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# TECHNOLOGICAL TRENDS AND THEIR APPLICATIONS IN UNIVERSITY LIBRARIES

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## Abstract

The paper examined the concept of technology, disruptive technologies such as Radio Frequency Identification (RFID), Artificial Intelligence (AI), Marchine Learning, Chatbot, Robotics, Big Data, Cloud Computing, Blok Chain Technologies and Augmented Realities were thoroughly discussed. The paper considered the infusion of ICT into library and information science curriculum, ICT scenario in Nigeria academic library was established. The study revealed that that the use of Information Communication technology, Artificial Intelligence, Radio Frequency Identification, Machine Learning, Big Data, Robotics, Chatbots, Cloud Computing, Augmented Reality, Drones Technology and Block Chain Technology with robust curriculum that encapsulate skills and competency in teaching and learning of library and information science can help both the academic librarian, students and the technical staff of the library in critical and innovative thinking. The study further recommended Curriculum of library and information science should be designed to accommodate or enriched with technology such as ICT, AI, RFID, Big Data, Robotics and Cloud Computing, also effort should be made to established linkage between library and information science and other technological base courses such as computer science, information and communication technology and mass communication for vitalization of ideas.

**Key Words:** Technology, Trend, University Libraries, Information Communication Technology, Artificial Intelligence.

## Introduction

Technology refers to the use of scientific knowledge to invent tools that assist human beings in their efforts to overcome environmental hazards and impediments to comfort (Marke, & Waziri, 2023). The dictionary of science and technology defines it as the practice, description and terminology of any or all of the applied sciences which have practical value and/or industrial use. Similarly, Merriam-Webster dictionary define technology as the practical application of knowledge especially in a particular area such as engineering (Eje & Dushun, 2018). Technology is considered as an input that enables communication and performance monitoring (Gilson, Maynard, Jones Young, Vartiainen, & Hakonen, 2015). Earliest form of technologists used for several centuries includes newspapers, books, photo albums, posters, theatre, human interactions, markets and plays. This was followed by an era of more sophisticated ICT peripherals. Among these are also radios, televisions, telegraphs, audio and video cassettes, films and filmstrips, and slides which have been used for several decades in libraries to advance their operations. Technologies are still changing, new ones are still emanating making huge impact on the society and turning the world into a global village. Academic library in particular, are those libraries that are established and maintained by institution of higher learning such as universities, polytechnics and colleges of education. They are established to support teaching, learning, research and community services that goes on in their parent institutions. This is supported by Aina (2014) which stated that the main purpose of an academic library is to support the objectives of a university, which is in the areas of learning, teaching, research and service. Disruptive technologies such as Radio Frequency Identification (RFID), **A**rtificial Intelligence (AI), Machine Learning, Chabot, robotics, big data, cloud computing, block chain technologies, augmented realities, 3D printing and other technologies are currently making waves globally and completely changing the way things are done in organizations including teaching and learning of library and information in Nigeria university.

## Radio Frequency Identification

Radio Frequency Identification **(**RFID) is a technology that uses electromagnetic fields to identify and track objects. Sungkur et al. (2021), defines Radio Frequency Identification (RFID) as an electromagnetic wireless system of communication that is used in libraries for identification and security purposes. Radiofrequency identification is an exciting and fast-growing technology for snowballing competence and refining viability and is an important area

of study in today's information environment. The use of RFID has been extended to libraries, keeping libraries efficient and competitive in a shifting environment (Khan et al., 2022). Libraries use RFID technology to increase the speed and convenience of their procedures and to improve the quality of their services (Boyd, 2018). Nisha (2018) elaborated that RFID is one of the tools in the academic library to manage and govern libraries' resources. Similarly, Ondieki (2013) quantified that, barcoding and electromechanical (EM) technology was used for the security of information materials. They are also used for security by triggering alarms or locking gate when unauthorized items are detected. It also helps in locating misplaced books by tracking their locations. RFID is the latest wireless technology to be used in library theft detection systems. It is another form of automated identification system. This technology is same as bar-coding system but it is very much refined and improved than bar-coding system.

