Smart Green Schools in Enugu State: Overcoming Perceived Future Challenges, Embracing Opportunities for Sustainable Education.

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Manuscript Number: IJOE/C03/07/2024

Abstract
The implementation of smart green schools in Enugu State presents both perceived future challenges and opportunities in the realm of education and sustainability. Challenges include initial infrastructure costs, technological integration hurdles, and the need for extensive teacher training to adapt to new educational paradigms. Additionally, ensuring equitable access to these facilities across urban and rural areas poses a logistical challenge. However, the prospects are promising. Smart green schools offer an opportunity to revolutionize education by incorporating technology for interactive learning experiences, enhancing students' digital literacy skills. These schools also prioritize environmental sustainability through energy -efficient, infrastructure, waste reduction measures, and eco-friendly curriculum integration, fostering a culture of environmental steward among students. Furthermore, the implementation of smart green schools aligns with global trends towards sustainable development, positioning Enugu State as a leader in environmentally conscious education. It has the potential to attract funding and partnerships from government and non-governmental organizations dedicated to sustainability initiatives. The adoption of smart green schools in Enugu State presents its share of perceived challenges; the potential benefits far outweigh them. With proper planning, investment, and commitment from stakeholders, these schools can serve as models of innovative, sustainable education contributing to the holistic development of students and the advancement of Enugu State's educational landscape.

Keywords: Smart green schools, Perceived challenges, Opportunities, Sustainable education.

INTRODUCTION

Researchers have been working tirelessly on developing a smart world where everything will be operated. Today, technology is the strongest factor shaping the educational landscape. Many school districts are showing support increased level of technology in the classroom by providing hardware such as tablets and computers, enhancing internet connectivity, and implementing programmes designed to improve computer literacy for both teachers and students. According to

Hamida et al., (2022), smart building combines the best available technologies, designs, materials, and systems to improve occupants' lives and provide cost-effective environments.

Due to increasing demand by countries to meet up with the challenges of the 21st century, technological advancement has led to the establishment of smart education and smart schools in various developed and developing countries. In response to these challenges, successive governments in Enugu state have implemented various educational reforms aimed at enhancing the quality and accessibility of education. These reforms have included the introduction of the Universal Basic Education (UBE) programme in Nigeria in 1999, a significant milestone for Enugu State's education system. In the quest to improve educational system in Enugu State, the current government initiated the innovation of 260 smart green schools to meet up with this demand. Smart green school is an innovative approach to education that integrates sustainable practices and cutting-edge technology to create health, energy-efficient learning environments. Smart school is school that incorporates technology and innovation in its teaching and learning processes to improve the quality of education. Nwankwo & Mkpa, (2023) stated that smart education is the process of optimally managing human, economic and technological resources from educational institutions and research centers. These schools prioritize environmental stewardship, energy conservation, and student well-being while also fostering academic excellence and innovation.

Sustainability education is often referred to as education for sustainable development, which has been defined by UNESCO, 2014. Education for sustainable development allows every human being to acquire the knowledge, skills, attitudes and values necessary to shape a sustainable future. Sustainable education is crucial for fostering a mindset that values environmental, social, and economic sustainability. By integrating sustainability principles into curricula, institutions can empower individuals to make informed decisions, promote responsible consumption and production patterns, and contribute to building resilient communities. However, the implementation of smart green school cannot be easy because of the perceived challenges identified. Despite the global shift towards sustainability and smart technologies in education, many schools in Enugu State are yet to fully embrace the concept of smart green schools. This slow adoption stems from perceived challenges such as lack of funding, limited access to modern technology, inadequate infrastructure, and insufficient policy support. There is also a gap in the awareness of the long-term benefits of integrating green initiatives and smart technology in

educational institutions. Without addressing these challenges, schools in Enugu State may lag behind in providing a sustainable and innovative learning environment that fosters both academic excellence and environmental stewardship. Therefore, this study seeks to explore the barriers to implementing smart green schools in Enugu State, while also identifying potential opportunities that can drive sustainable education in the region.

