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The Digital Divide and E-Learning Participation: A Mixed-Methods Study of Extended Curriculum Programme Students in South Africa

Masithembe Kafile, Amahle Ninana and Palesa Makhetha-Kosi*
University of Fort Hare,
South Africa

Abstract: Technology plays a critical role in modern education by enhancing access to resources, promoting knowledge exchange, and supporting student engagement; however, disparities in digital access and literacy continue to undermine equity in developing economies. This study investigates how digital inequality influences e-learning participation among Extended Curriculum Programme (ECP) students at a South African university, a population that is particularly vulnerable in digitally stratified environments. The analysis is guided by Wei et al.'s (2011) three-level digital divide framework, which conceptualises disparities in terms of access, capability, and outcomes, and builds on recent evidence from post-pandemic South African contexts (Mateko, 2025; Zongozzi & Ngubane, 2025; Mwansa, 2025). A mixed-methods design was employed: quantitative data were gathered through purposive sampling of 226 students across the Faculties of Law, Science & Agriculture, and Management & Commerce, while qualitative insights were derived from convenience-sampled interviews. Quantitative analysis involved descriptive and inferential statistics, whereas qualitative data were thematically analysed to capture students' lived experiences. The findings reveal persistent challenges with internet connectivity, inadequate infrastructure, and limited digital literacy, all of which restrict meaningful e-learning engagement. These disparities map clearly onto the three levels of the digital divide, disproportionately affecting marginalised students and widening existing academic inequalities. The study contributes by highlighting the urgent need for targeted institutional interventions, including affordable connectivity, digital literacy training, and inclusive pedagogical strategies, to foster resilient, equitable, and sustainable higher education systems.

Keywords: Digital divide; e-learning; access disparities; educational inequality; higher education

*Corresponding author: Palesa Makhetha-Kosi; *PMakhetha@ufh.ac.za*

1. Introduction

The COVID-19 pandemic accelerated the integration of digital technologies in higher education; this underscored the importance of equitable access and digital literacy for academic success. Yet, these advances have not been experienced uniformly, particularly in developing contexts such as South Africa, where systemic inequalities persist. Extended Curriculum Programme (ECP) students who enter higher education with academic and socio-economic disadvantages, are especially vulnerable to the effects of digital inequality. While digital learning environments provide opportunities to expand access and flexibility, disparities in device ownership, internet connectivity and digital skills remain significant barriers that restrict ECP students' full participation in online and blended learning (Faloye & Ajayi, 2022; Mateko, 2025).

Recent studies highlight that these inequalities are not only technical but also social and institutional in nature, with accessibility barriers for students with disabilities (Zongozzi & Ngubane, 2025), uneven institutional investment in ICT infrastructure (Maome et al., 2024) and widening post-COVID inequities across historically disadvantaged universities (Kelly, 2024).

The problem this study addresses is that despite extensive research on digital access in South African higher education, limited attention has been given to the specific experiences of ECP students, a group that represents both an equity intervention and a vulnerable population. Their challenges extend beyond access to devices and connectivity, encompassing digital literacy, confidence and academic outcomes, yet policy frameworks and institutional strategies rarely prioritise their needs. This gap creates the risk of reproducing inequality within a programme intended to advance inclusion.

The rationale for this research lies in applying Wei et al.'s (2011) three-level digital divide framework by focusing on access, capability, and outcomes to the ECP context. Doing so allows for a nuanced understanding of how digital inequality shape learning experiences and outcomes for students already facing structural barriers. The study is significant in three ways: theoretically, it extends the application of digital divide frameworks to marginalised higher education populations; empirically, it contributes original evidence on the intersection between digital inequality and ECP participation; and practically, it informs institutional and national strategies on digital inclusion, highlighting interventions such as targeted device provision, structured digital literacy support, and inclusive pedagogy.

By foregrounding the lived realities of ECP students, this study argues that addressing digital inequality is not only a technological necessity but also a matter of educational justice in post-apartheid South Africa.

Therefore, this study was guided by the following questions:
1. To what extent do students at the selected South African university differ in measurable indicators of access to technology resources for e-learning?

2. What are some of the key challenges encountered by students from marginalised backgrounds in acquiring and employing technology for e-learning?
3. How do differences in student digital literacy impact their academic performance in a blended learning institution?