**Artificial Intelligence**

Artificial intelligence (AI) is an area of computer science that focuses on the creation of intelligent machines that work and react more like humans. UK Government (2022), defines AI as machines that perform tasks normally requiring human intelligence, especially when the machines learn from data how to do those tasks. AI is the ability of a computer system to solve problems and perform tasks that would otherwise require human intelligence (US National Security Commission on AI, 2021). AI is a set of sciences, theories and techniques whose purpose is to reproduce by a machine the cognitive abilities of a human being. Current developments aim, for instance, to be able to entrust a machine with complex tasks previously delegated to a human (Council of Europe 2021). Artificial Intelligence can be understood as the collection of technologies that enables machines to sense, comprehend, act and perform several functions matching up with human intelligence. Humans have intelligence, which has developed organically through biology and evolution, and includes reasoning, logic, problem-solving, and other cognitive abilities. Artificial intelligence seeks to replicate this intelligence for narrow or broad purposes. For example, if a device were created to enable a dog to think like a human, that would be an artificial creation of intelligence Wang, Lund, Marengo, Pagano, Mannuru, Teel & Pange (2023). Artificial intelligence has become a critical technological tool used to eliminate human faults such as delays**,** biased approaches, and other minor flaws in libraries. Yoon, Andrews, & Ward, (2022), noted that AI has become a reliable substitute for some human services, assisting in various user services. Gujral, Shivarama, & Choukimath,

(2019), discussed specific roles and applications of AI in academic libraries, including data curation for collection management and digital preservation and navigating new information environments to better understand the scholarly communication landscape. AI in library systems can be seen in descriptive cataloguing, subject indexing, reference services, technical services, shelf reading, collection development and information retrieval systems.

**Machine Learning**

Machine Learning (ML) is an artificial intelligence (AI) technology that enables developed systems to train and gain new knowledge on their own without being specifically taught. The system may also be created repeatedly when its own output is used as an input or data source, it can be tested and programmed on an ongoing basis. Clifford (2019) described it the sub-discipline of artificial intelligence that uses collections of examples to train software to recognize patterns, and to act on that recognition. Machine learning is a section of artificial intelligence that does not provide solutions but rather trains the systems to apply solutions (Al-Mushayt, 2019). According to Jesubukade (2022), Machine Learning is only part of what a system required to become an artificial intelligence. Examples of Machine Learning tools within AI include: Big Data, Text Data Mining (TDM), Robotics, Pattern Recognition, and Chatbots. ML is a subset of AI that provides computers with the ability to learn without being explicitly programmed. World Customs Organization/World Trade Organization (2022) asserts that ML capabilities help solve general problems such as analyzing text for emotional sentiment, analyzing images to recognize objects or faces, converting speech (audio) to text, translating the text into many languages, then using the translated languages to get answers from a knowledge base. AI components can significantly enhance library operations. Visual search and facial recognition of library patrons, analyze users predictive behaviors, understand collection development models, knowledge organization and management, keeping users statistics and audit, targeting, analyzing and monitoring users of libraries.

**Big Data**

Data are symbols, numbers, alphabets, and figures, stored and presented in a formalized mode, derived from observations or measurements suitable for interpretation, or processing by humans or automatic means. Data are the raw material for actionable information and knowledge creation (Anyaoku, 2019). Big Data refers to “data whose scale, diversity, and complexity require new architectures, techniques, algorithms, and analytics to manage it and extract value,” as well as its hidden meaning (Panorea, Emmanouel, & Panos, 2014). Big Data