Theoretical Framework

The learning theory that could be adopted in this topic is experiential learning theory. This theory suggests that individuals learn best through hands-on experiences, reflection, and feedback. In the context of smart green schools, students can learn best by engaging in real-world projects related to sustainable development, such as designing and implementing green technologies, studying the impact of climate change, or creating solutions to environmental problems. Such experiential learning activities can help students develop critical thinking, problem-solving skills, and a sense of environmental responsibility while preparing them for the future challenges of sustainable development in Enugu State.

Perceived Challenges of Implementing Smart Green Schools in Enugu State

Enugu state's initiative to establish smart green schools represent a bold step towards sustainable education. However, many challenges have been perceived to affect the implementation of smart green schools in Enugu State as follows; limited funding and resources for implementing green initiatives, lack of awareness and education on sustainable practices, resistance to change from traditional education models, low/poor level of computer literacy, poor power supply and internet connectivity, non inclusion of ICT in the training of teachers.

Limited Funding and Resources

Enugu State, like many other regions, may face budgetary constraints in its education sector, which affects the allocation of funds for green initiatives in schools. The initial investment needed to implement sustainable technologies and practices is enormous, and schools may not have the resources to finance these upgrade. Eldowney (2021) noted that financial limitations are the key challenge for implementation smart initiatives. Additionally, Moyer (2020) stated that, despite the potential cost savings and educational benefits of smart green schools, funding

remains a significant challenge for many schools. The high costs of devices and installations, purchasing and configuring the equipment required for smart buildings may be prohibitively expensive (Hamida et al, 2022, AlMuharraqi et al., 2022). Finally, without sufficient resources, schools struggle to maintain existing green initiatives, leading to their eventual abandonment.

Lack of Awareness and Education on Sustainable Practices

Many regions globally, are striving to integrate sustainability into its education system, particularly within smart green schools. However, the challenge of awareness and education on sustainable practices limit curriculum integration. Lackovic and Ivanovic (2020) highlighted the importance of knowledge for successful implementation of smart schools. Also, El-Motasem et al., (2021) stated that a smart building is a structure that integrates advanced technologies and systems to enhance its performance, functionality, and sustainability. Therefore, lack of awareness and education may hinder the acceptance and adoption of sustainable practices, necessitating culturally sensitive approaches to education and awareness-raising.

Resistance to Change from Traditional Education Models

The transition from traditional education models to green schools may face significant challenges. Ramanathan and Luthra (2016) noted that, resistance to change can hinder the implementation of green initiatives and technologies in schools. Many regions have deep-rooted cultural institutional norms that prioritize traditional education methods such as reading, writing, and mathematics. These norms created resistance to adopting new approaches, such as those advocated by green schools.

Low/Poor Level of Computer Literacy

Low levels computer literacy presents a significant challenge to the implementation smart schools in Enugu State. Osuji (2012) stated that, the level of computer literacy in Nigeria is very low. Aboderia (2015) stated that, some students cannot log in and log out successfully, while other cannot access the school portal without any assistance. Lack of computer literacy among the educators hampers the effective implementation of smart green schools. Teachers who are not proficient in using computers struggle to incorporate technology into their lessons, hindering the adoption of digital learning resources.

Poor Power Supply and Internet Connectivity

Enugu State is currently being faced with irregular power supply both in rural and urban areas. Without reliable electricity, and internet connectivity, the essential technological infrastructure of

smarts schools initiatives, such as computer, smart boards, and energy-efficient system cannot function properly. Ekpe & Umoh (2019) stated that the average daily power production is below the estimated peak. Monyei et al., (2018), also ascertained that challenges faced by power generation range from outdated equipment and tools, unregulated facility maintenance, and inadequate power production. This may hamper the implementation of interactive learning tools and energy- saving measure, crucial for creating sustainable and modern educational environment.

