(REVIEW ARTICLE)

Designing accessible digital learning tools: Inclusive innovation for students with disabilities in emerging markets

Meron Aberra Tassew [1, *] and Uchenna William Nwoke [2]

[1] Marshall School of Business, University of Southern California, Los Angeles, United States.
[2] Department of Computer Science, Seattle University, Seattle, United States.

Abstract

Background: The rapid digitisation of education in emerging markets, particularly across Africa, risks creating a new digital divide by systematically excluding learners with disabilities. Traditional models of assistive technology are often high-cost and contextually inappropriate, while mainstream educational technology frequently overlooks fundamental accessibility principles, perpetuating a cycle of educational marginalisation.

Purpose: This research argues for a paradigm shift from retrofitting accessibility to proactively embedding it through "Inclusive Innovation." It aims to explore how digital learning tools can be designed and scaled to support learners with disabilities in underserved regions, moving beyond technical compliance to address pedagogical, cultural, and economic sustainability.

Methods: The research employs a qualitative analysis of existing literature and detailed case studies of initiatives within emerging markets. It synthesises findings from successful and failed interventions to construct a novel framework for design and implementation, grounded in the principles of Universal Design for Learning and community-led co-creation.

Results: The analysis reveals that successful initiatives are those that integrate accessibility from the outset, are developed through deep partnership with local communities, and are supported by robust ecosystems for teacher training and maintenance. Contrarily, failures consistently result from top-down technology imposition without community engagement or sustainable support structures. A four-pillar framework (Foundational Design, Community-Led Co-Creation, Ecosystem Development, and Context-Adaptive Scaling) is proposed as an effective model for action.

Conclusion: The digital revolution in education offers an unprecedented opportunity to build equitable systems. Realising this requires a steadfast commitment to Inclusive Innovation, ensuring that digital learning tools are designed for all learners from the start. This is not merely a technical challenge but an ethical imperative to fulfil the right to education for every child.

Keywords: Accessible Education; Digital Learning Tools; Inclusive Innovation; Disability; Emerging Markets; Co-Design; Universal Design for Learning

1. Introduction

The global education terrain is undergoing a significant transformation, driven by the rapid integration of digital technologies. In emerging markets, particularly across Africa, mobile devices and online platforms are heralded as

* Corresponding author: Meron Aberra Tassew

powerful tools for overcoming traditional barriers to education, such as geographical isolation and resource scarcity [1, 2]. This digital shift promises expanded access to quality learning materials for millions [3]. However, this promise remains tragically unfulfilled for a significant population of young learners. The World Health Organisation estimates that nearly 240 million children worldwide live with disabilities, with a disproportionate concentration in low and middle-income countries. In many African nations, over ninety per cent of these children are excluded from formal education systems entirely [4].

This exclusion is now at risk of being digitally replicated. The burgeoning educational technology sector, while innovative, frequently overlooks the fundamental principles of accessible design [5]. Many new learning applications and platforms are developed for a hypothetical mainstream user, inadvertently creating new barriers for students with visual, auditory, motor, or cognitive impairments [6]. The result is a dangerous paradox: digital tools designed to bridge educational equity gaps are instead cementing a new digital divide, one that systematically marginalises learners with disabilities [7, 8]. This neglect perpetuates a cycle of dependency on outdated models of assistive technology, which are often expensive, imported, and difficult to maintain in local contexts, rendering them impractical for widespread use.

Consequently, a critical juncture has been reached. The current period of intense technological adoption in emerging markets presents a unique and urgent opportunity. [9, 10]. This research thereby argues for a fundamental shift in approach. It proposes that the design and scaling of digital learning tools for underserved regions must be grounded in a principle of "Inclusive Innovation". This paradigm moves beyond technical compliance to embrace a holistic, human-centred methodology. It demands that solutions are co-created with learners with disabilities, their teachers, and communities, ensuring they are not only accessible but also pedagogically sound, culturally appropriate, and economically sustainable. This research will explore this paradigm, analysing the shortcomings of current models and proposing a framework for realising a truly equitable digital future for education.

