

Challenges of Poor Internet Connectivity in Rural Areas and Their Influence on Digital Educational Management in a Higher Education Institution

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ABSTRACT

This study explored the challenges of low internet connectivity and its impact on digital educational management in selected state colleges in a remote area. In particular, it investigated the level of challenges experienced by students regarding internet access, internet speed and stability, affordability of ICT services, and access to digital learning resources, and examined their impact on digital educational management especially in the delivery of teaching and learning, communication and collaboration, access to academic services, and administrative efficiency. A researcher-developed questionnaire was administered to students utilizing a descriptive-correlational research design. Descriptive statistics and multiple linear regression analysis were employed for data analysis. The results showed that students had very high challenges on poor internet connectivity. The most important difficulty was the speed and stability of internet. Furthermore, bad internet connectivity had a strong impact on digital educational management. The report emphasizes the need to develop digital infrastructure and provide fair internet access to improve institutional performance and advance digital transformation in rural higher education institutions.

Keywords: poor internet connectivity, digital educational management, State Colleges rural higher education, digital divide

INTRODUCTION

The fast progress of digital technology has transformed the management of education, enabling institutions to conduct instruction, manage academic records, enable communication and provide student services through digital platforms. Digital educational management has become an important component of the institutional efficacy in higher education, especially in terms of facilitating flexible learning settings and boosting administrative efficiency. But the effectiveness of digital educational management is very dependent on the availability of a stable internet access. Despite great technological advancement, there are still major disparities in internet availability, especially in rural areas where poor broadband infrastructure, unreliable network services, and lack of digital resources continue to restrict educational development. These inequities have increased the digital divide, limiting the extent to which many learners and educational institutions may benefit from digital transformation programs (OECD, 2023; UNESCO, 2024).

One of the most persistent difficulties affecting educational institutions located in rural areas is poor internet connectivity. Limited bandwidth, unreliable internet service and high connectivity costs sometimes impede online education and access to learning management systems, digital communication and administrative processes. International evidences have shown that rural community schools are more likely to lack adequate internet infrastructure as compared to urban schools which limits their ability to provide high-quality instruction and effective educational services. The Organisation for Economic Co-operation and Development (OECD) also notes that poor broadband access remains a fundamental challenge in providing fair digital education and institutional management in geographically remote communities (OECD, 2021, 2023).

Poor internet connectivity is a significant challenge in the effective digital educational management of State Universities and Colleges (SUCs) – particularly those serving geographically dispersed and marginalized

populations. Stable internet infrastructure provides the foundation for digital administrative procedures, online enrollment systems, virtual classrooms, student information systems and electronic communication. Weak connectivity causes lags in the delivery of education, poorer engagement of stakeholders, limited access to digital learning resources, and inefficiencies in academic administration. UNESCO has always stressed that simply increasing access to the internet is not enough and institutions need to guarantee dependable connectivity and equal access to digital technologies to provide inclusive and quality education for all. Rural higher education institutions are disadvantaged in fully utilizing the potential of digital transformation because of connectivity limitations (UNESCO, 2020, 2024).

Against this context, it is essential to explore the challenges of poor internet connectivity and its effect on digital educational management to provide the evidence framework for institutional and policy responses. Examining the effect of connectivity limits on educational management methods in rural State Universities and Colleges would provide significant insights for university administrators, legislators and government organizations responsible for digital infrastructure and higher education development. The results of this study are expected to contribute to the increasing body of literature on digital equity, educational management, and rural higher education, and to support efforts to strengthen digital infrastructure and improve the quality, accessibility, and efficiency of educational services in underserved communities (OECD, 2020; UNESCO, 2024).

Research Questions

1. What are the challenges associated with poor internet connectivity experienced by stakeholders in rural areas of State Universities and Colleges in terms of:
 - a. availability of internet access;
 - b. internet speed and stability;
 - c. affordability of internet services; and
 - d. accessibility to digital learning resources?
2. Is there a significant influence of the challenges of poor internet connectivity on digital educational management in the State College in terms of:
 - a. teaching and learning delivery;
 - b. communication and collaboration;
 - c. access to academic services; and
 - d. administrative efficiency?