Non Inclusion of ICT in the Training of Teachers

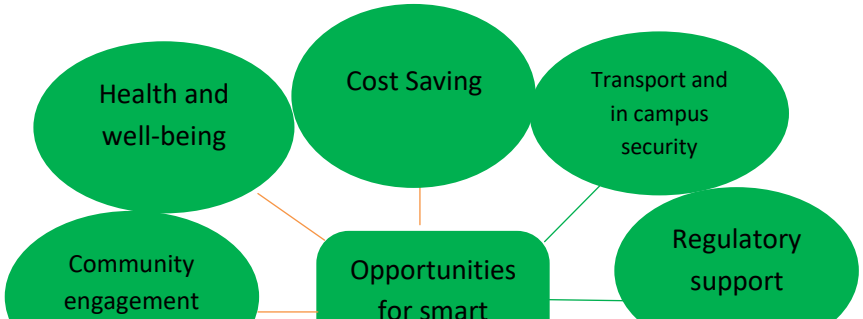
The absence of Information and Communication Technology (ICT) integration in the training of teachers may pose a significant challenge to the implementation of smart green schools. According to a study conducted by Fernández-Batanero, Román-Graván, Reyes-Rebollo, & Montenegro-Rueda (2021), the use of new technologies can be negative for teachers because it implies changes in their teaching methods or pressure to acquire technological skills, leaving sequelae such as physical, social, and psychological problems. Juke,I., et al (2014) stated that, teachers and staff need to be trained to effectively use and implement the new technologies and green initiatives. Without adequate training in ICT, teachers lack the necessary skills to effectively incorporate technology in their teaching methods, hindering the advancement toward the smart and environmentally sustainable educational institution.

Opportunities Sustainable Smart Green Schools

Despite the perceived future challenges, smart green schools offer significant opportunities for creating more sustainable, healthier, and ecologically aware learning environments that benefit students and communities. By resolving the challenges effectively and leveraging the opportunities, these schools can play an essential role in determining a more sustainable future.

A smart green school presents numerous opportunities to enhance education, sustainability, and community engagement (Emily Greenfield, 2023). These opportunities encompass various aspects of school operations, from infrastructure and resource management to educational practices and community involvement.

Here is a comprehensive look at the opportunities a smart green school can leverage:



Source: (Emily Greenfield 2023)

Cost Savings as an opportunity for smart green school: Implementing smart green initiatives in schools presents significant opportunities for cost savings, which can be reinvested in educational programs, further sustainability efforts, or other school needs (Emily Greenfield, 2023).Here are several ways smart green schools can achieve cost savings: Energy Efficiency, Water Conservation, Waste Reduction and Sustainable building materials and design that require less maintenance and replacement. These savings can then be redirected towards enhancing educational programs, improving school facilities, and supporting further green initiatives.

Health and wellbeing as an opportunity for smart green school. A smart green school presents numerous opportunities for enhancing health and wellbeing for students, staff, and the broader community. Schools can harbor sustainable practices such as smart green garden that grows organic food. Green foods are grown and harvested in the nonappearance of any form of environmental contamination or harmful conditions. (Ashaolu, Ashaolu ., 2020). Kaur (2016) noted that the whole idea of smart village is educating people about the use of new technologies, facilitates better implementation and leading to a better lifestyle for its people. Here are several ways in which health and wellbeing can be incorporated as opportunities in smart green schools: Using advanced air filtration systems to reduce pollutants, exposure to natural light, access to green spaces, well-maintained playgrounds and sports facilities. By implementing these strategies, a smart green school can significantly enhance the health and wellbeing of its students and staff.

Community Engagement as an opportunity for smart green school: Community engagement is a powerful tool for advancing the development and success of smart green schools (Emily

Greenfield 2023). By involving the community in the planning, implementation, and maintenance phases, schools can ensure they meet the need of all stakeholders while promoting sustainability and innovation. According to the European Network for Rural Development (2019), Smart villages' strategies aim to help rural communities test new solutions to some of the fundamental challenges they face as well as exploring the new opportunities created by technological and other forms of innovation. Here are several ways community engagement can be leveraged as an opportunity for smart green schools: Collaborative planning and design, form resource sharing and partnership with local organizations, encouraging volunteers both cultural and social. By effectively engaging the community, smart green schools can become hubs of sustainability and innovation.