2. The Disconnect: Assistive Technology and edtech in Parallel Silos

The historical approach to supporting learners with disabilities has been characterised by a fundamental separation of systems, a schism that the recent surge in educational technology has failed to heal [11]. On one side resides the traditional domain of assistive technology. This field has long been defined by specialised, often high-cost, hardware and software solutions such as screen readers, advanced braille displays, and sophisticated communication devices [12]. These tools are typically developed in high-income countries, designed for stable infrastructure and supported by extensive networks of trained specialists [13]. Their implementation in many African contexts faces immediate and often insurmountable hurdles. The procurement costs are prohibitive for most government education budgets, localised technical support is scarce, and software is rarely optimised for the linguistic diversity or the cultural context of the learners it aims to serve [5]. A braille note-taker designed in Boston may struggle with the character sets of local languages, and a high-end screen reader remains useless in a community without reliable electricity to charge its battery. This model creates a dependency on international imports and charitable donations, fostering a system that is unsustainable and unable to scale to meet the vast need.

Concurrently, the educational technology sector in emerging markets has experienced explosive growth, fuelled by venture capital and a focus on scalable solutions for mass markets. Platforms providing curriculum-aligned content, quiz applications, and school management systems are designed for the largest possible user base [14]. In the pursuit of rapid scaling and market capture, accessibility is frequently treated as a secondary feature, a niche concern to be addressed later if ever. Common oversights include a lack of alternative text for images, missing captioning for video content, poor keyboard navigation for those unable to use a mouse, and interfaces incompatible with open-source screen readers like NVDA (NonVisual Desktop Access [15]. This omission is not merely technical but pedagogical, as it excludes learners from the fundamental activities of engagement and interaction.

The consequence of this separation is the perpetuation of two unequal and segregated educational experiences. A student with a visual impairment might be provided with a dedicated, isolated device running a screen reader, while their peers engage with a dynamic, colourful EdTech application on a tablet. These two systems do not communicate. The assistive technology device cannot interpret the content within the mainstream application, and the application was not built to output data in a format the device can use [16, 17]. This technical divide mirrors a social one, isolating the learner rather than including them. This approach misses a significant opportunity to harness the universal design principles that underpin much assistive technology, which, when integrated into mainstream tools, can benefit all students [18, 19]. For example, captioning aids not only those who are deaf but also students learning in a second language or in a noisy environment. The current model, however, ensures that the innovative energy of the EdTech sector bypasses the very learners who could most benefit from its transformative potential, leaving them dependent on a separate, often broken, system of support.

3. Defining 'Inclusive Innovation': A Paradigm Shift for edtech

The deficiencies inherent in the current disjointed approach necessitate a fundamental reimagining of how technology for education is conceived and developed for marginalised communities. This proposed new direction, termed 'Inclusive Innovation', represents a paradigm shift away from remediation and towards integration [20]. It is a philosophy that asserts accessibility must be the starting point of the design process, not an expensive addition considered only after a product is mature. This concept challenges the very ethos of a technology sector that often prioritises speed to market and user acquisition numbers over equitable participation. Inclusive Innovation demands a slower, more deliberate, and profoundly more collaborative methodology that places the lived experiences of learners with disabilities at the centre of creation [21].

A foundation of this approach is the principle of community-led co-design. This moves beyond mere consultation to establish a process where students, their families, local teachers, and disability advocates become essential partners in the design studio. Their role is not to provide feedback on pre-conceived prototypes but to actively define the problems to be solved and to help generate the solutions. This collaborative effort ensures that the resulting tools are not only functionally useful but also culturally resonant and aligned with the practical realities of local classrooms and home environments. For example, a digital literacy tool might be co-designed to function effectively in a multilingual household where a device is shared, or to align with specific pedagogical practices common in a region [22]. This process inherently builds local capacity and ownership, increasing the likelihood of sustained adoption long after the initial project funding ends.

Furthermore, Inclusive Innovation is explicitly contextual. It requires a deep understanding of the infrastructural and economic landscapes of its intended deployment. This means designing for low-bandwidth environments, for devices with small screens and limited processing power, and for situations where internet connectivity is intermittent or unavailable. Affordability is treated not as a constraint but as a primary design criterion, pushing innovation towards lightweight applications, offline functionality, and the use of open-source platforms to avoid licensing fees. This stands in contrast to the importation of high-specification, cloud-dependent software from the Global North that is destined to fail in resource-constrained settings [23].

