

## REVITALIZATION OF DIGITAL TECHNOLOGY TOOLS IN THE SMART CLASSROOM FOR THE TEACHING AND LEARNING OF ADULTS

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### Abstract

The smart classroom has emerged as an innovative teaching and learning model in the digital age, providing greater flexibility, accessibility, and interactive learning opportunities. Nevertheless, its implementation raises several concerns relating to educational environments, technological infrastructure, pedagogical practices, and effective classroom management. These issues involve the uneven distribution of digital tools and networks, variations in personalized learning and unequal training of educators. The effective operation of smart classroom relies on high quality digital tools and stable network connection. In some developed regions, schools may find it relatively easy to access these resources, providing learners with a better experience of digital technology education. However, in underdeveloped areas, schools may face issues such as aging digital devices and poor network connectivity, preventing learners from enjoying an equal level of smart classroom teaching. Therefore this paper presents as; revitalization of digital technology tools in the smart classroom for the teaching and learning of adults. The paper however discusses; strategies for sustainable implementation of digital tool in the smart classroom setting, enhancing adult learners through digital classroom, challenges in digital technology in emerging smart classroom learning for adult learners, solution to the challenges highlighted. Though the information provided, it may be better to understand the comprehensive impact of digital technology in the smart classroom for effective teaching and learning, providing valuable insight for future educational transformation.

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**Keywords:** Revitalization, digital technology tools, smart classroom, teaching and learning

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### Introduction

The revitalization of digital technology has reshaped the landscape of education, introducing new methods for delivering instruction and supporting student learning. Digital learning tools such as Learning Management Systems (LMS), interactive simulations, and gamified content are now widely used to promote active learning, collaboration, and personalised educational experiences. These tools have been particularly effective in enhancing adult educational learning achievement in many developed regions, where digital infrastructure is robust and access is widespread (Uzorka & Kalabuki, 2024; Wang, Zuo, He, & Wang, 2025; Wong, Lee, Chan, Tan, Huang, & Lee, 2025). According to Liu (2023), a smart classroom is an instructional model based on advanced information technology, with its core focus on integrating digital tools and resources to create a more flexible and interactive learning environment. The definition of smart classrooms involves a reimagining of the educational process, emphasizing student participation and personalized learning. Its characteristics are primarily manifested in the following aspects:

Smart classrooms utilize electronic devices, online resources, and other digital tools to enable students to conveniently access, share, and communicate information. This expands the scope of education, breaking the temporal and spatial constraints of traditional teaching; personalized learning is a crucial feature of smart classrooms. Through the use of intelligent learning systems, learning content can be customized based

on each student's learning style, interests, and proficiency, thereby enhancing the effectiveness of learning; smart classrooms emphasize interaction and collaboration. Through methods such as online discussions and team projects, interaction among students is encouraged, fostering a spirit of teamwork and, consequently, enhancing students' overall competence.

Smart classrooms demonstrate significant advantages in improving teaching and learning. Through personalized learning, students will be more effectively digest and absorb knowledge, meeting their individual subject-specific learning needs. Educators can adjust teaching strategies promptly based on students' learning situations, better fulfilling their subject-specific requirements and improving subject grades (Long, 2023). Smart classrooms provide a more intuitive and vivid learning experience through digital means. For example, through virtual experiments and multimedia materials, abstract concepts are made more concrete, sparking students' interest in learning and enhancing their understanding and retention of subjects. It also offer students a more flexible learning schedule and environment. The importance of digital technology in emerging smart classroom cannot be overstated. These smart classroom often face substantial obstacles, including inadequate infrastructure, limited resources, and socio-economic disparities, which hinder delivering high-quality education to all population segments. Digital technology offers the potential to transcend geographical boundaries, reduce costs, and provide personalized learning experiences tailored to diverse learner needs. By leveraging digital tools and platforms, digital technology can facilitate access to educational resources, interactive learning experiences, and innovative teaching methodologies, thereby bridging the gap between learners and quality education through smart classroom setting (Eden, Chisom, & Adeniyi, 2024; Pinto & Leite, 2020).