Smart green schools present an opportunity for resilience: Smart green schools present an opportunity for resilience by integrating sustainable practices and advanced technologies to create a more adaptable and robust educational environment. Modern city infrastructure must be strong, resilient, adaptable to climate change, and flexible for improvement considering performance and price (Yamuna kaluarachchi, 2021). ENRD (2019) stated that the need to bridge the digitization gap between cities and villages is an important aspect so that lives and livelihood can be improved. Incorporating green infrastructure can improve resilience, efficiency, and performance, and deliver increased return on investment.

Smart green school as an opportunity for global connection: A smart green school can serve as a hub for global connection, fostering international collaboration, cultural exchange, and the sharing of best practices in sustainability and education. International collaborations and partnerships with sister school programs to share knowledge and resources, and to collaborate on sustainability projects (Yamuna kaluarachchi, 2021). Also, Holmes et al., (2015) ascertained that, the global call to an immediate and sustainable action for bettering rural life is seen when the world met in New York in 2015 and adopted the Sustainable Development Goals (SDGs), which set the benchmarks for defining the global development action. By embracing these opportunities, smart green schools can become powerful catalysts for global connection, fostering a sense of global responsibility.

Smart green school an opportunity for regulatory support: The regulatory support can play a pivotal role in promoting smart green schools by funding and financial incentives, offering tax breaks or credits to schools that achieve certain sustainability standards, monitoring and evaluation of health and safety regulations, mandating regular reporting on sustainability efforts

and outcomes. Smart technologies and innovations may support citizens quality of life, public services provision, efficient use of resources, and reduce environmental impact. European Commission (2016). By implementing these practices accountability and transparency can be ensured.

Smart school transport and in campus system: This is all about implementing smart school transport and on campus security system that make use of GPS, tracking route optimization algorithm and real-time monitoring to enhance efficiency and reduce emission. On-campus security system utilizes tools like biometric identification, CCTV cameras and smart access control remote. Ram et al., (2020) noted that a variety of ICT including sensors, actuators, cameras, drones, robots, medical devices, and agro-devices can be involved in automating decision-making in the smart village components such as smart mobility, smart energy, smart agriculture, and smart healthcare. Kaur (2016) highlighted that importance of smart homes and buildings can be made smart by the use of sensors and cameras. These help to detect danger, theft, vandalism and unauthorized access to the school premises.

Smart green school an opportunity for environmental education: A smart green school presents a significant opportunity for environmental education by integrating environmental science programs and sustainability curriculum, developing curricula that focus on ecology, climate change, renewable energy and efficient, curriculum that integrates sustainable development goals into lesson plans, teach sustainability education at young age that encompasses a variety of topics, including environmental issues and science, green practices, economics, social justice, and ethics. According to Compass Education (2015), a sustainable school is the one that applies sustainability into everything, governance, operation, community engagement and relationship, curriculum, teaching and learning processes. It should be engaging and interactive.

Research and innovation as an opportunity for smart green school: A smart green school not only benefits the environment but also serves as a dynamic platform for research and innovation. Ikechukwu and Amos (2023), asserted that implementation of smart education provide easy access to online resources. This implies that, teachers and students in smart schools have all the information at their finger tips. This can be helpful in class by giving students a way to work on their own projects and learn in real-time." By integrating sustainable practices and advanced

technology, such schools can foster a culture of environmental stewardship and technological proficiency among students, paving the way for a more sustainable and innovative future.

Case Studies and Success Stories of Smart Green Schools.

Many cases and successful stories have been recorded about smart green schools in the world. These schools include:

- The Bullitt Center Seattle, Washington, USA also known as the greenest commercial building in the world. The building is designed to be self-sustaining, generate energy than it consumes, it features various features like rainwater harvesting, using only rain water as source of water supply, energy efficient design, compositing toilets, and top roof garden.
- Beddington Zero Energy Development (BedZED) – London, UK. This is another smart school build on sustainability of community and students. The curriculum emphasizes environmental education, it is well designed to accommodate, energy efficient, natural ventilation, solar panel.
- Green School Bali – Bali, Indonesiathis is another one build with bamboo structures that uses natural ventilation, the curriculum includes hands-on learning about renewable energy and biodiversity. uses
- SABIS International School – Runda in Nairobi this is the first green start certifies school in Kenya
- Saint Francis Catholic Secondary School, Lagos State. This school has a building that integrated with photovoltaic panels mounted everywhere as source of generating energy and also reduce energy use.
- Green springs School, Lagos state. Also implemented initiatives such as waste recycling system, energy efficient, renewal energy and eco-friendly options for students.

