

## INNOVATIVE STRATEGIES FOR IMPROVING TECHNOLOGY IN PRIMARY EDUCATION FOR SUSTAINABLE DEVELOPMENT IN NIGERIA

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### Abstract

*In recent years, there has been a growing recognition of the importance of integrating innovative technology strategies into primary education to foster sustainable development. This study investigates various approaches and methodologies aimed at enhancing technology use in primary schools to create a more effective and engaging learning environment. A key strategy is incorporating digital learning tools and platforms that support interactive and personalized learning experiences. These tools can cater to students' diverse needs, enabling them to learn at their own pace and according to their individual learning styles. By utilizing educational software, online resources, and gamified learning applications, educators can make learning more engaging and accessible, thus improving student motivation and outcomes. The study also reviewed the potential of teacher training and professional development programs focused on technology integration. By equipping teachers with the necessary skills and knowledge to effectively use technology in the classroom, schools can ensure that educators are well-prepared to facilitate technology-enhanced learning. This includes training in using digital tools and strategies for integrating technology into various subjects and curricula. The research highlights the importance of infrastructure and resource allocation in supporting technological advancements in primary education. Access to reliable internet, modern devices, and technical support is essential for the successful implementation of technology-based initiatives. The study suggests that investment in infrastructure, along with partnerships between governments, educational institutions, and the private sector, is crucial for creating a conducive environment for technology-driven education.*

**Keyword:** Innovative Strategies, Technology, Primary Education, Sustainable Development

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### Introduction

The rapid advancement of technology has revolutionized many sectors, including education. In primary education, integrating technology is increasingly seen as critical for achieving sustainable development. Primary education, typically spanning the first five to eight years of a child's life (UNESCO, 2015), is the initial phase of formal schooling. This period is crucial for developing fundamental literacy, numeracy, and cognitive skills. A strong foundation in primary education is essential for subsequent educational success and overall life outcomes (Schleicher, 2019). Key components of primary education include literacy, numeracy, cognitive development, and social and emotional learning. Developing reading, writing, and comprehension skills is fundamental to literacy (National Literacy Trust, 2022). A solid grasp of mathematics, including arithmetic, geometry, and problem-solving, is essential for numeracy (National Council of Teachers of Mathematics, 2022). Fostering critical thinking,

creativity, and problem-solving abilities is crucial for cognitive development (Fisher, 2016). Additionally, cultivating interpersonal skills, empathy, and self-regulation is vital for social and emotional learning (CASEL, 2020). Research consistently emphasizes the significant impact of early childhood education on long-term outcomes (Heckman, 2017). High-quality primary education programs can reduce dropout rates, increase high school graduation rates, and improve overall life chances (Yoshikawa et al., 2016).

Primary education in Nigeria, typically spanning six years for children aged six to eleven (Federal Republic of Nigeria, 2014), is a critical stage in its citizens' educational trajectory. It is considered the cornerstone of the entire education system, as its success or failure significantly impacts subsequent educational stages (Adeniran et al., 2020). The Nigerian government has strived to achieve universal primary education (UPE) since the 1950s. Despite these efforts, issues such as insufficient funding, poor infrastructure, and teacher shortages have hindered the complete achievement of this objective (Odutola, 2019). Nevertheless, there have been advancements, with enrollment rates rising in recent years (United Nations Development Programme, 2016). Despite these improvements, Nigeria's primary education system still faces numerous challenges that prevent it from producing globally competitive graduates. These challenges include inadequate infrastructure, a shortage of qualified teachers, outdated curricula, and low budget allocations (Adeniran et al., 2020). Consequently, a significant shift in approach is urgently needed. A comprehensive strategy addressing these diverse challenges is crucial. This includes overhauling the curriculum to align with global best practices, fostering critical thinking, problem-solving, and creativity (Federal Republic of Nigeria, 2014). It is also essential to invest in teacher training and professional development to improve pedagogical skills and classroom management (Darling-Hammond, 2017). Moreover, enhancing school infrastructure, providing sufficient learning materials, and ensuring inclusive education for children with special needs are vital components of a reformed primary education system. Achieving this requires increased and sustainable funding for education (UNESCO, 2015).