is defined as information overload due to the volume, speed, variety, variability and authenticity of data that need to be processed to achieve good value and visualization than the data generated in academia and other institutions is large and complex (Fakiragouda, 2022). According to Winslow (2013), volume refers to the amount of data; speed refers to data in motion and more specifically to the rate at which data is created, processed, and analyzed; the variety involved in managing the complexity and heterogeneity of many data sets, including structured, semi-structured, and unstructured data; Finally, authenticity refers to the uncertainty of the data and the degree of reliability/quality associated with certain types of data (Anandgouda, 2022). Since current libraries are confronting the proliferation of data (GordonMurnane, 2012), the skills of librarians need to be updated in order to handle issues caused by big data (Affelt, 2015 & Reinhalter and Wittmann, 2014). Big Data is used for mining and text analytics in libraries, for taking decisions, for data standardization and modelling, for user behavior study, for collection development study and for tracking users of libraries. Information professionals use big data tools to analyze their large data in order to understand targeted users to provide effective and efficient library services to them.

**Robotics**

A robot is an automated or AI-enabled machine that is programmed to carry out specific task. They are often configured to be used to complete particular activities with or without human assistance. This might entail deploying robotics, such as the automated arm or robots that can remove books from libraries, to extract them off shelves (McCaffrey, 2021). Robotics immediately affects libraries, as well as the greater informational (and social) environment in which libraries and librarians of all kinds operate (Owolabi, Okorie, Yemi-Peters, Oyetola, Bello, and Oladokun, 2022). Library activities involve plenty of manual work, which can be partially or fully done effectively with the help of robots. Technology has advanced libraries in many ways; robots are being used instead of humans in various library operations, especially those tasks which are hazardous and time-consuming (Jesubukade, 2022). Robotics are now being used in libraries all over the world. Some libraries that have adopted robotics in their services are New York public libraries, Temasak Polytechnic library, UMKC Library, University of Chicago Library, Shanghai library and so on. They are used for filling, sorting and replacing the books in the shelf, for inventory purpose, demonstration for teaching, delivering of Newspapers, magazines or brochure, welcoming and directing users to various locations and asking Frequently Asked Questions (FAQs). According to Harisanty et al. (2020), some areas where robotic technologies have been integrated into library operations include

shelving and finding library materials, security, inquiries and responding to repetitive reference and directional queries, outreach and public relation via library tours, and even information illiteracy training. This could involve using robotics to retrieve books from shelves, such as the automatic arm or robots that can take them up from libraries (McCaffrey, 2021). Robots in libraries free up librarians' time to concentrate on other crucial information services that cater to the changing needs of the modern world. Robotic devices for automatic storage and retrieval have also been helpful in the management of library space (Echedom and Okuonghae, 2021). It is the responsibility of the libraries to ensure that all library users have opportunities to interact with robots in several programmes, using different types of robots to keep up with a range of skills, and a range of coding opportunities that libraries offer.

**Chatbots**

A chatbot is a piece of software or application that uses artificial intelligence (AI) to simulate a discussion (or chat) with a human via a messaging service, a weblog, a website, a smartphone app, or an android smartphone. For library services, voice assistants and chatbots can be used (Mckie & Narayan, 2019). Also, Jesubukade (2022), referred to Chatbots as intelligent agents, digital assistants, or virtual agents) are software applications which can converse intelligently, whether by speech, text, or possibly by embodied expression. Through their design, they closely emulate human conversation to communicate and interact with people. They are systems designed to respond automatically to messages through the interpretation of natural language. Typically, these are used to provide support in response to queries (e.g. "Where is my next class?", "Where can I find information about my assessment? Chatbots is a typical e.g of AI. It is an artificial intelligence (AI) software or application that can simulate a conversation (or a chat) with a human being in natural language via a messaging app, a blog, a website, a mobile app, or a smart device. Voice assistants and chatbots can be utilized for library services Mckie & Narayan (2019). However, Karimova & Shirkhanbeik, (2019), asserts that it is important to note that chat bots are not the be-all and end-all for customer service issues. At the very least, humans should be available when customers require them.

