization, and the benefits that students get from the digital-based learning process. This condition has implications for the uneven learning opportunities and the quality of educational services received by each student.

Equitable access to education in the digital era requires a comprehensive approach through synergy between the provision of technological infrastructure, improving the digital competence of educators and students, strengthening digital literacy, developing quality digital learning resources, and supporting policies oriented to the principles of inclusivity and justice. The success of digital transformation is determined not only by the level of technology adoption, but also by the ability of all stakeholders to effectively utilize technology to improve the quality of learning and expand learning opportunities.

Thus, efforts to reduce the digital divide must be an integral part of a sustainable education development strategy. Collaboration between the government, educational institutions, educators, families, and the community is an important factor in building a digital education ecosystem that is inclusive and adaptive to technological developments. Through strengthening the capacity of human resources, responsible use of technology, and policies based on equal access, digital transformation is expected to be able to support the realization of a higher quality, equitable education system, and able to answer the challenges of community development in the digital era.

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The authors declare that there is no conflict of interest.

Ethical Approval and Originality Statement

Ethical approval was obtained for this study. The manuscript represents original work and has not been previously published, nor is it under consideration by another journal.

Data Disclosure Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

REFERENCES

- Akpan, I. J., Offodile, O. F., Akpan, I. J., Offodile, O. F., Akpanobong, A. C., & Kobara, Y. M. (2024, July). A comparative analysis of virtual education technology, e-learning systems research advances, and digital divide in the global south. In *Informatics* (Vol. 11, No. 3, p. 53). MDPI.
- Alamprese, J. A. (2024). Adult learning and education in digital environments: Learning from global efforts to promote digital literacy and basic skills of vulnerable populations. *Adult Learning*, 35(2), 73-81.
- DigCompEdu Expert Group. (2020). *European framework for the digital competence of educators: DigCompEdu*. Joint Research Centre, European Commission. Retrieved November 29, 2024 from <https://share.google/xi0npzshuMpufF1OH>
- Gu, J. (2021). Family conditions and the accessibility of online education: the digital divide and mediating factors. *Sustainability*, 13(15), 8590.
- International Telecommunication Union (ITU). (2023). *Measuring digital development: Facts and figures 2023*. International Telecommunication Union. Retrieved December 12, 2024 from <https://share.google/xdeG5CtuozyY5XzzM5>
- Msila, V. (2021). Digitalization and decolonizing education: A qualitative study of university of south africa (unisa) leadership. *International Journal of Information and Education Technology*, 11(11), 553-560.
- Norman, H., Adnan, N. H., Nordin, N., Ally, M., & Tsinakos, A. (2022). The educational digital divide for vulnerable students in the pandemic: Towards the new agenda 2030. *Sustainability*, 14(16), 10332.
- Organisation for Economic Co-operation and Development. (2021). *OECD digital education outlook 2021: Pushing the frontiers with artificial intelligence, blockchain and robots*. OECD Publishing. Retrieved December 7, 2024 from <https://doi.org/10.1787/589b283f-en>
- Organisation for Economic Co-operation and Development. (2023). *Education at a glance 2023: OECD indicators*. OECD Publishing. Retrieved December 10, 2024 from <https://doi.org/10.1787/e13bef63-en>
- PLOS ONE. (2023). The persistent educational digital divide and its impact on societal inequality. *PLOS ONE*, 18(6), e0286795. Retrieved December 3, 2024 from <https://doi.org/10.1371/journal.pone.0286795>
- Redecker, C. (2017). *European framework for the digital competence of educators: DigCompEdu*.
- UNESCO. (2021). *An ed-tech tragedy? Educational technologies and school closures in the time of COVID-19*. UNESCO. Retrieved December 13, 2024 from <https://share.google/EXKdc5LqKd1MYGZJj>
- UNESCO. (2023). *Global education monitoring report 2023: Technology in education: A tool on whose terms?* UNESCO. Retrieved December 17, 2024 from <https://share.google/aEa6ya9ZUPCngu5NZ>
- UNICEF. (2021). *The state of the world's children 2021: On my mind—Promoting, protecting and caring for children's mental health*. UNICEF. Retrieved December 16, 2024 from <https://share.google/5P7HCRR0QLvUDPfpP>
- Van De Werfhorst, H. G., Kessenich, E., & Geven, S. (2022). The digital divide in online education: Inequality in digital readiness of students and schools. *Computers and education open*, 3, 100100.

- World Bank. (2021). *The state of the global education crisis: A path to recovery*. World Bank, UNESCO, & UNICEF. Retrieved November 25, 2024 from <https://share.google/buTkcrIXAWFCf1cKV>
- World Bank. (2024). *Collapse and recovery: How COVID-19 eroded human capital and what to do about it*. World Bank. Retrieved December 20, 2024 from <https://share.google/Ire9uGqZuiGp4m75T>