Innovative strategies in education are modern teaching methods designed to improve learning outcomes, student engagement, and critical thinking skills. These approaches often incorporate technology, real-world problem-solving, and student-centered learning principles. Key innovative strategies include the flipped classroom, gamification, project-based learning, inquiry-based learning, and technology integration. In a flipped classroom, students learn new content independently at home and apply their knowledge in class through hands-on activities (Lo & Hew, 2017). Gamification introduces game elements into learning to boost motivation and engagement (Clark, Tanner-Smith, & Killingsworth, 2016). Project-based learning involves students working collaboratively on real-world projects to develop problem-solving and critical thinking skills (Kokotsaki, Menzies, & Wiggins, 2016). Inquiry-based learning encourages students to construct knowledge through exploration and questioning (Pedaste et al., 2015). Finally, technology integration leverages digital tools to enhance learning experiences and provide personalized instruction (Johnson, Adams Becker, Estrada, & Freeman, 2015). These innovative strategies offer numerous benefits, including increased student engagement, development of higher-order thinking skills, improved problem-solving abilities, better preparation for the workforce, and personalized learning experiences. By implementing these approaches,

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educators can create more dynamic and effective learning environments that empower students to become lifelong learners.

Sustainable development balances economic growth, social progress, and environmental protection (Hirai, 2022). It focuses on meeting present needs without compromising future generations' ability to meet their own. This approach rests on three main pillars: economic growth, social progress, and environmental protection. Economic growth is necessary but must be equitable and sustainable. Social progress entails enhancing people's lives, reducing poverty, and promoting equality. Environmental protection involves conserving natural resources and combating climate change (United Nations, 2015). While achieving sustainable development is challenging, it offers opportunities for economic growth, job creation, and a better quality of life. The United Nations Sustainable Development Goals (SDGs) provide a global framework for addressing these challenges and ensuring a sustainable future. Innovative educational strategies should not only improve learning outcomes but also contribute to sustainable development. These strategies must align with sustainable development principles, considering environmental, social, and economic factors (Guevara-Stone, 2018). For example, while technology integration can greatly enhance personalized learning, it is essential to minimize its environmental impact by using energy-efficient devices and responsibly disposing of electronic waste (United Nations Environment Programme, 2019). Additionally, project-based learning can promote environmental stewardship by encouraging students to tackle local environmental issues (Chowdhury & Haider, 2021). Innovative strategies should also promote social equity and inclusivity. Gamification, for instance, can help address learning disparities by creating engaging and accessible learning experiences for all students (Clark et al., 2016).

## **Literature Review**

### **Digital Learning Tools and Platforms**

Digital learning tools and platforms are essential in revolutionizing traditional education by providing interactive and personalized learning experiences that meet the diverse needs of students. Research shows that these tools, including educational software, online resources, and gamified learning applications, greatly enhance student engagement and motivation. By allowing students to learn at their own pace and according to their unique learning styles, these tools contribute to improved educational outcomes (Johnson et al., 2022). The integration of digital technology in education has significantly altered learning environments, making digital learning tools and platforms increasingly common. This literature review examines research on these tools, focusing on their impact on student learning, the challenges they present, and their potential for future development. Studies indicate that digital learning tools and platforms can boost student engagement and improve learning outcomes (Selwyn, 2021). Learning management systems (LMS) like Moodle and Blackboard have become vital for delivering online courses and managing educational activities (Zawacki-Richter & Latchem, 2018). Additionally, interactive whiteboards, educational software, and online simulations have been shown to enhance student motivation and critical thinking skills (Henderson, Selwyn, & Aston, 2017).