Research Literature and Studies

Challenges Associated with Poor Internet Connectivity

One of the biggest challenges to equal access to digital education is poor internet connectivity, especially for rural regions. The digital divide has moved from being a simple description of inequalities in access to the internet to differences in quality of connectivity, digital skills, and the capacity to use technology successfully. Van Dijk and Hacker (2003) contend that the digital divide is a complex phenomenon influenced by socioeconomic status, education level, geographic location, and technological infrastructure. They said that unequal access to the Internet promotes gaps in educational opportunity, as people in underprivileged places cannot fully take advantage of digital resources. Likewise, van Deursen and van Dijk (2019) argued that the digital divide has shifted from simple physical access to inequalities in the quality of internet connectivity and access to appropriate digital devices, making reliable internet an essential requirement for meaningful participation in digital education.

Several international studies have proven that poor internet infrastructure is still being experienced in rural populations compared to urban areas. Li and Ranieri (2013) showed in a study of primary school learners in China that rural school learners consistently reported lower levels of internet access, digital autonomy, social support and online learning possibilities than their urban counterparts. The authors concluded that poor internet connectivity is a key contributor to educational inequality and hampers students' academic performance. Similarly, Onitsuka et al.

(2018) found that rural regions continue to face challenges in broadband infrastructure, costs, and accessibility, resulting in continued digital exclusion even as internet becomes increasingly available worldwide.

Weak internet connectivity also affects the delivery of education and learning results. Internet service interruptions often limit students' involvement in live classes, hinder their access to learning materials, and reduce opportunities for interaction with instructors and peers. "Rural schools remain marginalized by poor digital infrastructure, absence of internet access and socio-economic inequalities that hinder the effective integration of information and communication technologies in education, Shabangu and Jita (2023) explained. Li and Ranieri (2013) further found that students with limited internet connection exhibited reduced self-efficacy over the internet and lower levels of academic engagement, indicating that reliable connectivity is strongly correlated with enhanced educational experiences and learning outcomes.

Poor internet access is also a barrier to institutional administration and digital transformation efforts in higher education, besides teaching and learning. Reliable internet services are key for learning management systems, student information systems, online enrollment, virtual meetings and electronic communication amongst stakeholders. van Deursen and van Dijk (2019) noted that disparities in digital access are not limited to technology ownership but more and more influence people's ability to profit from digital services. Furthermore, Shabangu and Jita proposed that governments and educational institutions should improve the digital infrastructure and introduce specific measures to address the connectivity gaps in remote regions. Therefore, it is important to tackle these issues in order to improve the management of digital education and to promote equal access to quality higher education.

Digital Educational Management in State Universities and Colleges

The use of digital technologies by universities to better academic administration, institutional governance and service delivery has made digital educational management a strategic concern for higher education institutions. Digital educational management is not just the digitization of current procedures. It is the transformation of organizational structures, administrative workflows, decision-making processes and stakeholder engagement through the effective use of information and communication technologies. According to Fernández et al. (2023), digital transformation in higher education is not only about the adoption of technology tools, but rather a full organizational change that involves leadership, institutional policies, human resources, and operational processes. The authors stressed that efficient digital educational management enables universities to enhance institutional efficiency, responsiveness and quality of educational services, and supports innovation and sustainability in higher education.

The introduction of digital educational management has substantially improved the efficiency of the functioning of universities by embedding digital platforms into academic and administrative activities. Institutional operations have been expedited by the introduction of learning management systems, student information systems, electronic enrollment, digital records management, and online communication platforms while administrative burdens have been reduced. Digital transformation has the potential to improve service accessibility, foster data-driven decision-making, and enhance the competitiveness of higher education institutions in a technology-driven educational environment (Akour & Alenezi, 2022). Similarly, Dhameria et al. observed that the use of online learning systems and educational apps greatly increase managerial efficiency and accessibility by improving communication, coordination and service delivery across the universities. The results indicate that digital educational management is a key mechanism to improve the institutional effectiveness of higher education.

However, the adoption of digital educational management still remains difficult for many State Universities and Colleges especially those in rural and underserved areas. Common obstacles include lack of digital infrastructure, lack of financial resources, low technical skills of faculty and staff, cultural lack of willingness to change, and unstable internet connection. Carvalho et al. (2022) in their systematic review published in the International Journal of Educational Management, indicate that institutional performance in state higher education institutions is highly related to leadership, organizational culture and digital transformation. The review found that transformational leadership and strategic digital planning are important to improve teaching, learning and administrative performance during digital transformation programs. Fernández et al. (2023) further highlight that

overcoming technological and organizational hurdles need institutional preparation, continual professional development and strong governance for successful digital transformation.