Therefore, Inclusive Innovation is undergirded by the pedagogical framework of Universal Design for Learning (UDL). UDL provides a blueprint for creating learning experiences that accommodate individual learning differences from the outset [24]. An inclusively innovative EdTech tool, therefore, would inherently provide multiple means of representation for content, multiple means for action and expression, and multiple means of engagement [25]. This ensures the tool is flexible and powerful enough to serve a wide spectrum of learners, including those with disabilities, those facing linguistic barriers, and those who simply learn in diverse ways. It transforms accessibility from a separate feature into the foundational architecture of the educational experience itself.

4. A Framework for Design and Implementation: The Four Pillars

Translating the philosophy of Inclusive Innovation into tangible practice requires a structured yet adaptable framework. This framework, developed from decades of observing educational interventions succeed and fail, is built upon four essential pillars. These pillars provide a comprehensive roadmap for developers, policymakers, and educators to collaboratively create digital learning tools that are not only accessible but also sustainable and effective within the demanding contexts of emerging markets.

4.1. The first pillar

Concerns the Foundational Design and Pedagogy of the technology itself. This is where the commitment to accessibility becomes operational. It necessitates a design process that begins with compliance to international standards such as the Web Content Accessibility Guidelines (WCAG), but then moves decisively beyond them. True inclusivity requires compatibility with the free and open-source assistive technologies that are most likely to be adopted in resource-constrained environments [26]. A tool must be fully navigable using a keyboard alone for students with motor impairments, and it must interoperate seamlessly with screen readers like NVDA, which are freely available. Furthermore, pedagogical design must be infused with the principles of Universal Design for Learning. This means content must be available in multiple, flexible formats. Text should be accompanied by audio narration, videos must include accurate closed captions and audio descriptions, and interactive exercises should offer different pathways to demonstrate mastery. Specifically, this pillar demands linguistic and cultural localisation that goes beyond simple translation. Text-to-speech engines must support local languages and accents, and content examples must be relevant

to the lived experiences of the learners. A mathematics problem should use scenarios from a local market, not a foreign supermarket, to ensure cognitive accessibility and engagement for all students [26].

4.2. The second pillar

Community-Led Co-Creation, forms the ethical and practical heart of the entire process. Technology imposed from the outside, regardless of its technical excellence, is prone to failure [27]. Sustainable solutions are born from genuine partnership. This involves engaging learners with disabilities, their parents, local teachers, and Disabled Persons' Organisations (DPOs) not as subjects for research but as co-designers and equal partners throughout the project lifecycle, from initial ideation to prototyping, testing, and iterative refinement [28]. Their lived experience is the most valuable dataset available, revealing barriers and opportunities invisible to external developers. Methods for this engagement must themselves be accessible. Design workshops might need to be conducted in multiple formats, using physical prototypes, braille materials, or sign language interpreters to ensure full participation. This collaborative approach ensures the final product addresses real problems in a culturally acceptable manner, fostering a profound sense of ownership and significantly increasing the likelihood of long-term adoption and use [29, 30]. A digital literacy app designed with and by teachers from rural Kenyan schools will inherently account for large class sizes and intermittent electricity in a way that an app designed in Silicon Valley would not.

4.3. The third pillar

Addresses the critical need for Sustainable Ecosystem Development. A tool's launch is not the end point but the beginning of its life cycle. The most perfectly designed application will have zero impact if teachers are untrained in its use, if broken devices cannot be repaired locally, or if there is no community of support. This pillar emphasises the creation of an extensive support system around the technology. Investment must be made in comprehensive teacher professional development, moving beyond one-off training sessions to ongoing coaching and the creation of peer-support networks, as also related by Gerdeman, Garrett, Monahan (2018) [31]. Teachers need to feel confident not only in using the technology but also in integrating it effectively into their pedagogical practice to support diverse learners [32, 33]. Simultaneously, local capacity must be built for technical maintenance, troubleshooting, and minor repairs. Training local technicians or empowering school-based staff to perform basic maintenance creates a resilient support structure that avoids dependency on international experts [34]. Furthermore, establishing clear channels for user feedback and providing mechanisms for continuous, low-cost updates are essential for the long-term relevance and functionality of the tool [35].

