



Exploring the Role of Smart Libraries in Supporting the Enugu State Smart Schools Initiative

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Abstract

This conceptual paper explores the critical role of smart library systems in advancing the Enugu State Smart Schools Initiative. As the education sector transitions into the Fifth Industrial Revolution (5IR), the integration of smart technologies in libraries has become central to achieving equitable access to knowledge, digital literacy, and lifelong learning. The study argues that smart libraries are essential catalysts for innovation, information dissemination, and digital inclusion in education. It uses a conceptual and analytical approach to examine how smart library systems can complement the Smart Schools Initiative by promoting digital competencies, enhancing information delivery, and creating inclusive learning environments. The paper concludes that collaboration between smart libraries and the Smart Schools Initiative will help build a sustainable digital learning ecosystem across Enugu State.

Keywords

Smart Library, Smart School, Digital Learning, Fifth Industrial Revolution (5IR), Smart Education

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State Chapter

Introduction

The world is currently experiencing a major shift from the Fourth Industrial Revolution (4IR) to the Fifth Industrial Revolution (5IR), where human intelligence teams up with artificial intelligence (AI) to build inclusive, sustainable, and human-focused tech ecosystems. In this exciting landscape, libraries as centers of knowledge are crucial in connecting digital technologies with educational change. The Smart Schools Initiative in Enugu State, launched by the state government, aims to unite digital tools, e-learning resources, and smart infrastructure into basic and secondary education across all local government areas. On September 22, 2025, the Enugu State Government kicked off a significant overhaul of its education system with the launch of Smart Green Schools. This initiative represents a move away from the old-fashioned rote learning approach towards a more engaging, technology-driven, experiential education model (Njoku 2025). According to the state governor, Peter Mbah, each of the 260 Smart Green Schools is designed to be a comprehensive learning environment, complete with 25 digitally

connected classrooms, ICT centers, robotics and AI labs, e-libraries, and areas dedicated to hands-on learning. This initiative is all about equipping students with essential 21st-century skills, digital literacy, and innovative thinking.

Smart libraries can play a key role in this effort by providing access to digital content, supporting research, and enhancing information literacy skills for both teachers and students. As Michopoulou (2025) points out, “access to information and education is enshrined as a basic human right in international frameworks, including the Universal Declaration of Human Rights.” Smart library systems therefore, embody this principle by leveraging digital and AI-driven technologies to ensure that knowledge remains accessible to all learners. A smart library system goes beyond just being a digital library. It brings together cutting-edge technologies like artificial intelligence, the Internet of Things (IoT), big data analytics, cloud computing, and automation to improve how we find information, manage resources, and enhance the overall user experience.

These systems align with contemporary educational trends by supporting e-learning and virtual classrooms and providing access to a vast array of digital content, which is essential for smart school environments, especially in places like Enugu State (Simovic, 2018). Smart libraries also encourage innovation, civic participation, and the development of digital skills, empowering students to actively engage in a knowledge-driven society. Demir (2021) pointed out that smart libraries function within the larger framework of smart education, where learning spaces are adaptable, personalized, and data-driven. Adel (2024) pointed out that smart education really flourishes when there is a strong connection between digital tools, intelligent systems, and human creativity. This approach not only tackles the need for new skills and retraining but also fosters adaptability, resilience, and a spirit of self-improvement among learners. Therefore, the collaboration between smart libraries and smart schools signifies a blend of technology and teaching methods aimed at comprehensive educational growth.

The Enugu State Smart Schools Initiative is an ambitious project aimed at transforming public education throughout the state. Each smart school is outfitted with digital classrooms, interactive boards, internet-connected devices, and solar-powered ICT labs. The mission is to ensure that every child in Enugu State can participate in the digital age. For instance, Onyia (2025) highlighted that flagship schools like Owo Smart Green School are equipped with the technological infrastructure necessary for modern teaching methods, although there are still hurdles to overcome, including teachers training and resource distribution. The initiative aims to tackle these challenges to provide equitable, high-quality education for everyone, as discussed by Nweke, Ogwuiké & Iheonu, (2022). Despite the growing attention given to the provision of technological infrastructure

within the Smart Schools Initiative, limited attention has been paid to the role of smart libraries as complementary knowledge hubs that can support teaching, learning, research, and lifelong learning. This represents a significant gap in the discourse on the sustainability and effectiveness of the initiative. Existing studies have focused largely on digital classrooms and ICT facilities, with insufficient consideration of how smart libraries can enhance access to information resources and educational content.