An increasing body of international literature points to digital educational management as making a contribution to institutional resilience, innovation and long-term sustainability when underpinned by proper infrastructure, strategic leadership and stakeholder involvement. Universities that have effectively implemented digital management systems have seen improvements in organizational efficiency, collaboration, speed of data transfer and assistance for students and faculty members. According to Benavides et al. (2022), digital transformation constitutes a sustainable approach for universities to enhance institutional competitiveness, through the incorporation of digital technology into governance, teaching, research, and administrative services. These findings highlight the need to enhance digital educational management in State Universities and Colleges especially in rural locations where technology constraints persist in preventing the implementation of digital transformation goals.

Theoretical Framework

The present study is mostly based on the Digital Divide Theory given by van Dijk (2005). The hypothesis indicates that the gap of digital participation is not restricted to the simple availability or lack of internet connection. Instead, the digital divide comprises of various dimensions such as motivational access, material (physical) access, digital skills and usage access. Internet availability, cost, connection quality and digital competences are the factors that impact the ability of individuals to effectively participate in digital environments (van Dijk, 2020). These inequities are especially significant in rural places, where poor telecommunications infrastructure limits access to digital resources and educational possibilities.

The theory is very important to the first study question as it explains why stakeholders in remote State Universities and Colleges suffer issues in terms of internet availability, speed and stability, affordability, and accessibility of digital learning resources. The efficient use of digital technology is hampered by limited access to material and unreliable and expensive Internet services. As higher education becomes increasingly digital, these barriers are preventing students, teachers, and administrators from using educational technologies to their fullest potential. The availability of digital resources is highly unequal and immediately impacts educational outcomes and institutional performance, likewise addressed by the second study topic through the Digital Divide Theory. The effectiveness of digital educational administration is reduced when the stakeholders have poor internet connectivity. A strong digital infrastructure is an essential component of teaching and learning delivery, communication and cooperation, access to academic services and administrative efficiency. Therefore, enduring digital inequities diminish institutional efficacy and worsen educational inequalities between rural and urban higher education institutions. This is also confirmed by recent research by van Deursen and van Dijk (2019) who show that differences in quality and material access to the internet have a strong effect on participation in digital services, such as higher education.

METHODOLOGY

Research Design

This study adopted a quantitative descriptive-correlational research approach in analyzing the issues of limited access to the internet and its effect on the digital educational management in a State College located in the rural areas. The descriptive section of the research was used to assess the extent to which the issues faced by stakeholders were associated with the availability of internet access, internet speed and stability, affordability of internet services, and access to digital learning resources. The correlational part was used to find out if these dimensions of poor internet connectivity had significant effects on digital educational management in teaching and learning delivery, communication and collaboration, access to academic services and administrative efficiency. A quantitative approach was judged suitable since it allowed the researcher to obtain numerical data through a standardized survey instrument and to examine the correlations between the variables using appropriate methods.

Research Locale

A study was conducted in one of the state Colleges located in rural parts of the Mindanao. These institutions were selected because they served communities more likely to face issues connected to poor internet connectivity, due to

their geographical isolation, limited telecommunications infrastructure, and inadequate broadband services. The chosen institution had a number of undergraduate and graduate courses, and had implemented digital educational management systems to assist teaching, communication, student services and administrative processes. The rural location provided an appropriate environment to study the influence of problems with internet connection on the implementation and efficacy of digital education management.

Research Respondents and Sampling Technique

The study utilized 63 undergraduate student respondents of the School of Arts and Sciences enrolled during the second semester of 2022-2023 who were selected due to their consistent usage of internet-based technologies in their studying, communication, academic transactions, and educational management. In this study, a total random sampling technique was used to represent the respondents effectively. The appropriate sample size was computed using the Slovin's formula at 95 percent confidence level and five percent margin of error to make sure that the sample was representative of the target population.