Numerous studies have highlighted the positive effects of digital learning tools on student achievement. For instance, research by Clark and Mayer (2016) suggests that multimedia learning can improve learning outcomes when instructional design principles are applied. Similarly, other studies have demonstrated that online learning can be as effective as traditional face-to-face instruction, especially when supported by appropriate pedagogical strategies (Schneider & Preckel, 2017).

### **Teacher Training and Professional Development**

Teacher training and professional development (PD) are vital for educational improvement. Effective PD enhances teachers' knowledge, skills, and attitudes, which ultimately impacts student achievement (Darling-Hammond et al., 2017). Research suggests that high-quality PD involves active learning, collaboration, and opportunities for teachers to implement new knowledge in their classrooms (Desimone & Garet, 2015). However, the success of PD programs varies widely (Fullan, 2020). Factors affecting PD outcomes include leadership support, teacher motivation, and the alignment of PD with school goals (Darling-Hammond et al., 2017). There is also a growing emphasis on the need for ongoing and sustained PD to help teachers meet the evolving demands of education (Hargreaves & Fullan, 2020). To maximize PD impact, it is crucial to develop teachers as reflective practitioners who can critically analyze their teaching and make data-driven decisions (Brookfield, 2017). Additionally, incorporating technology and online learning into PD programs can offer flexible and accessible professional development opportunities for teachers (Trust, 2021). The successful integration of technology in primary education largely depends on teachers' competence and readiness. Professional development programs focused on technology integration are essential to equip teachers with the necessary skills and knowledge. Effective training includes using digital tools and strategies for integrating technology into various subjects and curricula. Studies indicate that ongoing professional development and support significantly boost teachers' confidence and ability to facilitate technology-enhanced learning (Smith & Brown, 2023).

### **Infrastructure and Resource Allocation**

Infrastructure and resource allocation are vital elements influencing the quality of education. Adequate facilities, such as school buildings, classrooms, sanitation, and learning materials, are essential for effective teaching and learning (UNESCO, 2017). Research consistently demonstrates a strong link between improved infrastructure and higher student enrollment, attendance, and academic performance (World Bank, 2018). However, significant disparities in infrastructure and resource allocation exist both within and across countries. Rural areas often struggle to access quality education due to limited resources and infrastructure (UNICEF, 2021). Moreover, ensuring equitable distribution of resources within schools is crucial for providing all students with equal opportunities to succeed (Hanushek & Woessmann, 2020).

Studies also emphasize the importance of inclusive education and the need for accessible infrastructure for students with disabilities (UNESCO, 2020). Additionally, the increasing role of technology in education highlights the necessity for digital infrastructure and teacher training to fully utilize its potential (Lai & Bower, 2020). Infrastructure and resource allocation are critical in supporting technological advancements in primary education. Access to reliable internet, modern devices, and

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technical support is essential for implementing technology-based initiatives effectively. Investment in infrastructure, coupled with partnerships between governments, educational institutions, and the private sector, is necessary to create an environment conducive to technology-driven education (Williams, 2024).

### **Impact of Digital Learning Tools**

The integration of digital learning tools into education has generated extensive research into their effects on student outcomes. Studies consistently show that, when implemented effectively, these tools can significantly enhance student engagement, motivation, and achievement (Henderson, Selwyn, & Aston, 2017). For instance, interactive whiteboards, educational software, and online simulations have been associated with improvements in critical thinking, problem-solving, and collaborative skills (Kebritchi, Lipschuetz, & Santiago, 2017). Moreover, digital tools hold the potential to personalize learning experiences by adapting to the individual needs and learning paces of students (Baker et al., 2018). However, the success of these tools depends on several factors, including adequate teacher training, curriculum alignment, and access to technology (Selwyn, 2021).