Therefore, this paper aims to examine the role of smart libraries in supporting the Enugu State Smart Schools Initiative. Specifically, it seeks to:

1. evaluate the concept, features, and relevance of smart libraries in the context of the Fifth Industrial Revolution (5IR).
2. examine the role of smart library systems in supporting teaching, learning, and administrative activities within smart schools.
3. identify the challenges associated with integrating smart libraries into the smart school framework.
4. propose strategies for enhancing the effective integration of smart libraries into smart schools.

To achieve these objectives, the study adopts a descriptive discussion methodology based on a review and synthesis of relevant literature, policy documents, government reports, and scholarly publications relating to smart schools, digital learning environments, and smart library services. Through this approach, the study provides insights into how smart libraries can serve as the intellectual backbone of the Enugu State Smart Schools Initiative and contribute to the realization of equitable and high-quality education.

Concept of Smart School

A smart school is an educational space that harnesses digital technologies to enhance teaching, learning, and administration. These schools utilize interactive boards, e-learning platforms, and real-time data analytics to create personalized learning experiences. As Koshiry and Tony (2025) pointed out, this approach allows for personalized, seamless, and widespread learning experiences, along with automated management of resources and processes. Instruction is customized to meet the unique needs, learning styles, and paces of each student. Aggarwal, Sharma, and Saxena (2024) noted that Smart schools implement differentiated instruction, collaborative learning, and real-time feedback to promote deeper understanding and engagement. According to Khan et al. (2024), these schools often feature energy-efficient buildings, real-time environmental monitoring, and sustainable practices, utilizing IoT for both educational and ecological advantages.

Concept of Smart Libraries

A smart library is an advanced information hub that integrates technology such as artificial intelligence (AI), the Internet of Things (IoT), big data, and cloud computing to offer user-centered data-driven, and automated services (Gul & Bano, 2019). Think of a smart library as the library of the future, utilizing innovative technologies and user-focused services to create a lively, accessible, and adaptable information space. Unlike the conventional traditional libraries, smart libraries are designed to cater to the changing needs of users in our digital world, promoting lifelong learning, research, and community involvement. They incorporate tools like chatbots, RFID systems, automated cataloging, and virtual learning environments to boost efficiency and engagement. The services provided are interactive, user-friendly, and often available round the clock. Examples of these services include self-service kiosks, digital lending, personalized

recommendations, and smooth integration with other digital platforms (Igwe and Sulyman, 2022). Both users and staff benefit from digital literacy, training, and collaborative opportunities, ensuring that technology enhances human expertise and engagement rather than replacing it (Yunus & Ismail, 2024).

The Relationship between Smart Schools and Smart libraries

Smart schools and smart libraries complement each other beautifully. Smart schools produce learners who need constant access to selected, high-quality information, and smart libraries provide the necessary infrastructure for that access. Braimah (2025) aptly stated that the library of the future will be defined by networks of knowledge promoting increased accountability and knowledge sharing across boundaries and specialties. The relationship between smart libraries and smart schools is deeply intertwined, with smart libraries acting as a crucial element that boosts the effectiveness, inclusivity, and innovation of smart schools. Nagani (2024) pointed out that a smart library is essential for a smart school, offering digital educational resources available anytime and anywhere. This highlights the crucial role smart libraries play in fostering ongoing, technology-enhanced learning experiences. This improves active, adaptive, and creative learning—key characteristics of smart schools (Baryshev et al., 2018). Smart libraries are not standalone entities; they engage with other school subsystems (like classrooms and administration) to support teaching, learning, and research.

This integration ensures that information, media, and educational functions are seamlessly delivered across the school environment (Le & Bui, 2020). Smart technologies enable real-time collaboration and access to learning materials from multiple platforms. They also create an interconnected system in which students, teachers, and administrators can share and utilize

knowledge efficiently. Smart libraries play a critical role in fostering digital literacy, creativity, and entrepreneurship among students and teachers, acting as both a “virtual teacher” and a hub for knowledge creation and sharing (Chan, 2017). Through interactive digital platforms, learners can explore innovative ideas and gain skills relevant to the modern information society. Moreover, teachers can integrate smart library tools into their instructional methods, promoting lifelong learning and innovation in education.