4.4. The fourth and final pillar

Involves the formulation of Context-Adaptive Scaling Models. Scaling in this context cannot mean simply distributing more devices. It requires strategic models that are tailored to the economic and institutional realities of the region. Traditional market-led scaling may be insufficient initially. Alternative pathways must be explored, such as deep integration into national educational technology policies and government procurement plans, as also related by King and South (2017) [36]. Partnerships with non-governmental organisations can facilitate last-mile delivery to the most remote schools [37]. Social enterprise models, where local entrepreneurs are supported to establish microbusinesses offering access to and support for the technology, can create economic incentives for sustainability. Another effective model is a phased approach, beginning with intensive piloting in a few regions to refine the tool and its support systems, before gradually expanding to a wider scale, ensuring that the necessary ecosystem development keeps pace with geographical spread. The choice of scaling strategy must be a deliberate decision, based on a clear understanding of the local infrastructure, political will, and community readiness [38].

Therefore, these four pillars, Foundational Design, Community-Led Co-Creation, Ecosystem Development, and Context-Adaptive Scaling, are interdependent. Strength in one cannot compensate for weakness in another. A well-designed tool will fail without teacher training; a brilliantly supported project will falter if the technology itself is not fit for purpose. This integrated framework provides a blueprint for moving from isolated pilot projects to transformative, system-wide change, ensuring that the digital revolution in education finally includes every learner.

5. Case Studies in Context: Illustrations of Success and Failure

Concrete examples from the field provide critical insight into the practical application of the principles underpinning Inclusive Innovation. These cases illustrate the tangible consequences of both adhering to and neglecting the proposed framework, offering valuable lessons for future endeavours.

A compelling example of success rooted in contextual intelligence and ecosystem development is found in the work of eKitabu, a Kenyan digital publishing initiative. Their approach to making digital books accessible for learners with print disabilities demonstrates a profound understanding of local constraints. Rather than developing a standalone, high-cost assistive device, eKitabu focused on creating software solutions that integrate accessibility features directly into their digital content platform. Their books are designed with built-in text-to-speech, adjustable fonts and colours, and compatibility with free screen readers. Specifically, their success was amplified through strategic integration into government systems. Aligning their offering with Kenya's national digital learning programme enables them to scale through public tender processes, ensuring their accessible content reaches schools across the country [39]. This model exemplifies how leveraging existing infrastructure and policy channels can facilitate widespread adoption without relying on charitable distribution.

On the contrary, a well-documented failure highlights the perils of neglecting community co-creation and sustainable support structures. Between 2010 and 2015, numerous projects aimed to distribute dedicated assistive hardware, such as specialised braille e-readers or tablets pre-loaded with educational applications, to schools in East Africa. One such initiative, which received significant initial funding, provided hundreds of such devices to schools for the blind. However, the project faltered within two years. The hardware, while technologically advanced, was not ruggedised for the environment, leading to frequent breakdowns from dust and heat. No local repair networks were established, and spare parts were unavailable. Furthermore, teachers received only a single day of training and were not involved in the selection of the content or the design of the devices, resulting in low engagement and ineffective pedagogical integration [40, 41]. The devices were thereby abandoned in storage cupboards, a testament to the fact that technology, no matter how innovative, is useless without a dedicated focus on the human and systemic elements required for its longevity.

These contrasting cases revealed a clear pathway. The Kenyan example shows that success is not merely a product of good design but of a holistic strategy that embeds innovation within supportive policy and economic ecosystems. The hardware distribution failure highlights a fundamental truth: importing solutions without deep local partnership and investment in maintenance capacity is a short-term intervention destined for obsolescence. The difference between these outcomes lies not in the sophistication of the technology but in the commitment to understanding and resourcing the context in which it must function. These real-world experiments affirm that sustainable inclusion is an organisational and systemic achievement, not a technological purchase.

Challenges and Future Directions

Despite the clear imperative and emerging frameworks for Inclusive Innovation, the path towards system-wide adoption is fraught with persistent obstacles. These challenges are deeply embedded in socio-cultural, economic, and political structures, demanding concerted and multifaceted responses. A primary barrier remains the pervasive stigma and deeply held cultural beliefs surrounding disability in many communities. In numerous contexts, disability is still perceived through a charitable or medicalised lens, rather than as a dimension of human diversity that necessitates rights-based responses to inclusion [42]. This can lead to low expectations for learners with disabilities, resulting in a lack of parental advocacy and even resistance to their inclusion in mainstream digital initiatives. Overcoming these attitudinal barriers requires sustained community engagement and awareness campaigns that are sensitive to local belief systems, a process that is often slow and resource-intensive.