Case in Enugu State.

The transformation, case for experiential learning is a beacon of hope for sustainable education in Enugu. The plans incorporate a revolutionary education reform that will drive poverty away and elevate the state GDP. For now no case has been recorded. However, according to Progress

Report on Enugu State Smart Green Schools on May 10th 2024, the Honorable Commissioner for Education, Prof. Ndubueze Mbah gave an update on the progress made by the government on investments in the state's pilot smart green school at Owo, Nkanu East Local government. He stated that government had trained 40 teachers to meet up with the driven technology and commitment to student welfare through available school lunch programs that will benefit 862 enrolled students ranging from preprimary to JS3. He shed light on the school infrastructure that will incorporate a world-class sick bay and implementation of clean water solutions, further enhancing student well-being.

Recommendations for Overcoming Perceived Future Challenges of Smart Green Schools Enugu State

To overcome the challenges of implementing smart green schools in Enugu State, it's crucial to focus on a multifaceted approach that addresses various aspects of sustainability, technology integration, and community engagement.

Investment in Infrastructure: Allocate funds for the development of smart infrastructure within schools, including renewable energy sources like solar panels, energy-efficient lighting, and smart HVAC system. Partnering with renewable energy companies or seeking government grants can help offset costs.

Curriculum Integration: Incorporate sustainability and technology education into the school curriculum. This can include lessons on renewable energy, waste management, and the importance of environmental conversation. Engaging students early on will foster a culture of sustainability.

Teacher Training: Provide professional development opportunities for educators to familiarize them with smart technologies and sustainable practices. This training should empower teachers to integrate these concepts into their lesson plans effectively.

Community Involvement: Foster partnerships with local communities, NGOs, and business to support sustainability initiatives. This can involve organizing community clean-up events, establishing recycling programmes, or inviting guest speakers to discuss environmental issues.

Monitoring and Evaluation: Implement systems to monitor and evaluate the effectiveness of smart green initiatives. This could include tracking energy consumption, waste reduction, and

student engagement with sustainability activities. Regular assessments will help identify area for improvement and celebrate successes.

Public Awareness Campaigns: Launch awareness campaigns to educate parents, students, and the boarder community about the benefits of smart green schools. Utilize various channels such as social media, workshops, and community events to spread the message and garner support.

Policy Support: Advocate for policies at the State and local levels that prioritize sustainability in educational institutions. This may include mandates for energy-efficient building standards, funding incentives for green initiatives, and integration of sustainability goals into educational policies.

By adopting these recommendations, Enugu State can overcome the challenges of implementing smart green schools, creating a more sustainable and technologically advanced educational environment for its students and communities.

CONCLUSION

In conclusion, the journey towards establishing smart green schools in Enugu State presents both perceived challenges and opportunities for sustainable education. By addressing these challenges head-on and embracing the opportunities that arise, Enugu State can pave the way for a brighter and more environmentally conscious future. Through strategic investment in infrastructure, curriculum integration, and teacher training, Enugu State can lay the foundation for sustainable education that empowers students to become responsible stewards of the environment. Engaging the community and fostering partnerships will further strengthen these efforts, creating a network of support for smart green initiatives. Monitoring and evaluation progress, coupled with public awareness campaigns, will ensure accountability and inspire ongoing commitment to sustainability. Additionally, advocating for supportive policies at the state and local levels will provide the necessary framework for long-term success.

As Enugu State navigates the path towards smart green schools, it has the opportunity to lead by example, demonstrating the transformative power of sustainable education. By overcoming future challenges and embracing opportunities, Enugu State can cultivate a generation of environmentally conscious citizens equipped to tackle the pressing issues of our time and create a more sustainable world for future generations. Together, let us build a brighter, greener future for Enugu State and beyond.

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