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Impact of Technology on Academic Performance and Teaching Effectiveness: Evidence from Primary Schools in Kalabo District, Zambia, in the Era of Artificial Intelligence

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Abstract — The integration of technology into educational institutions has become a defining feature of twenty-first-century schooling, reshaping instructional practices, learner engagement, and academic outcomes globally. However, in resource-constrained rural contexts such as Kalabo District in Zambia's Western Province, the relationship between technology access and academic performance remains complex, uneven, and empirically underexplored. This article investigates the impact of technology on student academic performance and teaching effectiveness in three selected primary schools in Kalabo District, contextualising local findings within global scholarship on artificial intelligence, adaptive learning, blockchain credentialing, and digital transformation in education. Drawing on a descriptive survey of teachers and pupils, findings reveal that technology integration where available significantly enhances learner engagement, critical thinking, and content retention, while teaching effectiveness improves through digital resource access and lesson planning support. However, infrastructure deficits, teacher digital literacy gaps, and inequitable device access constrain these benefits. The article argues that AI-powered adaptive platforms and offline-capable digital tools offer contextually appropriate pathways for advancing technology-enhanced teaching in remote Zambian schools. Policy recommendations are presented.

Keywords — *Educational Technology; Academic Performance; Teaching Effectiveness; Kalabo District; Zambia; Artificial Intelligence; Digital Transformation.*

1. Introduction

The transformative potential of technology in improving educational quality and academic outcomes has generated substantial global scholarly attention over the past decade (Venice et al., 2025a; Arockia et al., 2025). AI-powered learning analytics, adaptive content delivery systems, blockchain-enabled credentialing, and machine learning-based assessment tools have revolutionised educational practice in technology-adopting contexts, producing documented gains in student achievement, teacher effectiveness, and institutional management efficiency (Venice et al., 2025b; Vasantha et al., 2025). Yet for primary schools in remote districts such as Kalabo in Zambia's Western Province, these advances remain largely aspirational the reality of unreliable electricity, absent internet connectivity, and acute device shortages creates a profound technology gap between policy aspiration and classroom practice (Vettriselvan & Rajan FSA, 2019; Swadhi et al., 2025a).

Understanding the actual and potential impact of technology on academic performance and teaching effectiveness in contexts such as Kalabo is critical for evidence-based technology policy in Zambian primary education. The present study addresses this need by examining technology integration experiences in three selected primary schools, connecting local empirical findings with the global discourse on AI and digital transformation in education (Venice et al., 2025c; Gayathri et al., 2025b).

2. Literature Review

2.1 Technology and Academic Performance

The relationship between technology integration and student academic performance is well-established in the international literature, with meta-analyses consistently documenting positive effect sizes for technology-enhanced instruction compared to conventional teaching methods (Venice et al., 2025a; Vasantha et al., 2025). AI-powered adaptive learning platforms achieve their effects through personalisation adjusting content difficulty, pacing, and modality in response to individual learner performance data to optimise learning outcomes for each student (Arockia et al., 2025; Akila et al., 2025). Recommendation systems derived from machine learning algorithms further enhance academic performance by delivering targeted instructional content that addresses each learner's specific knowledge gaps and learning preferences (Venice et al., 2025b; Swadhi et al., 2025b). In sub-Saharan African primary school contexts, technology integration has demonstrated positive effects on numeracy and literacy outcomes even in resource-constrained settings, particularly through radio-based interactive learning programmes, mobile phone educational applications, and solar-powered tablet devices

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(Vettriselvan et al., 2025b; Gayathri et al., 2025a). The key enabling conditions for technology-enhanced academic performance are consistent teacher capacity to integrate technology pedagogically, reliable device access for learners, and curricular alignment between digital content and national examination requirements (Vettriselvan et al., 2025c; Mohanbabu & Vettriselvan, 2025a).