Smart Libraries in the Fifth Industrial Revolution (5IR)

The Fifth Industrial Revolution (5IR), often referred to as Industry 5.0, marks a significant shift from the tech-centric focus of Industry 4.0 to a more human-centered, sustainable, and resilient approach. While Industry 4.0 was all about automation, Ali, Al-Sultan, and Rubaie (2022) pointed out that 5IR aims to blend advanced technologies with human creativity, well-being, and societal values. This revolution is not just about tech; it is about making technology more human-friendly. It combines automation, AI, and human empathy to create systems that benefit all learners fairly. Smart libraries are a perfect example of this philosophy, using technology to enhance human learning instead of replacing it. These innovations provide personalized recommendations, streamline resource allocation, and create smooth user experiences (Adigun, Ajani, & Enakrire, 2024). Enakrire et al. (2024) noted that the shift to paperless libraries, driven by cloud computing and mobile tech, allows users to access resources anytime and anywhere, promoting lifelong learning while also being kinder to the environment. 5IR represents a collaborative relationship between humans and machines. Mahiri (2023) described it as a close partnership where intelligent machines (like robots, AI, and IoT) enhance human abilities rather than take over. In libraries, this collaboration shows up as smart systems that

anticipate user needs, suggest tailored resources, and provide round-the-clock digital access. Additionally, smart libraries in the context of 5IR foster innovation labs, makerspaces, and collaborative learning areas. These spaces promote critical thinking and creativity skills that are vital for success in today’s knowledge-driven economy.

Evidence from several countries demonstrates that smart libraries can significantly enhance the effectiveness of smart schools. In Singapore, for example, school libraries have been transformed into technology-enabled learning hubs that support reading, research, collaboration, and digital literacy. This article highlights how smart libraries in India are evolving into **technology-driven learning hubs**, similar to transformations seen in Singapore and other countries, emphasizing efficiency, personalization, and digital literacy, (Kumar, 2024). A case study of a Singapore secondary school found that the school library became a central learning space through the integration of digital resources, innovative library design, and reading promotion programmes, contributing to improved student engagement and learning outcomes.

Similarly, in Kerala, India, a large-scale digital library initiative was implemented across all high schools in the Vypeen constituency. A notable example of smart library development in India is the large-scale digital library initiative implemented across all high schools in the Vypeen constituency of Kerala. This project aimed to transform traditional school libraries into technology-enabled hubs by providing digital resources, e-learning platforms, and access to online databases. According to Sasidharan (2022), the initiative was designed to improve digital literacy, foster collaborative learning, and ensure equitable access to educational materials for students in both urban and rural areas. The study highlights how smart libraries can bridge educational gaps by integrating ICT tools, promoting reading culture, and

supporting collaborative research. It also underscores the importance of government-led initiatives in scaling digital transformation across schools, ensuring that students gain the skills necessary for a knowledge-driven society.

Smart libraries in Nigeria are emerging but remain unevenly deployed, with most initiatives concentrated in academic institutions. Studies highlight that while technologies such as AI-powered chatbots, machine learning for metadata extraction, and immersive digital spaces are being introduced, challenges like poor infrastructure, limited funding, and inadequate ICT training hinder full-scale adoption. A study by Adigun and Igboechesi (2024) examined smart academic libraries in Northern Nigeria. The research found that while smart services such as digital cataloging, online access, and AI-assisted systems exist, their deployment is still limited. The study emphasized that weak ICT policy frameworks, insufficient staff training, and poor funding remain major obstacles to effective smart service delivery. The authors recommended stronger institutional support and investment in ICT infrastructure to advance smart library adoption. Similarly, an analysis by Adamu (2026) described Nigerian libraries evolving into “Intelligent Ecosystems” that integrate AI, natural language processing (NLP), and smart technologies. Examples include AI-powered chatbots for 24/7 reference services, machine learning for automated metadata extraction, and NLP tools that interpret queries in multiple Nigerian languages. Some libraries are also experimenting with virtual exhibits and metaverse-inspired collaborative spaces to extend access beyond geographical boundaries.