The potential of digital technology to address challenges in access and quality of education in a smart classroom learning is multifaceted. It enables delivering educational content and resources to remote and underserved areas, expanding educational opportunities for marginalized communities. Additionally, digital technology can enhance the quality of instruction by providing teachers with access to professional development resources, enabling them to adopt student-centered pedagogies and leverage data-driven insights to personalize learning experiences (Bowman, Vongkulluksn, Jiang, & Xie, 2022; Hennessy et al., 2022). Furthermore, the integration of digital technology in the smart classroom fosters the development of digital literacy and 21st-century skills, which are essential for preparing learners to thrive in an increasingly technology-driven world. However, in developing countries, including Nigeria, some institution strived the integration of digital learning tools presents both opportunities and significant challenges. With large class sizes, limited physical resources, poor internet connectivity, and inadequate digital literacy among students and faculty (Olaniyan & Fakuade, 2023). Despite these barriers, the shift toward online education, accelerated by global trends and local needs, has led to the increased adoption of digital tools to support teaching and learning of adult and consistency education.

The general connotation of digital learning, much of this work is concentrated in contexts where technological adoption is already advanced and focuses predominantly on student experiences or global trends. There remains a gap in understanding how these tools function in less technologically developed settings. Specifically, there is limited empirical evidence on how digital learning tools affect teaching and learning of adult learner, in particularly from the perspective of teachers who play a central role in implementing digital pedagogy. This study discuss revitalization of digital technology tools in the smart classroom for the teaching and learning of adult. The paper however,

emphases on strategies for sustainable implementation of digital tools in the smart classroom, challenges in digital technology in emerging smart classroom learning for adults learners, discusses way forwards to the challenges, enhancing adult learners through digital classroom setting.

### **Strategies for Sustainable Implementation of Digital Tools in the Smart Classroom**

Realizing the full potential of digital technology in smart classroom requires a holistic and sustainable approach that extends beyond mere technological deployment. Effective implementation necessitates a multifaceted strategy that addresses critical factors such as stakeholder engagement, capacity building, infrastructure development, cultural relevance, and continuous monitoring and evaluation.

- **Capacity building and teacher training:** Equipping educators with the necessary skills and knowledge to effectively integrate digital technology into their teaching practices is paramount. Comprehensive capacity-building programs, including professional development opportunities, should be developed to train teachers on using digital tools, online pedagogies, and data-driven instruction (Agyei, 2021). These efforts enhance the quality of teaching and foster a culture of continuous learning and adaptation.
- **Monitoring and evaluation frameworks for impact assessment:** Implementing robust monitoring and evaluation frameworks is crucial for assessing the efficacy and impact of educational technology initiatives. These frameworks encompass a range of quantitative and qualitative indicators, such as learning outcomes, enrollment rates, completion rates, and stakeholder satisfaction. Continuous data collection and analysis can inform ongoing improvements, resource allocation, and evidence-based decision-making, ensuring the long-term sustainability and impact of the implemented solutions.
- **Building partnerships and collaborations:** Leveraging partnerships and collaborations is essential for maximizing resources, expertise, and reach. Public-private partnerships can bring together the resources and capabilities of government agencies, educational institutions, and private sector organizations, fostering a collaborative approach to implementation. Collaborating with non-governmental organizations (NGOs) and community-based organizations can facilitate grassroots outreach, cultural awareness, and localized support.
- **Ensuring cultural relevance and localization:** Digital technology in smart classroom must be tailored to the cultural contexts and local languages of the communities they serve. Localization efforts involve adapting content, user interfaces, and instructional approaches to reflect local customs, values, and learning preferences. Engaging local educators and community members in the development and adaptation process can ensure cultural relevance and foster a sense of ownership among learners.
- **Addressing infrastructure and connectivity challenges:** Access to reliable infrastructure and connectivity is a prerequisite for successfully implementing digital technology in the smart classroom. Strategies focus on improving physical infrastructure, such as classrooms, computer labs, and power supply, and enhancing digital infrastructure, including internet connectivity and device access. Public-private partnerships and collaboration with telecommunications providers can help address these challenges through innovative solutions like community networks and affordable internet access initiatives.
- **Stakeholder engagement and community involvement:** Sustainable implementation of digital technology solutions hinges on active engagement with stakeholders and

community involvement from the outset. Engaging with local communities, educators, learners, and their families is crucial for understanding their unique needs, challenges, and cultural contexts (Agyei, 2021). This approach fosters a sense of ownership and buy-in, increasing the likelihood of successful adoption and long-term sustainability.