A second, equally formidable challenge is the fragmented nature of government policy and implementation. While many countries have ratified the UN Convention on the Rights of Persons with Disabilities and have established policies on inclusive education, these mandates frequently fail to translate into actionable strategies or budgeted programmes at the ministerial level. The education and technology sectors often operate in silos, with national EdTech strategies remarkably silent on the issue of accessibility [43]. This policy paralysis creates an environment of uncertainty for developers and NGOs, stifling investment in inclusive tools. Future efforts must therefore prioritise high-level advocacy to ensure accessibility is not an optional addendum but a core requirement in national educational technology procurement and policy frameworks.

The financial sustainability of inclusive projects presents a third major hurdle. The development and scaling of high-quality, accessible, and designed tools necessitate significant upfront investment. Traditional venture capital, which fuels much of the mainstream EdTech sector, typically seeks rapid returns and massive scale, metrics that social-impact-focused, inclusive innovations may not meet in conventional terms. There is a critical need for more patient capital in the form of impact investment, catalytic grants, and public-private partnerships that are specifically designed to support initiatives prioritising equity over exponential growth [44]. New funding models must be developed that recognise the long-term social return on investment inherent in educating all of a nation's citizens.

Looking ahead, several key directions for future research and action emerge. First, there is a pressing need for robust, contextually relevant metrics to evaluate the impact of inclusive digital learning tools. Research must move beyond simple measures of access or usage to capture different data on learning outcomes, skill acquisition, and social inclusion for students with disabilities. Second, further investigation is required into the most effective models for training and supporting teachers in low-resource settings, as they remain the linchpin of any successful educational innovation. Finally, the field would benefit from detailed comparative studies analysing the cost-effectiveness of different scaling models, from government adoption to social enterprise approaches, to provide clearer evidence for policymakers and investors alike. Addressing these challenges and pursuing these research directions is essential for transforming the promise of Inclusive Innovation from a compelling theory into a tangible reality for millions of learners.

6. Conclusion

The digital transformation of education in emerging markets presents a significant historical choice. We can either replicate the exclusionary practices of the past within new technological systems, or we can seize this moment to build a more equitable future. This article has argued that the current trajectory, where assistive technology and mainstream educational technology develop in isolation, is unsustainable and morally indefensible. It actively perpetuates the very inequalities that digital tools are purported to solve. The alternative path requires a fundamental commitment to Inclusive Innovation, a paradigm that demands a radical reimagining of the design process, placing the voices and experiences of learners with disabilities at its very centre.

The framework proposed here is built upon the four integrated pillars of foundational design, community-led co-creation, ecosystem development, and context-adaptive scaling, and provides a practical blueprint for action. It moves beyond theoretical ideals to offer a structured approach for creating learning tools that are not only accessible but also pedagogically robust, culturally relevant, and economically viable. The case studies examined demonstrate clearly that success is determined not by the sophistication of the technology but by the depth of engagement with the context in which it must function. The challenges of stigma, policy fragmentation, and funding models are significant, yet they are not insurmountable. They define the critical work that lies ahead.

Therefore, this is more than a technical or pedagogical challenge; it is a test of collective ethical commitment to education as a universal human right. For researchers, policymakers, investors, and developers, the imperative is clear. We must converge our efforts to ensure that the digital future of learning is designed for everyone from the outset. The goal is not merely to provide access to technology, but to guarantee meaningful educational participation and outcomes for every learner, affirming the inherent value and potential of all children, regardless of ability or geography.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict-of-interest to be disclosed.

References

[1]   Mafenya NP. Exploring technology as enabler for sustainable teaching and learning during Covid-19 at a university in South Africa. Perspect Educ. 2022 Sep 30;40(3):212-23.

[2]   Oloyede AA, Faruk N, Raji WO. COVID-19 lockdown and remote attendance teaching in developing countries: A review of some online pedagogical resources. Afr J Sci Technol Innov Dev. 2022 Apr 16;14(3):678-96.

[3]   Haleem A, Javaid M, Qadri MA, Suman R. Understanding the role of digital technologies in education: A review. Sustain Oper Comput. 2022;3:275-85. doi: 10.1016/j.susoc.2022.05.004.