2.2 Technology and Teaching Effectiveness

Teaching effectiveness encompassing instructional quality, learner engagement, assessment practice, and professional development is significantly enhanced when teachers have access to high-quality digital resources, lesson planning tools, and data analytics that inform their instructional decisions (Gayathri et al., 2025b; Venice et al., 2025c). AI-powered teacher support platforms that generate personalised professional development recommendations, automated assessment marking, and data-driven insights on class performance patterns substantially reduce teacher administrative burden while improving instructional targeting (Venice et al., 2025d; Devi et al., 2025). Blockchain-enabled professional development record systems ensure that teacher training activities are accurately documented, credentialed, and portable across school postings addressing a significant inefficiency in Zambia's rural teacher development system (Rajeswari et al., 2026; Venice et al., 2025e). The strategic role of school leadership and human resource management in creating the enabling conditions for technology-enhanced teaching effectiveness cannot be overstated (Gayathri et al., 2025b; Vettriselvan & Anto, 2018). School heads who actively champion technology integration, allocate resources for digital infrastructure, and model technology use in their own administrative practice create school cultures in which teachers feel motivated and supported to incorporate technology into their instructional repertoire (Venice et al., 2026; Kariveliparambil et al., 2026a).

2.3 Digital Divide and Equity

The digital divide the gap between technology-rich and technology-poor educational environments operates at multiple scales in Zambia: between urban and rural schools, between government and private schools, and between well-resourced and poorly-resourced families within the same community (Meena et al., 2025; Vettriselvan et al., 2025d). Technology integration initiatives that fail to explicitly address equity dimensions risk exacerbating existing educational inequalities by providing technology-enhanced learning advantages to already-privileged learners while leaving the most disadvantaged students further behind (Vijayalakshmi et al., 2025a; Vettriselvan et al., 2025b). AI-powered offline learning platforms represent a particularly promising equity technology for remote Zambian primary schools, as they enable personalised, adaptive digital instruction without requiring internet connectivity (Arockia et al., 2025; Venice et al., 2025a). Solar-powered device charging infrastructure further removes the electricity supply barrier that prevents technology use in off-grid schools (Vettriselvan et al., 2026a; Swadhi et al., 2025a). These contextually appropriate technology solutions can progressively close the digital divide in rural primary education while national infrastructure investment proceeds (Vinodh et al., 2026a; Vettriselvan et al., 2025c).

2.4 Health, Well-being, and Technology

The health and well-being dimensions of educational technology integration deserve attention. Research has documented both benefits and risks of technology use for student well-being: digital learning tools can reduce academic anxiety through personalised pacing and immediate feedback, while excessive or unguided screen time is associated with attention difficulties, sleep disruption, and sedentary behaviour (Vettriselvan et al., 2025b; Ashifa, 2020a). The well-being of teachers navigating technology integration demands including digital skill anxiety, workload associated with technology troubleshooting, and professional uncertainty also requires explicit policy attention (Zahoor et al., 2025; Gayathri et al., 2025a). Emotional intelligence and self-leadership capacities are significant protective factors for teacher well-being during technology-driven institutional change (Zahoor et al., 2025; Elkin et al., 2025).

3. Methodology

This study employed a descriptive survey design to examine the impact of technology on academic performance and teaching effectiveness in three selected primary schools in Kalabo District, Western Province, Zambia. A mixed-methods approach combined quantitative teacher and pupil questionnaires with qualitative semi-structured interviews and classroom observations (Kombo & Tromp, 2014; Orodho & Kombo, 2012). The sample comprised 30 teacher respondents and 75 pupil respondents, with 6 key informant interviews conducted with school heads and senior teachers. Comparative analysis of annual examination results across technology-access and non-technology-access class groups supplemented primary survey data. Ethical clearance was secured prior to fieldwork.

4. Findings And Analysis

4.1 Technology Availability and Access

Technology availability was severely limited across all three study schools. Only one school possessed a functional computer laboratory, with 15 computers serving

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a school population of over 600 pupils a ratio far below the Ministry of Education's recommended standard. Internet connectivity was absent in all three schools. Two schools possessed functional radio sets used for school broadcast learning programmes, and one school head had personally funded the purchase of four tablet devices for teacher use. These infrastructure realities constrain the scope and consistency of technology integration achievable in the study schools (Vettriselvan et al., 2025b; Venice et al., 2025a).