- **Enhancing Adult Learners through Digital Classroom Setting**

Digital learning tools, particularly interactive features such as quizzes, discussion forums, and live polls, significantly enhanced adult learners. These tools encouraged learners to actively participate rather than passively consume information. Features such as real-time feedback and multimedia integration kept learners interested and involved in learning activities. Barbien (2025) it can be notice that with the use of digital tools, most learners are more engaged when they interact with the content. Features like quizzes and polls within the learning management system (LMS) keep them on their toes and encourage active participation. The ability to use videos, simulations, and animations has transformed how to teach learners. Here, learners longer just listen; they interact, ask questions, and even research further on their own. The effectiveness of digital classroom help learners as:

- Bridging the gap between theory and practice: The digital tools, particularly simulations and virtual labs, helped learners bridge the gap between theoretical knowledge and practical application. These tools provided adult learners with hands-on experience, allowing them to visualise abstract concepts and apply them in real-world scenarios. "In subjects like engineering and medicine, simulations have been a game changer. Learners can now practice virtually before handling real-life cases, which boosts their confidence and understanding".
- Positive impact on academic achievement: observed that learners who actively engaged with digital learning tools demonstrated improved academic performance. The availability of supplementary resources, self paced learning materials, and instant feedback contributed to better understanding and retention of concepts. When introduced interactive content and self-assessment quizzes, the students' performance has improved significantly. Learners take ownership of their learning, and it reflects in their grades. Learners who regularly engage with the learning management system (LMS)resources perform better in assessments compared to those who do not participate in the usage.
- Facilitating communication between learners and teachers: Digital learning tools found to improve communication between teachers and learners. Features such as discussion boards, chat functions, and email integrations provided students with easier access to their teachers, reducing hesitation in seeking clarification. Previously, learners hesitate to ask questions in class, but now they comfortably post their concerns on discussion forums. It has created an open and continuous learning environment. With digital platforms, learners provide timely feedback and address learners concerns much faster than before.
- Gamification and motivation: The incorporation of gamified elements, such as badges, leaderboards, and reward points, has seen as a powerful motivator for learners. Gamification made learning more enjoyable and competitive, fostering intrinsic motivation among learners to complete tasks and participate in activities. "When introduced leaderboards and achievement badges, learners became more engaged. They now challenge each other to perform better". "Gamification has helped sustain interest, especially in repetitive tasks like coding exercises. Learners see learning as a fun challenge rather than a burden".

- Student autonomy and self-directed learning: Digital tools empowered learners to take control of their learning, fostering autonomy and self-directed study habits. The flexibility of online resources allowed learners to learn at their own pace and revisit materials as needed. "With digital tools, learners can manage their learning schedule. Some learners prefer studying late at night, and the flexibility of online resources accommodates that". "It can be observed that learners who actively engage with online learning tools develop better time management and independent study skills. They no longer rely entirely on classroom instruction.

### **Interactive Learning and Learners' Engagement through Smart Classroom**

Interactive learning is a crucial feature of smart classrooms in the digital age, transforming not only traditional teaching methods but also providing learners with a more enriching and engaging learning experience. In smart classrooms, diverse online tools and platforms encourage learners to actively participate in learning, making subject content more dynamic and interesting.