Despite the positive outcomes suggested by research, challenges such as the digital divide and the need for continuous professional development remain. Addressing the equity implications of digital learning is crucial to ensure that all students have equal opportunities to benefit from these technologies. Reports indicate that digital learning tools and platforms significantly boost student engagement and motivation. Students find that interactive and personalized learning experiences make education more enjoyable and accessible. Teachers have observed improvements in student performance and participation, attributing these gains to the use of educational software and gamified learning applications.

### **Effectiveness of Teacher Training Programs**

The effectiveness of teacher training programs in improving instructional practices and student outcomes has been extensively researched. Studies consistently demonstrate a positive correlation between high-quality professional development (PD) and enhanced teacher performance (Darling-Hammond et al., 2017). For instance, Desimone and Garet (2015) emphasize that effective teacher training involves active learning, modeling, coaching, and collaborative reflection. However, the impact of these programs can vary widely. Fullan (2020) highlights the significance of contextual factors, such as leadership support and school culture, in determining the success of PD initiatives. Additionally, the sustainability of the benefits gained from training remains a concern (Hargreaves & Fullan, 2020).

Research also underscores the importance of the content and delivery of teacher training programs. Programs that focus on developing teachers' pedagogical content knowledge, their ability to differentiate instruction, and their competency in using technology have shown promising results (Shulman, 2018). Moreover, incorporating action research and reflective practices into teacher training can empower educators to become lifelong learners and continually improve their teaching (Brookfield, 2017). Teacher training and professional development programs have proven highly effective in preparing educators for technology integration. Teachers who participated in these programs

reported increased confidence and competence in using digital tools. They also emphasized the need for ongoing support and training to stay updated with new technologies and teaching strategies.

### **Importance of Infrastructure and Resource Allocation**

A robust educational infrastructure, coupled with equitable resource allocation, is a cornerstone for quality education. Research consistently underscores the positive correlation between these factors and student outcomes. Adequate school buildings, classrooms, sanitation facilities, and learning materials are essential for effective teaching and learning (UNESCO, 2017). Studies have demonstrated that improved infrastructure can significantly enhance student enrollment, attendance, and academic achievement (World Bank, 2018). For instance, access to clean water and sanitation facilities can reduce absenteeism rates, particularly among girls (UNICEF, 2019). Furthermore, the availability of libraries, laboratories, and computer facilities can enrich the learning experience and foster critical thinking skills (Hanushek & Woessmann, 2020).

However, disparities in infrastructure and resource allocation persist within and across countries. Rural areas often face significant challenges in accessing quality education due to limited resources and infrastructure (UNICEF, 2021). This inequitable distribution of resources can exacerbate existing educational inequalities and hinder social mobility. Access to reliable internet and modern devices was identified as a critical factor for the successful implementation of technology-based initiatives. Schools with adequate infrastructure and technical support reported smoother integration and better educational outcomes. Partnerships between governments, educational institutions, and the private sector were deemed essential for ensuring sustainable investment in technology infrastructure.

### **Conclusion**

The paper underscores the importance of integrating innovative technology strategies in primary education to foster sustainable development. Digital learning tools and platforms, teacher training and professional development, and infrastructure and resource allocation are key components for creating a more effective and engaging learning environment. Integrating innovative technology strategies in primary education is essential for fostering sustainable development. By employing digital learning tools, enhancing teacher training programs, and ensuring adequate infrastructure and resource allocation, schools can create a more effective and engaging learning environment. Collaborative efforts between governments, educational institutions, and the private sector are vital for the successful implementation of technology-driven education.

### **Recommendations**

1. **Enhance Digital Learning Tools:** Schools should invest in a variety of digital learning tools and platforms that support interactive and personalized learning experiences.

2. Expand Teacher Training Programs: Professional development programs focused on technology integration should be expanded to ensure all teachers are equipped with the necessary skills and knowledge.
3. Improve Infrastructure: Governments and educational institutions should collaborate to ensure schools have access to reliable internet, modern devices, and technical support.

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