[4]   World Health Organization. Almost one billion children and adults with disabilities and older persons in need of assistive technology denied access, according to new report. 2022. Available from: https://www.who.int/news/item/16-05-2022-almost-one-billion-children-and-adults-with-disabilities-and-older-persons-in-need-of-assistive-technology-denied-access--according-to-new-report

[5]   Lynch P, Singal N, Francis GA. Educational technology for learners with disabilities in primary school settings in low- and middle-income countries: A systematic literature review. Educ Rev. 2022;76(2):405-31. doi: 10.1080/00131911.2022.2035685.

[6] Harris JE. The aesthetics of disability. Columbia Law Rev. 2019 May 1;119(4):895-972.

[7] Zelenev S. Promoting digital inclusion: Intergenerational aspects. In: Digital Transformation and Social Well-Being. Routledge; 2022. p. 3-22.

[8] Bandyopadhyay S, Bardhan A, Dey P, Bhattacharyya S. Bridging the education divide using social technologies. Singapore: Springer; 2021.

[9] Lister K, Pearson VK, Coughlan T, Tessarolo F. Inclusion in uncertain times: Changes in practices, perceptions, and attitudes around accessibility and inclusive practice in higher education. Educ Sci. 2022;12(8):571. doi: 10.3390/educsci12080571.

[10] Molina Roldán S, Marauri J, Aubert A, Flecha R. How inclusive interactive learning environments benefit students without special needs. Front Psychol. 2021 Apr 29;12:661427. doi: 10.3389/fpsyg.2021.661427.

[11] Rizk J, Hillier C. Digital technology and increasing engagement among students with disabilities: Interaction rituals and digital capital. Comput Educ Open. 2022;3:100099. doi: 10.1016/j.caeo.2022.100099.

[12] Hersh M, Mouroutsou S. Learning technology and disability Overcoming barriers to inclusion: Evidence from a multicountry study. Br J Educ Technol. 2019 Nov;50(6):3329-44.

[13] Banes D, Hayes A, Kurz C, Kushalnagar R. Using information communications technologies (ICT) to implement universal design for learning (UDL). In: Universal Access in Human-Computer Interaction. Applications and Practice. 2019. p. 545-56.

[14] Rosário AT, Dias JC. Learning management systems in education: Research and challenges. In: Digital active methodologies for educative learning management. IGI Global Scientific Publishing; 2022. p. 47-77. doi: 10.4018/978-1-6684-4706-2.ch003.

[15] Billah SM, Ashok V, Porter DE, Ramakrishnan IV. Ubiquitous accessibility for people with visual impairments: Are we there yet? Proc SIGCHI Conf Hum Factor Comput Syst. 2017 May;2017:5862-8. doi: 10.1145/3025453.3025731.

[16] McNicholl A, Casey H, Desmond D, Gallagher P. The impact of assistive technology use for students with disabilities in higher education: a systematic review. Disabil Rehabil Assist Technol. 2021 Feb 17;16(2):130-43.

[17] Senjam SS, Manna S, Bascaran C. Smartphones-based assistive technology: accessibility features and apps for people with visual impairment, and its usage, challenges, and usability testing. Clin Optom. 2021 Nov 27:311-22.

[18] Botelho FH. Accessibility to digital technology: Virtual barriers, real opportunities. Assist Technol. 2021 Dec 1;33(sup1):27-34.

[19] Brandt Å, Jensen MP, Søberg MS, Andersen SD, Sund T. Information and communication technology-based assistive technology to compensate for impaired cognition in everyday life: a systematic review. Disabil Rehabil Assist Technol. 2020 Oct 2;15(7):810-24.

[20] Patnaik J, Bhowmick B. Promise of inclusive innovation: A re-look into the opportunities at the grassroots. J Clean Prod. 2020 Jun 20;259:121124.

[21] Holloway C, Barbareschi G. Disability interactions: Creating inclusive innovations. Springer Nature; 2022 May 31.

[22] Han Y. Understanding multilingual young adults and adolescents' digital literacies in the wilds: Implications for language and literacy classrooms. Issues Trends Learn Technol. 2021;9(1). doi: 10.2458/azu_itlt_v9i1_han.

[23] Opara-Martins J, Sahandi R, Tian F. Critical analysis of vendor lock-in and its impact on cloud computing migration: a business perspective. J Cloud Comp. 2016;5:4. doi: 10.1186/s13677-016-0054-z.