## Cloud computing

Cloud computing refers to providing computing and communications-related services with the aid of remotely located, network-based resources without a user of such resources having to own these resources. Cloud Computing is a new technology that could potentially revolutionize IT implementation and delivery (Alismaili, Shen, Huang, He & Zhan (2020). It is a model that can provide on-demand network access to configurable computing resources from a shared pool with minimal management effort or service provider interaction (Mell & Grance, 2009). Service providers are divided into three classes according to the service offered, such as PaaS, SaaS, and IaaS (Rimal, Jukan, Katsaros, & Goeleven, 2011). Platform -as- a- Service (PaaS) is defined as a cloud computing where a third party offers the necessary software and hardware resources. Pass solutions cope with modern business requirements while considerably reducing costs and complexities of buying, installing, and managing in-house hardware and software. A typical PaaS model encompasses the physical infrastructure, cloud applications, and a graphic user interface (GUI).

- Software as a Service (Saa) is a way of delivering applications over the internet- as a service. Instead of installing and maintaining software, you simply access via the Internet, freeing yourself from complex software and hardware management. SaaS are often times, called web-based software, on demand software or host software. E.g of SaaS software are Google, Salesforce, Zoom, DocuSign, Netflix etc.
- Infrastructure as a service (IaaS) is a cloud computing model that provides on-demand access to company resources such as server, storage, networking and visualization.

Many companies or users can use cloud systems for data storage and backup to save capital and infrastructure costs. Dropbox, Google Drive and Amazon S3 are of cloud computing solutions Borodako, Berbeka, & Rudnicki (2021). Cloud computing enables data scientists to analyze data, find correlations, predict future crises, and assist data-driven decision making in an enterprise. Most libraries through cloud computing host their repository, host their websites, access OCLC via remote access. Library operations such as classification,

### AR (augmented reality)

AR (augmented reality) is a cutting-edge technology that allows users of smart devices to view the natural environment via a digitally enhanced lens. AR may be used for headphones and/or digital devices like tablets, smartphones, and even desktop computers. Software, sensors, and digital projectors make up the systems, which enable digital displays to be projected onto real-

world objects. Since augmented reality has the ability to change what is actually happening, it is a great fit for libraries. Library professionals should commit to working with AR applications more effectively and efficiently under the library – AR binary in light of today's customers' requirements. By integrating sights, sounds, and smells into the natural world as it is, Augmented Reality aids in the physical world. People can interact with both virtual and augmented reality because AR is too similar to the real (World Customs Organization/World Trade Organization, 2022).

**Drones technology**

According to Webster's dictionary, a drone is an unmanned aircraft or ship guided by remote control or onboard computers. Unmanned aerial vehicles (UAVs) are a component of an unmanned aircraft system (UAS) which includes a UAV, a ground-based controller, and a system of communications between the two. The flight of UAVs may operate with various degrees of autonomy: either under remote control by a human operator, or autonomously by onboard computers (Rouse, 2018). Libraries such as Dubai Libraries Rose Memorial Library, New York Public Library, and Florida Library have started using Drones technology as effective tools for delivering books for library patrons and vice versa.

**Block chain technology**

Block chain is a type of sophisticated cryptographic decentralized and distributed ledger architecture, a continuously growing list of records. It has the capability to move any kind of data securely among participants in the network (called nodes) on a peer-to-peer basis and, at the same time, make a record of that change, movement, or transaction available instantly, in a trusted and immutable manner to all participants. No entity controls it (it is decentralized) and data is distributed among the participants in the network (each participant has a copy of the records). The decentralized and distributed nature of block chain, combined with the use of advanced cryptographic techniques, makes it a highly secure technology. World Customs Organization/World Trade Organization (2022), explains that Block chain was invented by Satoshi Nakamoto in 2008 for use in the crypto currency bit coin, as its public transaction ledger. The invention of the block chain for bit coin made it the first digital currency to solve the double-spending problem without a need for a trusted authority or central server. The bit coin design has been the inspiration for other applications. Block Chain technology in libraries are used to collect and store data or build enhanced metadata system for libraries, to protect and keep track of digital-first sale rights and ownership, to connect networks of libraries and

universities, to host digital peer to peer sharing, to carry out resource sharing in libraries and to enables libraries to securely and transparently manage and share digital assets, including research data and scholarly works.