2. Literature review

2.1. Overview of the digital divide in higher education

The digital divide remains a persistent barrier in higher education, but scholars conceptualize it differently. While early work emphasized structural access gaps such as devices and internet connectivity (Ohemeng & Ofosu-Adarkwa, 2014; Frankfurter et al., 2020), more recent studies stress multidimensional inequalities that extend into skills and outcomes (Scheerder et al., 2017; Wei et al., 2011). This three-level framework (access, capability, outcomes) has been validated in African contexts where unequal digital literacy often compounds infrastructural deficits (Zhao et al., 2023; Kigwilu & Nyonje, 2024).

Importantly, recent evidence highlights how these divides are not only technological but also social and institutional: for example, Zongozzi & Ngubane (2025) demonstrate the exclusion of students with disabilities in South African e-learning spaces, while Amoah (2024) shows that built environment students in Ghana face discipline-specific challenges in online learning. Taken together, these studies suggest that while progress has been made in improving access, deep inequalities remain in capability and outcomes, particularly for vulnerable student groups such as Extended Curriculum Programme (ECP) cohorts.

2.2 E-learning in South African universities

E-learning has been widely adopted in South African higher education, with researchers generally agreeing on its potential benefits for flexibility and accessibility (Al-Samarraie et al., 2018; Pinto & Leite, 2020). However, findings diverge on its actual effectiveness. Some studies emphasize enhanced engagement and knowledge acquisition (Arkorful & Abaidoo, 2015), while others stress persistent inequities in access and literacy that undermine e-learning's promise (Akhter et al., 2021; Al-Rawashdeh et al., 2021). South African case studies highlight these tensions: Queiros & de Villiers (2016) found that supportive institutional structures improve online learning adoption, but Sibanda & Donnelly (2014) reported that entry-level students often underperform in e-learning compared to face-to-face settings. More recent contributions reveal post-pandemic challenges, such as sustaining institutional digital capacity (Maome et al., 2024) and addressing psychosocial barriers to engagement (Shange, 2023). This literature points to a paradox: e-learning can democratize access to knowledge, but without targeted support, it risks reproducing or even intensifying inequalities.

2.3 Access to technology resources for university students in South Africa

Access remains one of the most critical determinants of e-learning participation in South Africa. Earlier studies highlighted stark disparities between urban and rural students, as well as between affluent and under-resourced schools (Bornman, 2016; Oyedemi & Mogano, 2018). More recent analyses confirm that

despite expanded connectivity initiatives, affordability and infrastructure remain major barriers (Faloye & Ajayi, 2022; Hamburg & Lütgen, 2019). Recent surveys show that even when devices are provided, bandwidth limitations and unstable Wi-Fi constrain effective use (Mabotja & Mavutha, 2025; Yakobi et al., 2025). Furthermore, capability gaps intersect with access: students with limited prior digital exposure struggle to maximize the learning potential of technology, creating unequal outcomes even among those technically "connected" (Zhao et al., 2023). This underscores the importance of viewing access not only as device ownership, but as a holistic intersection of affordability, reliability, and user skills.

3. Theoretical and conceptual frameworks

This study is guided by Wei et al.'s (2011) three-level digital divide framework, which conceptualises digital inequality in terms of access, capability, and outcomes. The framework provides a structured lens for analysing how systemic disparities shape student engagement in e-learning. To strengthen its application, the framework was explicitly mapped to the study's research questions, variables, and instruments. Research Question 1, which examines disparities in access to technology resources, corresponds to the first-level divide (access) and was operationalised through survey items on device ownership, connectivity type, and affordability (Appendix A). Research Question 2, which explores challenges faced by marginalised students, aligns with both access and capability constructs, captured through survey questions on formal digital literacy training and interview probes on barriers to participation.

Research Question 3, which assesses the impact of digital literacy on academic performance, reflects the second- and third-level divides (capability and outcomes), operationalised via survey indicators of self-rated digital skills and performance comparisons, as well as interview narratives on learning experiences. By mapping the framework to specific questions, variables, and instruments, the study ensures theoretical coherence between its conceptual lens, methodological design, and empirical evidence. This alignment strengthens the explanatory power of the findings and underscores the relevance of the digital divide framework in analysing higher education inequalities in South Africa.