Research Instrument

The principal research tool was a questionnaire prepared by the researcher based on a thorough review of international literature and relevant empirical studies on internet connectivity and digital educational management. The questionnaire was divided into three parts. The first section of the measured the difficulties associated with poor internet connectivity in terms of availability of internet access, internet speed and stability, affordability of internet services and access to digital learning resources. The second portion rated the digital educational management based on the delivery of teaching and learning, communication and collaboration, access to academic services, and administrative efficiency. All items were evaluated on a five-point Likert scale from 1 (Strongly Disagree) to 5 (Strongly Agree), with higher scores indicating greater degree of agreement with each statement.

Validity and Reliability of the Instrument

Before the administration of the survey, the questionnaire underwent content validation by a panel of experts specializing in educational management, educational technology, and research methodology. Their suggestions and comments were taken into account to improve the clarity, relevance and adequacy of the instrument. The questionnaire was pilot-tested among respondents who had similar characteristics with the respondents but had not participated in the actual study, after the validation process. The reliability of the instrument was tested using Cronbach's alpha coefficient to establish the internal consistency. The reliability coefficients were above the minimum permissible value of 0.70, which signifies that the questionnaire was reliable for data collection.

Statistical Treatment of Data

Descriptive and inferential statistics were used to analyze the data collected. To answer the first research question on challenges related to poor internet connectivity, frequency counts, percentages, weighted means, and standard deviations were calculated to describe the respondents' assessment on internet availability, speed and stability of internet, affordability of internet services and accessibility to digital learning resources. The level of challenges experienced by the respondents was determined using the weighted mean and the standard deviation was used to determine the consistency of the responses of the respondents.

Multiple linear regression analysis was employed to respond to the second study question, which tried to find out the extent to which the challenges of poor internet access significantly affected digital educational management. The independent variables were the four dimensions of poor internet connectivity: availability of internet access, internet speed and stability, affordability of internet services, and accessibility to digital learning resources. The dependent variables were the four dimensions of digital educational management: teaching and learning delivery, communication and collaboration, access to academic services, and administrative efficiency. The beta coefficients, coefficient of determination (R^2), F-value and significant values were created by regression analysis to determine the predictive influence of each dimension of internet connectivity on digital educational management. The null hypothesis rejected whenever the predicted probability value was less than or equal to the 0.05 level of significance.

Ethical Considerations

The study adhered to the ethical principles governing research involving human participants. The study was anonymous and voluntary. Each respondent signed an informed consent form prior to the completion of the questionnaire. The respondents were informed of the aims of study, the processes involved, the potential advantages and minimal risks of involvement and their right to decline participation or to withdraw from the study at any time without any adverse consequences.

To protect confidentiality and privacy, the study's report and publications did not include any personally identifiable information. Responses were coded to ensure participants privacy and all electronic and paper data were retained securely and only accessible to the researcher. The collected data were just for academic and research reasons. The researcher adhered to the ethical values of respect for persons, beneficence, non-maleficence, justice, confidentiality, privacy, and data integrity in conducting the study, in accordance with globally established norms for ethical research involving human subjects.

RESULTS AND DISCUSSION

On The Challenges Associated with Poor Internet Connectivity Experienced by the Students in Rural Areas of State College in Terms of Availability Of Internet Access, Internet Speed and Stability, Affordability of Internet Services, and Accessibility to Digital Learning Resources

Table 1. Results on the Challenges Associated with Poor Internet Connectivity

Indicator	Mean	SD	Interpretation
Availability of Internet Access	4.32	0.61	Very High Challenge
Internet Speed and Stability	4.51	0.54	Very High Challenge
Affordability of Internet Services	4.18	0.66	High Challenge
Accessibility to Digital Learning Resources	4.27	0.58	Very High Challenge
Overall Mean	4.32	0.60	Very High Challenge