Studies on Nigerian school libraries consistently reveal challenges such as inadequate facilities, insufficient professional staffing, and limited access to current information resources, all of which hinder

their ability to support effective teaching and learning. These systemic issues have been documented in recent academic research, highlighting the urgent need for reforms in infrastructure, funding, and professional development. Akinsanya (2024) emphasizes that Nigerian school libraries face insufficient funding, poor infrastructure, inadequate resources, and lack of trained personnel, limiting their transformative potential in fostering literacy and digital skills. In the same vein, Olajide and Zinn (2020) similarly note that many Nigerian school libraries remain underdeveloped due to unqualified librarians, inadequate facilities, and poor resource provision, despite national policy mandates for functional libraries. These findings explain the need for revitalization strategies such as increased funding, ICT integration, and professional training to transform Nigerian school libraries into effective learning hubs.

The Role of Smart Library Systems in Supporting Smart Schools

1. **Enhancing Access to Digital Learning Resources:** Smart libraries can host a wide range of educational resources, including e-textbooks, open educational resources (OERs), and multimedia learning content. Through digital repositories, students and teachers in smart schools can access materials beyond the traditional classroom. As Chan and Chan (2018) observed, by leveraging technologies like big data, AI, and IoT, smart libraries offer personalized content recommendations, facilitate peer collaboration, and support virtual classrooms—key elements of the smart school model. By extending learning beyond physical boundaries, smart library systems democratize access to knowledge.
2. **Promoting Information Literacy and Research Skills:** One of the essential roles of smart libraries is fostering information literacy. The ability to

locate, evaluate, and use information effectively. This aligns with the goals of smart schools, which emphasize critical thinking and creativity. Through workshops, online tutorials, and AI-driven learning analytics, smart libraries can help learners develop lifelong research competencies.

3. **Supporting Curriculum Delivery and Teacher Development:** Smart libraries can assist teachers by providing access to teaching resources, curriculum support materials, and digital pedagogy guides. With tools such as AI-assisted information retrieval and collaborative platforms, teachers can design innovative lessons that integrate multimedia content and data-driven insights.
4. **Bridging the Digital Divide:** While smart schools provide technological infrastructure, disparities in digital skills and access to resources persist. Smart libraries can act as equalizers by providing inclusive digital environments, community access points, and assistive technologies for learners with disabilities. Varganova, G. (2024) rightly stated, that offering digital literacy education, technology training, and support, libraries empower individuals to navigate and benefit from the information society, particularly those at risk of exclusion due to age, disability, or socioeconomic status. This inclusive approach helps bridge the digital divide, ensuring that all members of society have equal opportunities to access, understand, and utilize information for personal and professional growth.
5. **Facilitating Collaboration and Innovation:** Modern smart libraries can host innovation labs, makerspaces, and co-creation hubs

where students experiment with digital technologies, robotics, and creative projects. These spaces encourage problem-solving and collaboration which are essential for 5IR learning environments.

Challenges of Implementing Smart Library Support Systems in Nigeria

The success of smart library support systems hinges largely on building capacity at all levels of administrators, teachers, and students. Unfortunately, in Nigeria, despite the potential, the implementation of smart libraries face several challenges including inadequate funding, poor internet connectivity, limited digital skills among librarians, and maintenance issues as outlined below:

Funding Constraints:

Adequate funding is very essential for establishing and sustaining smart library support systems, including the acquisition of digital infrastructure, subscription to electronic resources, staff training, and system maintenance. However, inadequate funding remains a persistent challenge facing libraries in Nigeria. Adekoya (2023) found that funding for major library projects and information resources in higher institutions is often insufficient, limiting the development of modern library services. Similarly, Garba, Garba, and Zubairu (2023) reported that inadequate government funding and poor budget implementation significantly affect the growth and effectiveness of public libraries in Nigeria. In the context of emerging technologies, Nduka, Tella, and Okiki (2023) identified inadequate funding as one of the major barriers to the implementation of artificial intelligence and other digital innovations in Nigerian libraries. ([Taylor & Francis Online](#)). While adequate funding and robust infrastructure are prerequisites for both technology deployment and institutional adaptation, many schools and public libraries lack funding to establish digital

infrastructures. Financial constraints and lack of resources remain major barriers in many African contexts (George & Chukwuka, 2023).