[24] Rao K, Meo G. Using universal design for learning to design standards-based lessons. Sage Open. 2016 Nov;6(4):2158244016680688.

[25] Capp MJ. The effectiveness of universal design for learning: A meta-analysis of literature between 2013 and 2016. Int J Incl Educ. 2017 Aug 3;21(8):791-807.

[26] Bauer C, Gallagher MJ. Education for humanity: Higher education for refugees in resource-constrained environments through innovative technology. J Refug Stud. 2020 Jun;33(2):416-36.

[27] Cook A, Thomas A. Community led technology co-creation in engineering education. In: Innovation, Practice and Research in Engineering Education EE2012. 2012. p. 7.

[28] Hayes AM, Bulat J. Disabilities Inclusive Education Systems and Policies Guide for Low- and Middle-Income Countries [Internet]. Research Triangle Park (NC): RTI Press; 2017. doi: 10.3768/rtipress.2017.op.0043.1707.

[29] Yalcinkaya G. A culture-based approach to understanding the adoption and diffusion of new products across countries. Int Mark Rev. 2008 Apr 25;25(2):202-14.

[30] Harrison R, Fischer S, Walpola RL, Chauhan A, Babalola T, Mears S, Le-Dao H. Where do models for change management, improvement and implementation meet? A systematic review of the applications of change management models in healthcare. J Healthc Leadersh. 2021 Mar 12;13:85-108. doi: 10.2147/JHL.S289176.

[31] Gerdeman D, Garrett R, Monahan B. Teacher Professional Learning through Teacher Network Programs: A Multiple Case Study Investigation. American Institutes for Research. 2018 Mar.

[32] Akram H, Abdelrady AH, Al-Adwan AS, Ramzan M. Teachers' perceptions of technology integration in teaching-learning practices: A systematic review. Front Psychol. 2022 Jun 6;13:920317.

[33] Anderson SE, Putman RS. Special education teachers' experience, confidence, beliefs, and knowledge about integrating technology. J Spec Educ Technol. 2020 Mar;35(1):37-50.

[34] Richter A, Sjunnestrand M, Romare Strandh M, Hasson H. Implementing school-based mental health services: A scoping review of the literature summarizing the factors that affect implementation. Int J Environ Res Public Health. 2022 Mar;19(6):3489. doi: 10.3390/ijerph19063489.

[35] Viswanath K, Synowiec C, Agha S. Responsive feedback: Towards a new paradigm to enhance intervention effectiveness. Gates Open Res. 2019 May 28;3:781. doi: 10.12688/gatesopenres.12937.2.

[36] King J, South J. Reimagining the role of technology in higher education: A supplement to the national education technology plan. US Department of Education, Office of Educational Technology. 2017;10:1-0.

[37] Nagarajan L, Muesembi T, Fernando A. Review of Existing Last Mile Seed Delivery Models and Approaches. A Feed the Future Global Supporting Seed Systems for Development activity (S34D) report. 2019 Oct 30.

[38] Bulthuis SE, Kok MC, Raven J, Dieleman MA. Factors influencing the scale-up of public health interventions in low- and middle-income countries: a qualitative systematic literature review. Health Policy Plan. 2020 Mar 1;35(2):219-34. doi: 10.1093/heapol/czz140.

[39] Barasa PL. Digitalization in teaching and education in Kenya: Digitalization, the future of work and the teaching profession project. Int Labour Organ. 2021.

[40] Gunter GA, Reeves JL. Online professional development embedded with mobile learning: An examination of teachers' attitudes, engagement and dispositions. Br J Educ Technol. 2017 Nov;48(6):1305-17.

[41] Liu SH. Factors related to pedagogical beliefs of teachers and technology integration. Comput Educ. 2011 May 1;56(4):1012-22.

[42] Berghs M, Chataika T, El-Lahib Y, Dube K, editors. The Routledge handbook of disability activism. New York: Routledge; 2020.

[43] Hackman ST, Reindl S. Challenging EdTech: Towards a more inclusive, accessible and purposeful version of EdTech. Knowl Cult. 2022;10(1):7-21.

[44] Mazzucato M, Macfarlane L. Patient Finance for Innovation-Driven Growth. UCL Inst Innov Public Purpose, Policy Brief Ser. 2018;(IIPP PB 01).