**Infusing ICT into library and Information Science Curriculum**

Infusing ICT into library and information science curriculum would motivate the student, academic librarian, and professional librarian to solve real problems. ICT can help librarian integrate several subject areas, such as library practice, classification and circulation which require automation. This will help to improve students learning and the management of the library. In corroboration, Anyaoku (2012) emphasized that incorporation or infusing of ICT tools into teaching and library operations have gone beyond partial integration but build competences in effectiveness and new innovation in teaching and learning of library and information as a profession. College or faculty librarian explore new ways in which ICT changes their personal productivity and professional practice. The curriculum begin to merge subject areas to reflect real-word applications.

**ICT Scenario in Nigeria Library**

Enumerating the situation of ICT in Nigeria library and LIS education as a whole entails the prevailing conditions of the college staff, the students, practitioners and LIS schools themselves in the formulation of effective curriculum that will provide effective competencies in rendering services to the university community. However, library and information science schools still face many challenges in trying to provide appropriate and sustainable solutions for improving curriculum and skills that will enable development in all aspects. Adeya (2017) observes that there are constraints against the development of ICT in Africa such as inadequate computerization, inadequate infrastructure and inadequate human capacity, most of which adherent to the economic disadvantage of these countries. In relation to Nigeria, Disco (2014) asserted that Nigeria is characterized by underdeveloped economy, unstable political culture and chaotic socio-cultural environment, with low productivity and low capacity utilization, low industrialization, poor reading culture, unfavorable information environment. All these problems have undermined the development of library and information science and the library as a profession in Nigeria especially with regards to the deployment of ICT. However, the conditions under which college or faculty librarian, students, practitioners and the system in particular operates are not in line with the objectives that are exterblised to work base on, in relation to this the system is totally deprived by:

- Under funding
- Poor motivation of the librarian leading to migration, brain drain, low productivity and unethical practices
- Graduating unqualified practitioners, leading to change in profession and working environment.
- Poor infrastructures or institutional facilities for teaching and learning
- Lack of or absence of collaboration or linkages between institutions of learning at national and international levels
- Lack of Network with global knowledge system
- Lack of clear policy formulation and implementation with regards to educational development

These and many are the challenges render incapacitated the use of ICT for effective performance that can translate to improvement in teaching and learning of library and information science also reduce the performance of university library as an institution.

**Conclusion**

By and large, it is obvious that the use of Information Communication technology, Artificial Intelligence, Radio Frequency Identification, Machine Learning, Big Data, Robotics, Chatbots, Cloud Computing, Augmented Reality, Drones Technology and Block Chain Technology with robust curriculum that encapsulate skills and competency in teaching and learning of library and information science can help both the academic librarian, students and the technical staff of the library in critical and innovative thinking. Additionally, technology based collaborative tools are part of the teaching and learning of library and information science. This is because they allow lecturers to communicate effectively with the learners. They also obtain immediate feedback from the user regarding their performance.

**Suggestions**

The following recommendation are based on the conclusion of this study:

1. Curriculum of library and information science should be designed to accommodate or enriched with technology such as ICT, AI, RFID, Big Data, Robotics and Cloud Computing.
2. Effort should be made to established linkage between library and information science and other technological base courses such as computer science,

information and communication technology and mass communication for vitalization of ideas.

3. Adequate funding from government to all library school to show enough commitment to the educational system to which library and information science education belong.
4. There should be proper utilization of ICT in all institutional library
5. Finally, efforts should be made to ensure that academic librarian are well paid to afford brain drain in education system.

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