Inadequate Internet Connectivity: Reliable internet connectivity is fundamental to the successful operation of smart library support systems because it enables access to digital collections, cloud-based services, online databases, and collaborative learning platforms. However, inadequate internet infrastructure remains a significant challenge in Nigeria. Igbinovia and Aiyebilehin (2023) noted that digital inclusion efforts in Nigerian libraries are constrained by unequal access to ICT infrastructure and internet services, particularly in underserved communities. Similarly, Esse and Haliso (2024) identified poor and unsustainable internet connectivity as one of the major obstacles affecting the sustainability of institutional repositories in Nigerian university libraries. Consequently, unstable internet services can limit access to digital resources and reduce the effectiveness of smart library initiatives as stable broadband remains inconsistent in many parts of Enugu State.

Skills Gap: The effectiveness of smart library systems depends largely on the digital competencies of librarians and other stakeholders responsible for managing technology-driven services. Nevertheless, studies have shown that many library professionals in Nigeria still require advanced digital and emerging technology skills. Ojobor, Okafor, and Ugwuanyi (2025) found that a lack of expertise remains one of the factors slowing the adoption of innovative technologies in Nigerian libraries. Likewise, Adetunla and Chowdhury (2023) reported that while some digital skills training programmes exist, many university librarians lack the advanced competencies required to function effectively in an increasingly technology-driven environment. These skill deficiencies may hinder the implementation and management of smart library support systems.

Successful implementation of smart library support systems requires coherent policies that integrate library development, digital transformation, and educational technology initiatives. However, fragmented institutional policies and weak coordination among stakeholders often impede implementation efforts. Studies on digital transformation in Nigerian libraries suggest that technology adoption is frequently undertaken in isolation, without comprehensive strategic frameworks to guide implementation and sustainability (Ojobor, Okafor, & Ugwuanyi, 2025). The absence of coordinated policy frameworks can result in duplication of efforts, inefficient resource utilization, and uneven implementation of smart library initiatives across institutions.

Sustainability Issues

Maintenance of smart systems requires continuous technical support and upgrades. Sustaining smart library systems requires continuous funding, technical support, staff development, reliable internet connectivity, and regular system upgrades. However, maintaining digital initiatives over the long term remains a challenge for many Nigerian libraries. Esse and Haliso (2024) found that funding shortages, inadequate technical expertise, poor collaboration between IT personnel and librarians, unreliable internet connectivity, and unstable power supply significantly affect the sustainability of institutional repositories in Nigerian university libraries. Similarly, Nduka, Tella, and Okiki (2023) identified poor maintenance culture, inadequate technical know-how, and insufficient funding as barriers to the successful implementation of emerging technologies in Nigerian libraries. These challenges raise concerns about the long-term viability of smart library support systems in the country.

Recommendations

For smart library systems to thrive, it is important to address the implementation

challenges. These challenges require increased investment, ICT policy development, staff training, and infrastructure improvements e.g., solar power, better internet access (Orji & Echezonamanyira, 2021). Oke and Fernandes (2020) posited that inclusive strategies that address local contexts and socio-economic disparities, including training and resource allocation, among others must be prioritized. Addressing these issues requires a collaborative approach involving government agencies, librarians, and ICT experts to build sustainable smart library ecosystems. To that extent, the following recommendations are proffered:

Integration Policy: The Enugu State Government should formally integrate smart libraries into the Smart Schools framework to ensure resource sharing and coordination.

Capacity Building: The Enugu State Government, through the Ministry of Education and relevant educational agencies, should prioritize continuous training for librarians and teachers on emerging technologies and information literacy to strengthen their capacity to effectively support smart library services and digital learning initiatives.

Infrastructure Development: the state government should invest in reliable power supply, broadband internet, and digital devices for smart library operations.

Partnerships: Educational policymakers should facilitate collaborations with technology companies, universities, and donor agencies to secure technical and financial support for smart library initiatives.

Awareness and Inclusion: School leaders, working with community organizations, should champion inclusive access programmes to ensure that rural and marginalized communities benefit equally from smart learning resources.

Conclusion

Smart libraries are indispensable in actualizing the Enugu State Smart Schools Initiative. They provide the digital foundation for knowledge access, skill development, and lifelong learning. In the 5th Industrial Revolution era, libraries must evolve from passive information centers to active partners in smart education. As Tinio (2020) once said, “the illiterate of the 21st century will not be those who cannot read and write, but those who cannot learn, unlearn, and relearn. By embracing smart technologies and inclusive practices, libraries in Enugu State can truly become the intellectual engines driving the Smart Schools vision, a future where every learner has the power to access, create, and share knowledge seamlessly.

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