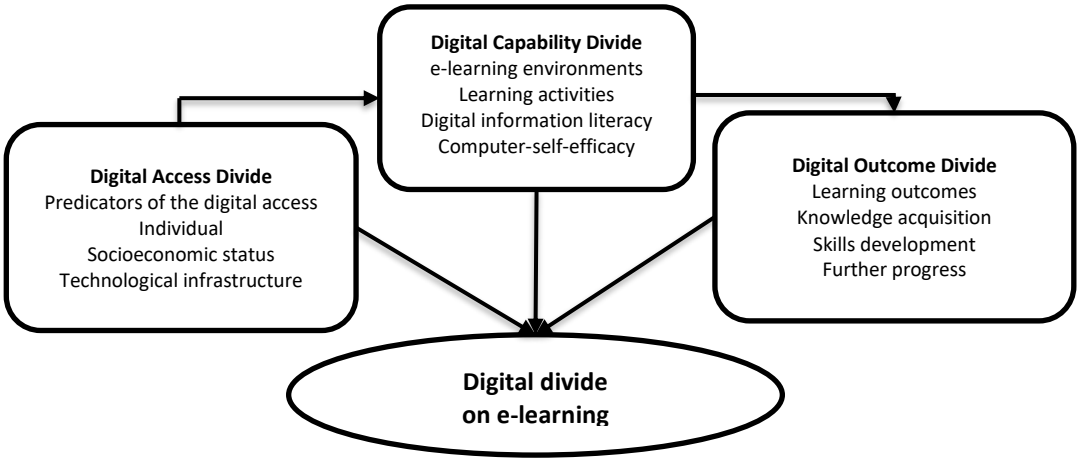

Figure 1: The three-level digital divide framework Wei et al. (2011)

3.1 Method

A mixed-methods design was employed to provide a comprehensive understanding of the phenomenon under study, combining both quantitative and qualitative strands as advised by Sekaran and Bougie (2016). The study used purposive sampling for quantitative data and convenience sampling for qualitative data (Saunders et al., 2019). A total of 300 Extended Curriculum Programme (ECP) students were recruited from three faculties—Law, Science & Agriculture, and Management & Commerce—resulting in 226 usable survey responses.

In addition, 30 interviews were conducted for qualitative data, with data collection ceasing once thematic saturation was reached (Malterud et al., 2016). Data were collected using a researcher-developed questionnaire that captured demographic information, access to devices and connectivity, digital literacy, and e-learning engagement. The full instrument is reproduced in Appendix A, identical to the administered version but with all personally identifying fields removed to protect confidentiality.

Quantitative and qualitative data were analysed concurrently but with distinct procedures. Survey responses were processed in SPSS to generate descriptive statistics, correlation analysis, and chi-square tests to examine associations between digital access variables and academic outcomes. Interview transcripts were coded and thematically analysed using the approach outlined by Creswell and Plano Clarke (2017). Findings from both strands were triangulated to enhance validity and to capture both statistical patterns and lived experiences of students. This design ensured that the strengths of each method complemented one another, enabling a deeper and more reliable account of how digital inequality shapes e-learning participation among South African ECP students.

Before conducting inferential analyses, key statistical assumptions were tested. For correlation analysis, the distributional properties of the variables were examined to ensure appropriate use of Spearman's rho for non-normally distributed data. For chi-square tests, expected cell counts were reviewed, and results indicated that 58.3% of cells had counts less than 5. In line with this, both Pearson's chi-square values and the linear-by-linear association statistic were reported, while acknowledging limitations of the chi-square test in this context. Where assumptions were partially violated, supplementary analyses (e.g., Fisher's exact test) were considered to support the robustness of the findings. By explicitly checking and reporting these assumptions, the study ensured that the interpretation of correlations and chi-square results remained valid and transparent.

3.2 Ethical considerations

This study was approved by the University of Fort Hare Interfaculty Human Research and Ethics Committee (IFHREC) under the approval number KAF001-24. All research procedures adhered to institutional and ethical guidelines for conducting studies involving human participants. Participants provided written informed consent before taking part in the study. The consent process ensured that participants were fully informed about the nature, purpose, and voluntary

nature of their participation. They were also made aware that they could withdraw from the study at any time without facing any negative consequences. To protect participant privacy, all data collected was anonymized and stored securely. Personal identifiers were removed, and responses were coded to prevent any link to individual participants. Data was stored on secure university-approved platforms and will be retained for a minimum of five years, in compliance with institutional data management policies. Access to the data was restricted to the researchers involved in the study. This study did not involve research on animals or any vulnerable populations requiring additional ethical considerations. The findings of this study will be disseminated through academic publications and presentations, ensuring that participants' anonymity and confidentiality are always maintained.