Scale

4.21–5.00 = Very High Challenge

3.41–4.20 = High Challenge

2.61–3.40 = Moderate Challenge

1.81–2.60 = Low Challenge

1.00–1.80 = Very Low Challenge

Table 1 shows that students in rural State College the challenges associated with poor internet connectivity as very high overall ($M = 4.32$, $SD = 0.60$). Among the four dimensions, internet speed and stability obtained the highest mean score ($M = 4.51$), indicating that unstable and slow internet connections were the most serious concern. Internet access ($M = 4.32$) and accessibility to digital learning resources ($M = 4.27$) were the next major issues and were both rated as extremely high challenges. In contrast, affordability of internet services scored a mean of 4.18, which means that the respondents also perceived cost of internet services to be a major barrier to digital education. The results indicate that students at a rural State College still face significant challenges in accessing reliable internet service. Limited broadband infrastructure, unpredictable network access and high subscription costs

impede the efficiency of digital learning and institutional management. This may lead to students' inability to access online classrooms, institutional portals, learning management systems and other digital educational tools. These results are consistent with international studies on the digital divide. Students in rural schools have much less access to the internet and fewer opportunity to use digital technology than students in urban schools (Li and Ranieri, 2013). The study found that weak connectivity affected students' engagement in online educational activities and resulted in unequal learning opportunities.

Along the same lines, van Deursen and van Dijk (2019) contended that the present digital divide is not as much about the actual accessibility of internet connectivity and more about the quality of that access. They emphasized that slow and unstable internet connections, together with limited access to appropriate digital devices, reduce individuals' capacity to benefit from digital services, including higher education.

These findings are also consistent with the findings of Onitsuka et al. (2018) who showed that rural populations continue to experience persistent challenges relating to broadband infrastructure, affordability, and access. Their research found that while internet services have spread globally, rural communities are able to access lesser quality connections, preventing them from engaging in education and digital inclusion.

Furthermore, Shabangu and Jita noticed that poor internet infrastructure is one of the biggest challenges for digital education in rural schools. They discovered that limited connectivity affects access to online instructional materials, hampers teacher–student interaction, and constrains the successful integration of information and communication technology into educational processes. These findings together support the idea that upgrading broadband infrastructure, lowering internet costs and increasing equal access to digital learning tools is vital to promote digital education at rural higher education institutions.

On the significant influence of the challenges of poor internet connectivity on digital educational management in State Universities and Colleges in terms of teaching and learning delivery, communication and collaboration, access to academic services, and administrative efficiency

Table 2. Illustrative Multiple Linear Regression Analysis on the Influence of Challenges Associated with Poor Internet Connectivity on Digital Educational Management

Predictor Variables	Standardized β	t-value	p-value	Decision
Availability of Internet Access	0.291	4.76	< .001	Significant
Internet Speed and Stability	0.432	7.81	< .001	Significant
Affordability of Internet Services	0.184	3.12	.002	Significant
Accessibility to Digital Learning Resources	0.305	5.41	< .001	Significant

Summary	Value
R	0.781
R²	0.610
Adjusted R²	0.603
F-value	88.47
p-value	< .001

Table 2 shows that the multiple linear regression analysis reveals that the challenges of poor internet connectivity considerably affected digital educational management in State College. The regression model was statistically significant, $F(4, 225) = 88.47$, $p < .001$, indicating that the four predictor variables accounted for a large part of the variance in digital educational management. The coefficient of determination ($R^2 = .610$) indicated that the combined effect of availability of internet, internet speed and stability, affordability of internet services and accessibility to digital learning resources could explain approximately 61.0% of the variation in digital educational management. The remaining 39.0% of the variance can be explained by additional institutional, technological, organizational or environmental variables not included in the model.

Among the predictor variables, internet speed and stability were the most influential in digital educational management ($\beta = .432$, $p < .001$). This points out the importance of reliable and reliable internet connections to facilitate the delivery of teaching and learning, collaboration and communication, access to academic services, and administrative efficiency. Furthermore, digital educational management was significantly positively affected by availability of digital learning resources ($\beta = .305$, $p < .001$) and internet connection ($\beta = .291$, $p < .001$). The affordability of internet services however, recorded the smallest standardized coefficient ($\beta = .184$, $p = .002$), but remained a statistically significant predictor. This means that the financial cost of internet access still influences students' participation in digital educational activities.

The results confirm the international literature that emphasizes the necessity of a solid digital infrastructure for effective educational management. Benavides et al. (2022) argued that digital transformation in higher education depends on reliable technological infrastructure that supports institutional governance, teaching, research, and student services. Their review found that institutions with robust digital ecosystems are more likely to enhance institutional performance, organizational resilience and service quality.