- Create an open academic environment through online discussion platforms, sparking learners' desire to participate. In virtual spaces, learners can share their insights, raise questions, and collectively explore subject knowledge. This open interaction encourages learners to engage more actively in subject learning, promoting intellectual collisions, and expanding the depth and breadth of subjects (Shi, 2023).
- Emphasize collaboration and mutual assistance among learners through collaborative projects. Learners can form subject project teams via online platforms to collectively complete subject tasks. This teamwork not only enhances the effectiveness of subject learning but also nurtures learners' teamwork skills, laying the foundation for future collaboration in society.
- Real-time interactive mechanisms in smart classrooms positively impact subject teaching. Learners can ask educators questions at any time during subject learning, receiving timely feedback. This personalized interaction enables educators to better understand students' subject needs and offer targeted guidance, enhancing the specificity and effectiveness of subject teaching.
- In the era of digital interactive learning, tools such as social media and online discussion forums become significant platforms for subject communication. Learners can share subject insights in virtual communities, establishing a global subject network. This international exchange not only promotes the international dissemination of subject knowledge but also broadens the international perspective of subject learning (Li, 2023).

However, interactive learning in the digital age enhances learners' subject engagement, making subject learning more dynamic and lively. Through diverse interactive methods, smart classrooms create a more dynamic and profound subject learning environment for students, cultivating their abilities in subject collaboration and communication, and laying a solid foundation for their future subject development.

### **Challenges in Digital Technology in Emerging Smart Classroom**

Emerging smart classroom face many challenges in providing equitable access to quality education and achieving effective teaching and learning. These challenges are multifaceted and deeply rooted in socio-economic, infrastructural, and cultural factors that impede progress toward inclusive and equitable educational opportunities in adult and community education. The most significant challenges are:

1. To education access in emerging smart classroom is the lack of adequate infrastructure. Many schools lack basic facilities such as classrooms, libraries, and educational resources, smart classroom establishing and maintaining effective learning environments difficult (Gupta, Liu, Lin, Zhong, & Suzuki, 2024).
2. Geographical constraints pose a formidable challenge, with remote and rural areas often isolated from educational services due to poor transportation networks and dispersed populations (Burden, 2020).
3. A crucial role in hindering education access. Poverty, child labor, and societal norms that prioritize immediate income generation over education contribute to low enrollment and high dropout rates, particularly among marginalized groups. Gender disparities, cultural biases, and discrimination further exacerbate inequalities in educational opportunities, disproportionately affecting girls, ethnic minorities, and individuals with disabilities (Familoni & Onyebuchi, 2024; Familoni & Shoetan, 2024).
4. Inadequate teacher training and professional development opportunities limit the effectiveness of pedagogical approaches and the ability to adapt to diverse learning needs (Familoni & Babatunde, 2024). Furthermore, outdated or culturally irrelevant curricula fail to equip learners with the knowledge and skills necessary for personal growth and productive participation in the workforce. Resource constraints, including shortages of qualified teachers, educational materials, and technological infrastructure, further impede the delivery of high-quality education.
5. Limited funding and inefficient resource allocation often result in overcrowded classrooms, inadequate learning materials, and a lack of essential educational tools and resources, hindering effective teaching and learning processes (Peter & Ligembe, 2022).

Addressing the multifaceted challenges in education using digital technology in the smart classroom requires innovative and scalable solutions that transcend traditional barriers. Conventional approaches to educational delivery and resource allocation have proven inadequate to meet the growing demand for quality education and achieve effecting learning process. Solutions are urgently needed to leverage technological advancements, foster partnerships and collaborations, and promote community-driven initiatives. Digital technology, in particular, holds immense potential to overcome infrastructural limitations, provide access to quality educational resources, and facilitate personalized learning experiences tailored to diverse learner needs (Klašnja-Milićević & Ivanović, 2021). By embracing innovative and scalable solutions, emerging smart classroom can accelerate progress towards inclusive and equitable quality education while simultaneously contributing to achieving learning. However, successfully implementing these solutions requires a holistic approach that addresses infrastructural challenges, builds capacity, and fosters stakeholder engagement and community ownership.