4. Results and Analysis

This section presents the findings from both the quantitative and qualitative data, which forms the foundation for interpreting the results. The quantitative data presents frequency distribution, descriptive, and inferential statistics. The findings from this data allow for generalisation to the broader population of ECP students at the selected South African university. In addition, qualitative data provides deeper insights into the students' experiences and challenges related to digital access and literacy. Before conducting inferential analyses, key statistical assumptions were tested. For correlation analysis, the distributional properties of the variables were examined to ensure appropriate use of Spearman's rho for non-normally distributed data.

For chi-square tests, expected cell counts were reviewed, and results indicated that 58.3% of cells had counts less than 5. In line with this, both Pearson's chi-square values and the linear-by-linear association statistic were reported, while acknowledging limitations of the chi-square test in this context. Where assumptions were partially violated, supplementary analyses (e.g., Fisher's exact test) were considered to support the robustness of the findings. By explicitly checking and reporting these assumptions, the study ensured that the interpretation of correlations and chi-square results remained valid and transparent

4.1 Quantitative findings

The quantitative sample included 300 students, with 225 usable responses (75.3% response rate). Before analysis, assumptions were checked: chi-square expected cell counts and distributional properties were verified, with supplementary tests noted where assumptions were violated. Results showed that although 87.6% reported access to a personal computer, many still faced unreliable connectivity and limited digital literacy support. Correlation analysis confirmed a positive link between formal training and academic engagement ($p < 0.05$). Chi-square tests further indicated that students without consistent device access or training were disproportionately less engaged in e-learning. These findings highlight that resource disparities extend beyond ownership, aligning with the three-level digital divide framework (access, capability, outcomes).

Table 1: Access to technology resources among ECP students (N = 225)

Access to technology resources	Frequency (n)	Percentage (%)
Do you have access to a personal computer or laptop for e-learning purposes?		
Yes	197	87.6
No	28	12.4
Have you received any formal training or support in developing your digital literacy skills for e-learning?		
Yes	115	68.9
No	52	31.1
Have you faced any challenges in accessing e-learning materials or participating in online activities owing to limitations in technology resources or digital skills?		
Yes	106	47.3
No	118	52.7

4.1.1 Correlation analysis

Correlation analysis was conducted to examine the relationship between access to technology resources and academic performance and engagement. The analysis focused on whether access to a personal computer or laptop for e-learning, formal training in digital literacy, and academic performance and engagement were related significantly with p-values set at <0.05 and <0.01, of which the results showed a strong correlation. In addition, significant correlations were found between receiving formal digital literacy training and improved academic performance and engagement in e-learning activities.

Table 1: Correlation analysis of access, training, and academic performance

			Access to computer	Formal training	Academic performance
Spearman's rho	Access to computer	Correlation coefficient	1.000	.181*	.374**
		Sig. (2-tailed)	.	.015	<.001
		N	197	197	197
	Formal training	Correlation coefficient	.181*	1.000	.141
		Sig. (2-tailed)	.015	.	.060
		N	197	197	197
	Academic performance	Correlation coefficient	.374**	.141	1.000
		Sig. (2-tailed)	<.001	.060	.
		N	225	225	225

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

4.1.2 Chi-square test results

To assess the relationship between access to technology resources and students' ability to engage in e-learning, a chi-square (χ^2) test was conducted. The Pearson chi-square value was 8.774 with 6 degrees of freedom (df) and an asymptotic significance of $p = .187$. Because this exceeds the conventional threshold ($p < .05$), the association is not statistically significant. The likelihood ratio test also produced a nonsignificant result ($\chi^2 = 9.839$, df = 6, $p = .132$). The linear-by-linear association test yielded $p = .034$, suggesting a possible trend. However, this result should be interpreted cautiously because 58.3% of the expected cell counts were below 5, violating chi-square assumptions. These limitations reduce confidence in the robustness of the findings. Future analyses using alternative methods, such as Fisher's Exact Test or logistic regression, would provide a more reliable assessment of potential relationships.

Table 3: Chi-square test results for access to technology and student engagement

	Value	df	Asymptotic significance (2-sided)
Pearson chi-square	8.774[a]	6	.187
Likelihood ratio	9.839	6	.132
Linear-by-linear association	4.483	1	.034
No. of valid cases	225		

a. 7 cells (58.3%) have expected count less than 5. The minimum expected count is 0.11.