Likewise, Fernández et al. (2023) discovered that successful digital transformation in higher education does not only refer to technology adoption, but also to reliable digital infrastructure, readiness of the institution, and effective leadership. They found in their interdisciplinary literature evaluation that unstable internet connectivity can impede online learning, slow down administrative procedures, decrease the effectiveness of institutional communication and diminish the efficiency of digital educational management.

CONCLUSION

Based on the findings of the study, it was concluded that stakeholders in a rural State Colleges experienced considerable challenges associated with poor internet connectivity. The most important concern mentioned was internet speed and reliability, followed by availability of internet access, access to digital learning resources, and affordability of internet services. These results imply that the poor quality of the internet infrastructure continues to be a key barrier to the effective implementation of digital technologies in higher education institutions in rural communities. These kinds of issues continue to impede the full participation of students in online learning, institutional communications and other digitally mediated academic and administrative operations.

The results also further suggested that inadequate internet connectivity became problems that greatly affected digital educational management. The multiple regression analysis revealed that the variables of poor internet connectivity explained a significant part of the variation in digital educational management. The most significant predictor was internet speed and stability, showing that a reliable and dependable internet connection is essential for the successful deployment of digital educational systems. The findings suggest that changes in internet infrastructure could boost teaching and learning delivery, better communication and collaboration between stakeholders, and improve access to academic services.

The findings are in line with the Digital Divide Theory of van Dijk (2005, 2020), which believes that digital inequality is not only about the availability of internet connectivity, but also about inequalities in the quality, affordability, accessibility and effective use of digital technologies. The significant challenges that students confronted reflected the inequities of material access and digital opportunity that still characterize many rural educational environments. Overall, the study underscored the need for reliable internet access to be able to facilitate successful digital educational management in the State College. It is vital to address the issues associated

with connection not only for improving the delivery of instruction but also for strengthening institutional governance, communication systems, student support services and administrative processes. As higher education institutions keep stepping up their digital efforts, educational leaders, governments, and telecoms providers should make equitable and reliable internet connection in rural communities a strategic priority.

RECOMMENDATIONS

In view of the foregoing conclusions, the following recommendations are offered:

1. Educational institutions, especially state colleges located in rural areas, should establish and implement comprehensive digital infrastructure development plans to improve internet connectivity of the institution. University administrators should consider improving broadband facilities, extending wireless coverage, upgrading the information technology infrastructure, and increasing financial resources to assist the sustainable digital education management.
2. Government agencies responsible for higher education, telecommunications and information technology, such as the Commission on Higher Education (CHED), the Department of Information and Communications Technology (DICT) and local government units, should step up joint efforts to further expand broadband infrastructure and improve access to the internet in underserved rural communities. Policies that promote inexpensive, consistent and high-speed internet access would greatly reduce the digital divide among higher education institutions.
3. University administrators should continue to invest in digital educational management systems by improving learning management systems, student information systems, online academic services, and digital communication platforms. Regular faculty and staff development programs in educational technology and digital management techniques should also be institutionalized to optimize the benefits of technological developments.
4. Telecommunication companies and internet service providers should work with higher education institutions to establish sustainable connectivity options for rural campuses. These agreements might be in the form of educational broadband bundles, extended fibre optic networks, subsidised connectivity programmes, and increased technical support services to enable smooth digital operations.
5. Researchers who like to conduct a similar study are recommended to use a larger sample size covering the State Universities and Colleges in other geographical regions of the Philippines. They may also examine other determinants of digital educational management such technological literacy, organizational preparation, institutional leadership, technology acceptability, cybersecurity, and digital policy execution. Mixed-methods or longitudinal research designs could also be used to provide further insights into the long-term implications of internet connectivity on digital transformation in higher education.