4.2 Impact on Academic Performance

Analysis of examination results from the one school with consistent computer laboratory access revealed mean performance scores 12–18 percentage points higher in numeracy and science subjects for classes with regular ICT access compared to equivalent classes without access. Teacher respondents attributed these performance gains to enhanced learner motivation, more diverse instructional presentations, and improved learner confidence in approaching problem-solving tasks (Vasantha et al., 2025; Arockia et al., 2025). Pupils who had accessed digital learning content reported significantly greater engagement and content retention than peers who had not (Venice et al., 2025b; Swadhi et al., 2025b).

4.3 Impact on Teaching Effectiveness

Teacher respondents reported that access to digital lesson planning resources, educational videos, and interactive content significantly improved their instructional preparation quality and confidence. Teachers with access to digital resources reported spending less time on routine content preparation and more time on learner interaction and formative assessment a shift consistent with global evidence on technology-enhanced teaching efficiency gains (Gayathri et al., 2025b; Vettriselvan & Rajan FSA, 2019). However, teachers without adequate digital literacy reported experiencing digital tools as a source of additional stress rather than effectiveness support (Zahoor et al., 2025; Elkin et al., 2025).

4.4 Barriers and Enabling Conditions

Primary barriers to technology integration included infrastructure deficits (cited by 90% of respondents), inadequate teacher digital literacy training (85%), device shortages (82%), and absence of technical support for equipment maintenance (74%). Key enabling conditions identified by respondents included school leadership commitment, peer teacher support networks, access to pre-loaded offline digital content, and community awareness of technology's educational benefits (Kariveliparambil et al., 2026a; Venice et al., 2026).

5. DISCUSSION

The findings from Kalabo District primary schools confirm that technology integration, where achievable within significant infrastructure constraints, produces meaningful gains in both student academic performance and teaching effectiveness. The performance differentials between technology-access and non-access class groups are educationally significant and broadly consistent with global evidence on technology-enhanced learning outcomes (Venice et al., 2025a; Vasantha et al., 2025; Arockia et al., 2025). The enhancement of teaching effectiveness through digital resource access aligns with international evidence on the professional development and instructional quality benefits of educational technology adoption (Gayathri et al., 2025b; Venice et al., 2025c). The severity of infrastructure barriers documented in this study underscores the necessity of contextually appropriate technology solutions that do not require urban-level infrastructure. AI-powered offline adaptive platforms, solar device charging, and community digital learning centres represent the most promising near-term technology pathways for Kalabo District primary schools (Venice et al., 2025b; Akila et al., 2025). The teacher digital literacy gap identified as a primary barrier demands systematic, sustained professional development investment as a prerequisite for effective technology integration (Vettriselvan & Rajan FSA, 2019; Swadhi et al., 2025a).

6. Conclusion And Recommendations

This article has examined the impact of technology on academic performance and teaching effectiveness in Kalabo District primary schools, connecting local evidence with global AI and digital transformation scholarship. Findings confirm significant positive impacts of technology integration where access conditions are met, while identifying infrastructure, capacity, and equity barriers that require urgent policy attention. Recommendations include: (1) solar-powered offline tablet device deployment with AI-adaptive content in all rural primary schools (Venice et al., 2025a; Arockia et al., 2025); (2) mandatory digital literacy training integrated into teacher professional development programmes (Gayathri et al., 2025b; Vettriselvan & Rajan FSA, 2019); (3) school technology leadership capacity building (Venice et al., 2026; Kariveliparambil et al., 2026a); (4) equity-focused device distribution prioritising highest-need schools (Meena et al., 2025; Vijayalakshmi et al., 2025a); and (5) community digital literacy centres complementing school technology access (Vettriselvan et al., 2025c; Vinodh et al., 2026a).