Table 4: Off-campus internet connection access types among ECP students (N=225)

	Responses (N)	Percent	Percent of cases
Wi-Fi	112	49.8%	98.9%
Mobile data	111	49.3%	89.4%
Wired connection	2	0.9%	1.7%
Total responses	225	100.0%	416.8%

Note. Multiple responses were allowed; percentages exceed 100% as respondents could indicate more than one internet connection type.

Table 3 presents the distribution of off-campus internet connection types among the respondents. The majority accessed the internet through Wi-Fi (49.8%), with 98.9% of cases reporting this as their primary connection type. Mobile data was also a common choice, used by 49.3% of respondents and accounting for 89.4% of the cases. In contrast, wired connections were the least utilised, representing only 0.9% of the responses and 1.7% of the cases. These findings indicate a high reliance on wireless internet solutions, highlighting the importance of robust Wi-Fi and mobile data infrastructure for off-campus connectivity.

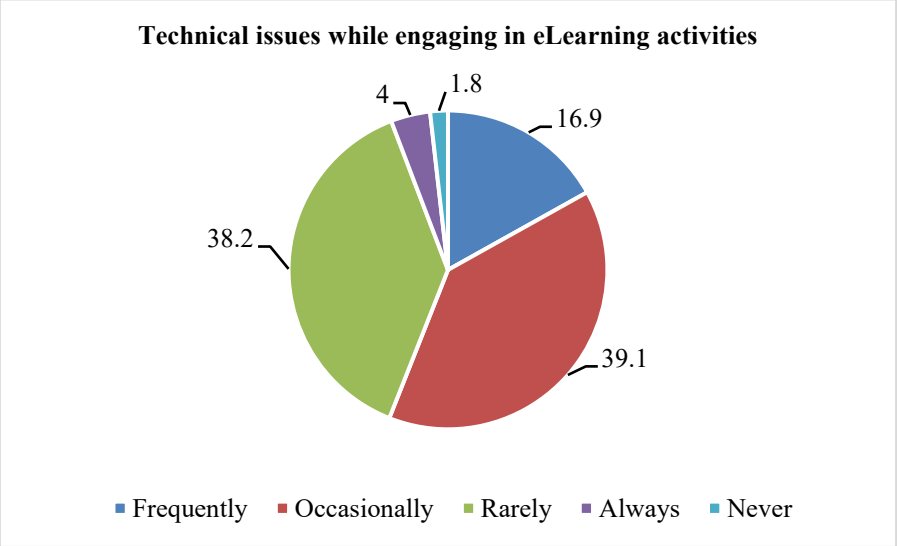

Figure 1: Technical issues while engaging in eLearning activities (N = 225)

Figure 2 illustrates the frequency of technical issues encountered by respondents during e-learning activities, directly addressing Research Question 2: What are the main challenges encountered by students from marginalised backgrounds in acquiring and employing technology for e-learning? The most common occurrence was 'Occasionally' (39.1%), followed by 'Rarely' (38.2%). Smaller proportions reported issues 'Frequently' (16.9%) or 'Always' (1.8%), while 4% reported 'Never.' These findings indicate that technical problems are not constant but intermittent, which can still create significant disruption. Intermittent connectivity and platform breakdowns undermine students' ability to meet deadlines and maintain consistent engagement, particularly for those relying on mobile data or unstable Wi-Fi. This pattern suggests that even when outright exclusion (no access) is avoided, unreliable digital infrastructure continues to disadvantage ECP students by reducing the predictability and quality of their e-learning experiences.