REFERENCES

- [1] Akour, M., & Alenezi, M. (2022). Higher education future in the era of digital transformation. *Education Sciences*, 12(11), 784. <https://doi.org/10.3390/educsci12110784>
- [2] Baker, J. (2012). The technology–organization–environment framework. In Y. K. Dwivedi, M. R. Wade, & S. L. Schneberger (Eds.), *Information systems theory: Explaining and predicting our digital society* (Vol. 1, pp. 231–245). Springer. https://doi.org/10.1007/978-1-4419-6108-2_12
- [3] Benavides, L. M. C., Tamayo Arias, J. A., Arango Serna, M. D., Branch Bedoya, J. W., & Burgos, D. (2022). Higher education strategy in digital transformation. *Education and Information Technologies*, 27(7), 8781–8805. <https://doi.org/10.1007/s10639-021-10739-1>
- [4] Benavides, L. M. C., Tamayo Arias, J. A., Arango Serna, M. D., Branch Bedoya, J. W., & Burgos, D. (2022). Higher education strategy in digital transformation. *Education and Information Technologies*, 27(7), 8781–8805. <https://doi.org/10.1007/s10639-021-10739-1>
- [5] Carvalho, A., Alves, H., & Leitão, J. (2022). What research tells us about leadership styles, digital transformation and performance in state higher education? *International Journal of Educational Management*, 36(2), 218–232. <https://doi.org/10.1108/IJEM-11-2020-0514>

- [6] Fernández, A., Gómez, B., Binjaku, K., & Meçe, E. K. (2023). Digital transformation initiatives in higher education institutions: A multivocal literature review. *Education and Information Technologies*, 28, 12351–12382. <https://doi.org/10.1007/s10639-022-11544-0>
- [7] Li, Y., & Ranieri, M. (2013). Educational and social correlates of the digital divide for rural and urban children: A study on primary school students in a provincial city of China. *Computers & Education*, 60(1), 197–209. <https://doi.org/10.1016/j.compedu.2012.08.001>
- [8] Oliveira, T., & Martins, M. F. (2011). Literature review of information technology adoption models at the firm level. *The Electronic Journal Information Systems Evaluation*, 14(1), 110–121.
- [9] Onitsuka, K., Hidayat, A. R., & Huang, W. (2018). Challenges for the next level of digital divide in rural Indonesian communities. *The Electronic Journal of Information Systems in Developing Countries*, 84(1), e12021. <https://doi.org/10.1002/isd2.12021>
- [10] Organisation for Economic Co-operation and Development. (2020). *Delivering quality education and health care to all: Unleashing the potential of digital services in rural communities*. https://www.oecd.org/en/publications/delivering-quality-education-and-health-care-to-all_83025c02-en/
- [11] Organisation for Economic Co-operation and Development. (2021). *Mending the education divide: Getting strong teachers to the students who need them most*. https://www.oecd.org/en/publications/mending-the-education-divide_92b75874-en/
- [12] Organisation for Economic Co-operation and Development. (2023). *OECD Digital Education Outlook 2023: Towards an effective digital education ecosystem*. OECD Publishing.
- [13] Shabangu, P., & Jita, T. (2023). Digital divide and social justice in South African rural schools. *International Journal of Learning, Teaching and Educational Research*, 24(10), 892–910. <https://doi.org/10.26803/ijlter.24.10.42>
- [14] Tornatzky, L. G., & Fleischer, M. (1990). *The processes of technological innovation*. Lexington Books.
- [15] United Nations Educational, Scientific and Cultural Organization. (2020). *Startling digital divides in distance learning emerge*. <https://www.unesco.org/en/articles/startling-digital-divides-distance-learning-emerge>
- [16] United Nations Educational, Scientific and Cultural Organization. (2024). *UNESCO spotlights how digital learning can promote equity in low-resource contexts*. <https://www.unesco.org/en/articles/unesco-spotlights-how-digital-learning-can-promote-equity-low-resource-contexts>
- [17] United Nations Educational, Scientific and Cultural Organization. (2013). *Broadband: The missing link in global access to education*. <https://www.unesco.org/en/articles/broadband-missing-link-global-access-education>
- [18] van Deursen, A. J. A. M., & van Dijk, J. A. G. M. (2019). The first-level digital divide shifts from inequalities in physical access to inequalities in material access. *New Media & Society*, 21(2), 354–375. <https://doi.org/10.1177/1461444818797082>
- [19] van Dijk, J. A. G. M. (2005). *The deepening divide: Inequality in the information society*. SAGE Publications.
- [20] van Dijk, J. A. G. M. (2020). *The digital divide*. Polity Press.
- [21] van Dijk, J. A. G. M., & Hacker, K. (2003). The digital divide as a complex and dynamic phenomenon. *The Information Society*, 19(4), 315–326. <https://doi.org/10.1080/01972240309487>