### **Way forward to the challenges**

In the face of the challenges hindering access to quality education of adult and continuing education in smart classroom learning, digital technology presents a promising array of solutions with far-reaching potential. The rapid advancement of digital technologies and the proliferation of internet connectivity have given rise to digital technology solutions that can be leveraged to overcome traditional barriers and enhance learning experiences in a smart classroom:

- The digital technology landscape is vast and constantly evolving, offering a range of tools and platforms to support teaching and learning. Online learning platforms, such

as massive open online courses (MOOCs) and virtual learning environments (VLEs), provide access to educational content and resources, enabling learners to engage in self-paced or instructor-led courses from virtually anywhere.

- Mobile applications have emerged as a powerful medium for delivering educational content and facilitating interactive learning experiences. With increasing smartphone penetration in smart classroom, mobile learning (m-learning) solutions offer a convenient and accessible way to engage learners, particularly in remote areas with limited infrastructure (Zain & Bowles, 2021).
- Virtual classrooms and videoconferencing tools have revolutionized distance education, enabling real-time collaboration and interactive learning experiences that transcend geographical boundaries. These solutions facilitate synchronous instruction, student-teacher interactions, and peer-to-peer collaboration, enhancing the overall learning experience.
- Digital technology holds significant potential in addressing access and quality challenges in smart classroom learning. By leveraging digital platforms and tools, educational content and resources can be distributed to remote and underserved areas, expanding educational opportunities for marginalized communities. Additionally, digital technology can facilitate the delivery of high-quality instructional materials and professional development resources for teachers, enabling them to enhance their pedagogical practices and better support diverse learner needs
- Furthermore, digital technology can alleviate resource constraints by providing cost-effective alternatives to traditional educational delivery methods. Open educational resources (OERs) and digital textbooks can reduce the financial burden of acquiring educational materials, making education more accessible and affordable for learners from economically disadvantaged backgrounds (Clinton-Lisell, Legerski, Rhodes, & Gilpin, 2021).

Therefore, one of the most significant advantages of digital technology in the smart classroom lies in its ability to facilitate personalized and adaptive learning experiences. Intelligent tutoring systems and adaptive learning platforms leverage data analytics and machine learning algorithms to tailor educational content and instructional approaches to individual learners' needs, preferences, and progress. By adapting to each learner's pace, strengths, and areas for improvement, these solutions can enhance engagement, motivation, and overall learning outcomes. Personalized and adaptive learning approaches are particularly beneficial in the smart classroom learning, where learners may have diverse backgrounds, varying levels of prior knowledge, and unique learning styles. By catering to these individual differences, digital technology can provide equitable access to quality education and ensure no learner is left behind.

Unlike traditional educational models that rely heavily on physical infrastructure and resources, many digital technology can be deployed and scaled using existing digital infrastructure and devices. Online learning platforms, mobile applications, and virtual classrooms can reach many learners simultaneously without requiring extensive physical facilities or transportation (Pham, Dao, Nguyen-Thanh, Cho, & Pham, 2021). This scalability reduces operational costs and extends educational opportunities to remote and underserved areas, where building physical infrastructure may be challenging or prohibitively expensive. Moreover, the cost-effectiveness of digital technology is further enhanced by the ability to leverage open-source software, open educational resources, and cloud-based technologies. These resources can significantly reduce the financial burden of acquiring proprietary software and educational materials, making high-quality education

more accessible and affordable for learners and educational institutions in smart classroom.

## Conclusion

Revitalization of digital technology tools in the smart classrooms have a dual impact on learners learning experiences. It facilitate comprehensive expansion of subject knowledge and active interaction among adult learners, bringing new possibilities to education. However, the ensuing challenge is the escalating digital education inequality. The uneven distribution of technology and resources has resulted in some regions and schools being unable to fully benefit from the advantages of smart classrooms, deepening educational disparities. Overcoming this issue requires strengthening the fair distribution of digital technology resources at the policy level and committing to the effective teaching and learning of comprehensive quality education. In the future, continuous attention is needed on the development of digital technology in the smart classrooms, striving to create an educational environment that better serves the diverse learning needs of students, ensuring that the potential of digital education is shared by all learners of adult and beyond.

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