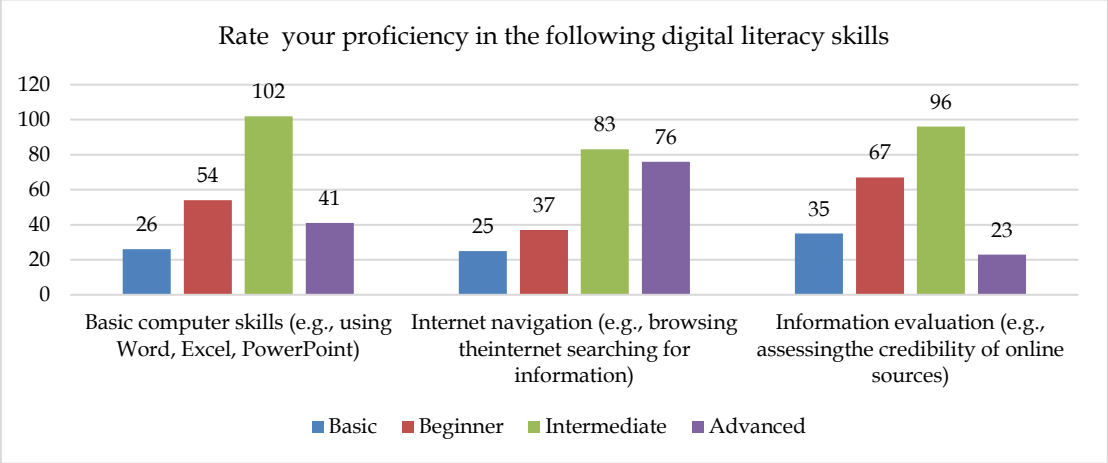

Figure 2: Proficiency in digital literacy skills among ECP students (N = 225)

Figure 3 illustrates respondents' self-rated proficiency across three digital literacy skills: basic computer skills, internet navigation, and information evaluation.

- Basic computer skills: 102 students (45.1%) rated themselves as intermediate, 54 (23.9%) as beginners, 26 (11.5%) as basic, and 41 (18.1%) as advanced.
- Internet navigation: Responses were more balanced, with 83 (36.7%) reporting intermediate, 76 (33.6%) advanced, 37 (16.4%) beginner, and 25 (11.1%) basic.
- Information evaluation: The majority, 96 (42.5%), rated themselves intermediate, followed by 67 (29.6%) beginner, 35 (15.5%) basic, and 23 (10.2%) advanced.

Overall, most respondents demonstrated intermediate proficiency across the three skills, with a notable share achieving an advanced level in internet navigation. However, a significant portion still rated themselves as basic or beginner, particularly in computer skills and information evaluation. This highlights persistent gaps in foundational digital competencies that could limit effective engagement in e-learning.

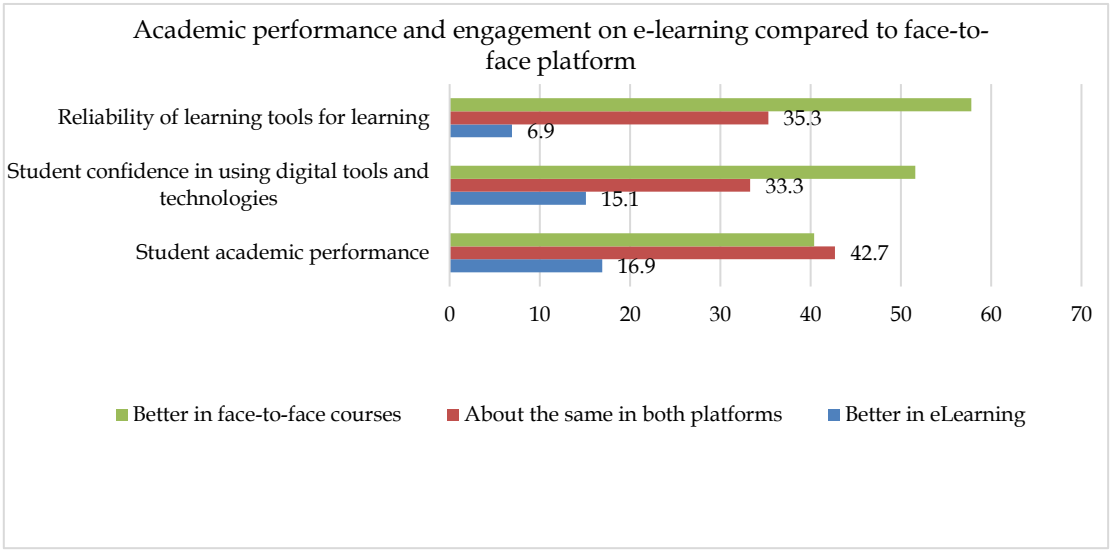

Figure 3: Academic performance on e-learning compared to face-to-face platform

Figure 4 compares perceptions of academic performance and engagement between e-learning and traditional face-to-face learning environments across

three dimensions: reliability of learning tools, student confidence in using digital tools, and overall academic performance. In terms of reliability of learning tools, 35.3% of respondents perceived traditional tools as more reliable, while 6.9% found e-learning tools more reliable, and 35.3% felt that both platforms were equally reliable. Regarding student confidence in digital tools, confidence levels were higher in face-to-face settings, with 33.3% indicating greater confidence in traditional environments. Meanwhile, 15.1% reported better confidence in e-learning, and 33.3% felt equally confident in both.