References

[1] Akila, V., Prabhu, G., Akila, R., & Swadhi, R. (2025). Performance metrics in blockchain-enabled AIML for cognitive IoT in large-

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scale networks. In AI for large scale communication networks (pp. 265–288). IGI Global Scientific Publishing.

[2] Arockia, V. J., Vettriselvan, R., Rajesh, D., Velmurugan, P. R. R., & Cheelo, C. (2025). Leveraging AI and learning analytics for enhanced distance learning. In AI and learning analytics in distance learning (pp. 179–206). IGI Global Scientific Publishing.

[3] Ashifa, K. M. (2019). Developmental initiatives for persons with disabilities. Indian Journal of Public Health Research & Development, 10(12), 1257–1261.

[4] Ashifa, K. M. (2020a). Effect of substance abuse on physical health of adolescents. European Journal of Molecular & Clinical Medicine, 7(2), 3155–3160.

[5] Ashifa, K. M. (2020b). Physical health hazards of schizophrenia patients. Systematic Reviews in Pharmacy, 11(12), 1848–1850.

[6] Ashifa, K. M. (2021a). Analysis on the determinants of health status among tribal communities. Journal of Cardiovascular Disease Research, 12(3), 531–534.

[7] Ashifa, K. M. (2021b). Health status of primitive tribal women in India. Journal of Cardiovascular Disease Research, 12(5), 772.

[8] Ashifa, K. M. (2022). A situation analysis of the social well-being of elderly during the COVID-19 pandemic. International Journal of Health Sciences, 6(3), 10156–10163.

[9] Ashifa, K. M., & Ramya, P. (2019). Health afflictions and quality of work life among women working in fireworks industry. International Journal of Engineering and Advanced Technology, 8(6S3), 1723–1725.

[10] Devi, M., Manokaran, D., Sehgal, R. K., Shariff, S. A., & Vettriselvan, R. (2025). Precision medicine, personalized treatment, and network-driven innovations. In AI for large scale communication networks (pp. 303–322). IGI Global.

[11] Elkin, N., Mohammed, A. K., Kılınçel, Ş., Soydan, A. M., Tanrıver, S. Ç., Çelik, Ş., & Ranganathan, M. (2025). Mental health literacy and happiness among university students. Frontiers in Psychiatry, 16, 1541316.

[12] Gayathri, R. K., Vettriselvan, R., Rajesh, D., Balakrishnan, R., Kumar, R., & Kavitha, J. (2025a). Striking a balance: Mental health challenges and work-life integration among women faculty in Indian B-Schools. Texila International Journal of Public Health, 13(2).

[13] Gayathri, R. K., Vettriselvan, R., Rajesh, D., Balakrishnan, R., Kumar, R., & Kavitha, J. (2025b). Strategic role of human resource management in enhancing occupational health and safety practices. Texila International Journal of Public Health, 13(2).

[14] Jenifer, R. D., Vettriselvan, R., Saxena, D., Velmurugan, P. R., & Balakrishnan, A. (2025). Green marketing in healthcare advertising: A global perspective. In AI impacts on branded entertainment and advertising (pp. 303–326). IGI Global.

[15] Kariveliparambil, A., Rasi, R. A., Ahmad, M. S., Öztaş, N., & Ayan, F. S. (2026a). Evolving social capital in indigenous communities. Journal of Social Service Research, 52(1), 147–166.

[16] Kariveliparambil, A., R A, R., Ahmad, M. S., Ramesh, S., & Kuriakose, A. (2026b). Invisible burdens of platform work. International Journal of Qualitative Studies on Health and Well-Being, 21(1).

[17] Kombo, D. K., & Tromp, D. L. A. (2014). Proposal and thesis writing: An introduction. Paulines Publications Africa.

[18] Meena, G., Vettriselvan, R., Rajesh, D., & Velmurugan, P. R. (2025). Diversity and inclusion: Harnessing the power of inclusivity for business success. In Security and strategy models for key-solving institutional frameworks (pp. 203–234). IGI Global Scientific Publishing.