In terms of academic performance, 42.7% believed they performed better academically in traditional face-to-face environments, 16.9% reported better performance in e-learning, and 42.7% perceived their performance as similar across both platforms. Overall, the findings indicate a preference for traditional learning environments in terms of tool reliability, confidence, and academic performance. However, a notable proportion found e-learning equally effective, suggesting a growing adaptability to digital learning platforms.

4.2 Qualitative findings

The qualitative findings are organised into three key themes; each aligned with the study's research questions.

4.2.1 Theme One: Access to technology resources

Students reported significant disparities in technology access, shaped by socioeconomic background. Those from disadvantaged schools described limited exposure before university: "In Grade 12, we were given computers but only for specific tasks, not for general use." Others had better access, including university-issued laptops and 24/7 labs, though these were often overcrowded. Delayed laptop deliveries—sometimes up to eight months—hindered assignment completion. Connectivity challenges also emerged: "The Wi-Fi during exams was unstable, and that increased stress and reduced my productivity." Outside campus, many relied on mobile data or public Wi-Fi. Students from rural areas were especially disadvantaged, with one noting, "Government support is insufficient, and our schools don't have enough infrastructure." These findings directly address RQ1 on access to technology resources.

4.2.2 Theme Two: Digital literacy skills

Digital literacy levels varied widely. Some students adapted quickly: "My skills improved significantly after learning to use online tools, and this enabled me to achieve better grades." University-provided computer literacy training helped some, while others relied on self-learning, creating gaps in proficiency. Students with stronger digital literacy navigated platforms more confidently, contributing actively to virtual classrooms: "My digital literacy skills allow me to participate easily in discussions." Higher literacy was linked to better time management, productivity, and comprehension, often supported by tools like recorded lectures: "Rewatching recorded lectures helps me understand complex topics better." These results align with RQ2 on challenges related to digital skills.

4.2.3 Theme Three: Challenges with technology use

Students also highlighted systemic obstacles in using technology effectively. Frequent Wi-Fi outages disrupted assignments, delayed laptop deliveries caused stress, and crowded labs limited access. One participant stated, "Frequent Wi-Fi outages disrupt my assignments, and this leads to late submissions and stress." These recurring issues undermined focus, productivity, and well-being, negatively influencing academic performance. Such barriers respond directly to RQ3 on how digital inequality shapes student outcomes.

5. Discussion of findings

This study demonstrates that digital inequality among ECP students is multi-layered, spanning access, capability, and outcomes. Consistent with Wei et al.'s (2011) three-level framework, the findings reveal how infrastructural gaps, digital skill disparities, and uneven learning outcomes are interconnected. The evidence builds on earlier South African research (Oyedemi & Mogano, 2018; Nyahodza & Higgs, 2017), which highlighted access deficits, but extends it by showing how these deficits cascade into capability and outcome inequalities for ECP students.

Recent studies echo this pattern: Zongozzi and Ngubane (2025) reported accessibility barriers for students with disabilities, while Maome et al. (2024) noted institutional weaknesses in sustaining digital adoption. Our results reinforce these arguments while adding new insights about infrastructural instability and uneven digital literacy training compound inequities among ECP cohorts specifically.

Theoretically, the findings validate the three-level digital divide model's utility in higher education, but also suggest refinements: infrastructural instability (e.g., delayed laptop provision, unstable Wi-Fi) should be treated as both an access and capability barrier, since it undermines skill development. This nuance strengthens the explanatory power of the model in contexts where infrastructure is fragile. Practically, the implications are clear.

Universities should act simultaneously across all three levels: (1) invest in reliable, affordable connectivity and device provision targeted at marginalised groups; (2) embed compulsory digital literacy training in curricula; and (3) monitor equity in outcomes through academic performance data. Policymakers should design national digital equity strategies that link infrastructure investments to pedagogical support, ensuring that interventions do not stop providing access but also build capacity and evaluate impact. Without coordinated strategies, ECP students remain at risk of exclusion in an increasingly digital academic environment.