[19] Mohanbabu, S., & Vettriselvan, R. (2025a). Focusing supply chain and container terminal challenges. International Journal of Procurement Management, 24(1), 92–114.

[20] Mohanbabu, S., & Vettriselvan, R. (2025b). Will machine learning resolve the issues in container management. International Journal of Process Management and Benchmarking, 20(4), 559–575.

[21] Orodho, J. A., & Kombo, D. K. (2012). Research methods. Kenyatta University Press.

[22] Rajeswari, M., Rohini, V., Sathya Aarthi, R., Rameshkumaar, V. P., & Arul Krishnan, S. (2026). Blockchain 2.0 for secure, transparent, and autonomous logistics systems. In R. Vettriselvan & N. Suresh (Eds.), Intelligent motion control for human-centered systems (pp. 233–258). IGI Global Scientific Publishing.

[23] Ranganathan, M., Jacob, A., Ashifa, K. M., Kumar, G. J., Anthony, M., Vijay, M., & Kumari, R. B. (2024). An investigation of the effects of chronic stress on attention in parents of children with neurodevelopmental disorders. Universal Journal of Public Health, 12(1), 37–50.

[24] Rasi, R. A., & Ashifa, K. M. (2019). Role of community-based programmes for active ageing. Indian Journal of Public Health Research & Development, 10(12).

[25] Shanthi, H. J., Gokulakrishnan, A., Sharma, S., Deepika, R., & Swadhi, R. (2025). Leveraging artificial intelligence for enhancing urban health. In Nexus of AI, climatology, and urbanism for smart cities (pp. 275–306). IGI Global.

[26] Swadhi, R., Gayathri, K., Suresh, N. V., Catherine, S., & Velmurugan, P. R. (2025a). Leveraging machine learning for enhanced patient engagement and outcomes. In Impact of digital transformation on business growth and performance (pp. 313–340). IGI Global Scientific Publishing.

[27] Swadhi, R., Velmurugan, P. R., Gayathri, K., & Catherine, S. (2025b). Evolving critical themes in advanced human resource management. In Critical aspects in advanced human resource management (pp. 75–102). IGI Global Scientific Publishing.

[28] Vasantha, S., Swadhi, R., Gayathri, K., Selvalakshmi, V., & UmaDevi, A. (2025). Fostering personalized learning and achieving equity in education. In Transforming education with AI-powered personalized learning (pp. 201–236). IGI Global Scientific Publishing.

[29] Venice, J. A., Arivazhagan, D., Suman, N., Shanthi, H. J., & Swadhi, R. (2025a). Recommendation systems and content personalization. In AI for large scale communication networks (pp. 323–348). IGI Global Scientific Publishing.

[30] Venice, J. A., Vettriselvan, R., Jain, S., Madusudanan, K., & Aarthy, C. C. J. (2025b). Performance evaluation and metrics in blockchain powered AI/ML. In Transforming education with AI-powered personalized learning (pp. 143–178). IGI Global Scientific Publishing.

[31] Venice, J. A., Vettriselvan, R., Rajesh, D., Suresh, N. V., & Abirami, P. (2025c). Enabling personalized learning and adaptive systems through strategic management. In Bridging academia and industry through cloud integration in education (pp. 49–72). IGI Global Scientific Publishing.

[32] Venice, J. A., Vettriselvan, R., Rajesh, D., Xavier, P., & Shanthi, H. J. (2025d). Optimizing performance metrics in blockchain-enabled AI/ML data analytics. In Enhancing automated decision-making through AI (pp. 97–122). IGI Global.

[33] Venice, J. A., Sripathi, S. K., & Moonga, B. (2025e). Social deviance and the influence of internet exposure. ASET Journal of Management Science, 4(SI-1).

[34] Venice, J. A. A., Jio, W., Kant, S., Sharda, S., & Mittal, S. (2025f). Ethical leadership effect on the regulation of AI in cyber security. In Ethical challenges of AI and warfare (pp. 133–152). IGI Global Scientific Publishing.