6. Limitations

This study has several limitations that should be acknowledged. First, the use of purposive and convenience sampling restricted the representativeness of the sample and may have introduced self-selection bias, as students with stronger digital access or skills might have been more likely to participate. Second, academic performance was measured through self-reported perceptions rather

than institutional records such as GPA, which may limit accuracy. Similarly, digital literacy proficiency was also self-reported, raising the possibility of over- or underestimation. Future studies could address these concerns by triangulating survey data with institutional performance records and using performance-based digital literacy assessments (Kigwilu & Nyonje, 2024; Mateko, 2025). Third, the study was conducted at a single South African university, which limits the generalisability of findings to other institutions with different digital infrastructures and support systems. As recent work highlights, institutional contexts in Africa vary widely in terms of ICT capacity and digital inclusion policies (Mwansa, 2025; Zongozzi & Ngubane, 2025). Fourth, although mixed-methods triangulation and anonymity assurances were used to minimise bias, reliance on self-reported measures remains a constraint.

Finally, the scope of the literature integrated in this section is still developing. While this study adds new empirical insights on Extended Curriculum Programme students, further comparative research across mainstream and ECP cohorts, as well as across universities, is needed to validate and extend these findings. Despite these limitations, the study provides timely evidence on inequitable digital access and literacy in higher education and highlights urgent areas for institutional and policy intervention.

7. Recommendations and directions for future research

This study proposes several key recommendations to address the digital access and literacy challenges faced by ECP students. To improve access to technology, participants suggested providing laptops to students upon registration, improving IT infrastructure, and expanding institutional facilities. Additionally, greater government support was recommended for digital literacy initiatives in high schools. Students also emphasized the importance of continuous feedback and adaptability in e-learning environments, advocating for ongoing improvements to meet evolving technological needs.

For future research, comparative studies across different cultural and socioeconomic contexts are recommended, as they could provide valuable insights into the global digital divide in higher education. These studies would deepen the understanding of the impact of digital inequality on educational outcomes and help guide further policy interventions.

8. Contributions

This study makes several important contributions.

Theoretical contribution: By applying Wei et al.'s (2011) three-level digital divide framework within a South African higher education context, the study demonstrates how access, capability, and outcomes are interrelated in shaping student participation in e-learning. Recent research (Kigwilu & Nyonje, 2024; Mateko, 2025) confirms that the framework remains highly relevant but requires contextual adaptation. This study refines its application by foregrounding the Extended Curriculum Programme (ECP) cohort, highlighting how systemic inequities manifest differently compared to mainstream students. Empirical contribution. The findings provide original evidence from 226 ECP students

across three faculties, an under-researched group in South African digital education studies. Whereas most literature has focused on general student populations (Zhao et al., 2023; Zongozzi & Ngubane, 2025), this study generates new insights into how digital inequality specifically affects ECP students' academic participation, confidence, and outcomes. Practical and policy contribution. The results carry clear implications for higher education institutions and policymakers. Universities are encouraged to expand laptop provision schemes, integrate structured digital literacy modules, and invest in reliable connectivity. Policymakers should also prioritise digital equity policies that explicitly address marginalised student groups. These recommendations are consistent with recent calls for equity-driven digital policy in African higher education (Mwansa, 2025).

9. Conclusion

This study set out to examine how digital inequality shapes e-learning participation among Extended Curriculum Programme (ECP) students in South Africa, applying Wei et al.'s (2011) three-level digital divide framework. By combining survey data from 226 students across three faculties with qualitative interview insights, the analysis has demonstrated that disparities in access, capability, and outcomes remain pervasive and disproportionately affect marginalised students. The findings provide several important contributions.

Theoretically, the study extends the application of the three-level divide framework within an African higher education context, highlighting how interrelated deficits in infrastructure, digital literacy, and educational outcomes reinforce inequality. Empirically, it generates evidence on an often-overlooked student population, offering nuanced insights into the lived realities of ECP students navigating digitally stratified learning environments. Practically, the results carry significant implications for institutional policy and practice.

Universities should prioritise affordable and reliable connectivity, integrate structured digital literacy programmes into curricula, and ensure that laptop provision schemes reach the most vulnerable groups in a timely manner. Policymakers are also urged to design national digital equity strategies that address both infrastructural and pedagogical gaps to promote inclusive education. More broadly, the study underscores that digital equity is not only a technical challenge but also a social justice imperative for higher education in developing economies. Future research should explore longitudinal impacts of interventions and comparative studies across institutions to build a stronger evidence base for transformative digital inclusion.

10. Acknowledgements

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