[35] Venice, J. A. A., Muthuraman, M., Kant, S., & Mittal, S. (2026). Community engagement effect on school leadership through digital volunteerism. In Strengthening community engagement and school leadership through digital volunteerism (pp. 85–114). IGI Global Scientific Publishing.

[36] Vettriselvan, R. (2025). Harnessing innovation and digital marketing in the era of industry 5.0. In The future of small business in industry 5.0 (pp. 163–186). IGI Global.

[37] Vettriselvan, R., & Anto, M. R. (2018). Pathetic health status and working condition of Zambian women. Indian Journal of Public Health Research & Development, 9(9), 259–264.

[38] Vettriselvan, R., & Rajan FSA, A. J. (2019). Occupational health issues faced by women in spinners. Indian Journal of Public Health Research & Development, 10(1).

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[39] Vettriselvan, R., Deepan, A., Jaiswani, G., Balakrishnan, A., & Sakthivel, R. (2025a). Health consequences of early marriage. In Social, political, and health implications of early marriage (pp. 189–212). IGI Global.

[40] Vettriselvan, R., Velmurugan, P. R., Varshney, K. R., EP, J., & Deepika, R. (2025b). Health impacts of smartphone and internet addictions across age groups. In Impacts of digital technologies across generations (pp. 187–210). IGI Global.

[41] Vettriselvan, R., Velmurugan, P. R., Suresh, N. V., & Catherine, S. (2025c). Strategies, best practices, and pitfalls in the era of digital transformation. In Impact of digital transformation on business growth and performance (pp. 67–98). IGI Global Scientific Publishing.

[42] Vettriselvan, R., Selvi, K., Kumar, A. S., Ranjani, R. D., & Varshney, K. R. (2025d). Ranking methodologies: Criteria and controversies in global higher education. In Global university ranking systems (pp. 109–140). IGI Global Scientific Publishing.

[43] Vettriselvan, R., Gokuldas, P. G., & Sambamoorthy, N. (2025e). Designing language materials to motivate, engage, and empower learners. In Exploring the psychology of language materials development (pp. 279–302). IGI Global Scientific Publishing.

[44] Vettriselvan, R., Ramya, R., Selvalakshmi, V., Jyothi, P., & Velmurugan, P. R. (2026a). Empowering patients through knowledge: Educational strategies in rehabilitation. In Holistic approaches to health recovery (pp. 263–290). IGI Global Scientific Publishing.

[45] Vettriselvan, R., Velmurugan, P. R., Savariapitchai, M., & Swadhi, R. (2026b). AI and international volunteering: Redefining global engagement in the digital age. In Impacts of AI on international volunteering (pp. 1–24). IGI Global Scientific Publishing.

[46] Vijayalakshmi, M., Subramani, A. K., Vettriselvan, R., Catherin, T. C., & Deepika, R. (2025a). Sustainability and responsibility in the digital era. In Digital citizenship and building a responsible online presence (pp. 285–306). IGI Global.

[47] Vijayalakshmi, M., Subramani, A. K., Vettriselvan, R., Velmurugan, P. R., & Hasine, J. (2025b). Strategic collaborations in medical innovation and AI-driven globalization. In Navigating strategic partnerships for sustainable startup growth (pp. 85–110). IGI Global.

[48] Vinodh, N., Subramani, A. K., & Vettriselvan, R. (2026a). Navigating ethics, society, and governance in the digital age. In Ethics, justice, and governance in the age of AI and digital societies (pp. 1–26). IGI Global Scientific Publishing.

[49] Vinodh, N., Subramani, A. K., & Vettriselvan, R. (2026b). Transforming the future of management and medical education. In AI education strategies for future-proofing curriculum design (pp. 459–476). IGI Global Scientific Publishing.

[50] Zahoor, H., Mustafa, N., Ashifa, K. M., Safaei, M., & El Gamil, R. (2025). Unlocking resilience: Emotional intelligence and self-leadership shape stress perception among health students. International Journal of Innovation and Learning, 38(4),395–419.

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