

THE CONSORTIUM OF TANZANIA UNIVERSITY AND RESEARCH LIBRARIES (COTUL)



PROCEEDINGS

THE 4TH COTUL SCIENTIFIC CONFERENCE

**PROCEEDINGS OF THE 4TH COTUL SCIENTIFIC
CONFERENCE HELD FROM 7TH TO 11TH
NOVEMBER 2022 AT THE INSTITUTE OF
ACCOUNTANCY ARUSHA (IAA) IN ARUSHA, TANZANIA**

THEME:

**"UTILISING DIGITAL TECHNOLOGIES FOR ENHANCING INFORMATION SERVICES:
OPPORTUNITIES AND CHALLENGES"**

ISSN: 2953-2566

eISSN: 2953-2574

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Published by
Dar es Salaam University Press (DUP)
P. O. Box 35182
Dar es Salaam
Tanzania

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2023

ISSN: 2953-2566

eISSN: 2953-2574

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Foreword

The Consortium of Tanzania University and Research Libraries (COTUL) is a formally registered association of higher learning and research institutional libraries from both public and private sectors. It was established in 2008 as a voluntary organisation for the purpose of engaging in joint information provision activities, particularly: acquisition of electronic information resources, supporting research works and providing capacity building training to its members geared towards enhancing teaching, learning and research works in Tanzania. COTUL was officially registered in 2017 by the Ministry of Home Affairs (Reg. No. S.A 21148) under the Societies Act [CAP. 337 R.E. 2002].

The 2013 COTUL Annual General Meeting (AGM) that was held at Ruaha Catholic University in Iringa Region decided, among other issues, to begin conducting scientific conferences for the purpose of sharing research knowledge and expertise among information professionals in the country and beyond. Since then, four (4) scientific conferences have been conducted. The last COTUL scientific conference was held in November 2022 at the Institute of Accountancy Arusha (IAA), whereby twenty (20) papers were presented under the major conference theme: *Utilising Digital Technologies for Enhancing Information Services: Opportunities and Challenges*. Therefore, COTUL is pleased to publish 14 papers that were returned and met the publication merits in its 4th Conference Proceedings.

On behalf of the COTUL Executive Committee and the Conference Organising Committee, I would like to extend my sincere gratitude to all authors, conference participants, sponsors, employers and other individuals for their contributions that have made the AGM and the Scientific Conference successful.

Dr. Sydney E. Msonde
COTUL Chairperson

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Assumptions of the Future of Artificial Intelligence in Tanzania Academic Libraries: A review of literature

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Abstract

This paper insight the assumptions, opportunities and challenges of the use of interactive and engaging applications of artificial intelligence in academic libraries in Tanzania. It determines assumptions and pitfalls inherent and the debate whether the technologies have effectively replicated academic libraries, library resources, services and operations. The inclusion criteria of the literature were assumptions, opportunities and challenges towards artificial intelligence in academic libraries. The literature was searched from databases to include Sage, Taylor & Francis, Emerald, Google Scholar and Research Gate. The results were analysed, evaluated, compared, contrasted and discussed in the lenses of UTAUT theory. The results indicate that artificial intelligence brings the world together in which people work and network in the integral function of provision of library resources and services to the library users. Artificial intelligence is as enabler for academic libraries to create library spaces, store, process, preserve, conserve, access, retrieve library resources and services timely with less costs. Also, artificial intelligence lessens inadequacy of funds to purchase printed materials in academic libraries, lack of digital devices and limited spaces in the libraries. Artificial intelligence has transformed the complex attitude and behaviors of library staff and users. Though, artificial intelligence has created fear towards employment opportunities of workers and library staff in particular. Besides, it was realised that library staff mismatch with the artificial intelligence in academic libraries due to lack of awareness, inadequate qualifications and limited infrastructure in academic libraries. This review contributes to the practices, knowledge, theory and literature of the use of artificial intelligence in academic libraries. The study proposed that there should be step by step towards interventions to introduce artificial intelligence in academic libraries. The process should consider the environments, needs and socio-economic developments of the developing countries and Tanzania in particular.

Keywords: Artificial intelligence, Academic libraries, Emerging technology, University, Education, Tanzania

1 Introduction

The 4th Industrial Revolution (4IR) is a transformation of the digitization which invented a new paradigm in real world. Artificial Intelligence (AI) is among the 4IR with broad application in the fields of human life and more prominent in academic libraries. AI is a computational science that replace operations that would be attended or controlled by human beings or digitally programmed (Ajakaye, 2022). It can be programmed remotely with autonomous to perform activities controlled in a fixed location or portable use applications (Vijayakumar & Sheshadri, 2019; Han & Conti, 2020).

1.1 Overview of artificial intelligence in academic libraries in Tanzania

Artificial intelligence is traced to 1920 out of Rossum's Universal Robots play by Karel Capel. AI is a Czech word 'Robota' referring to drudgery or boring but must be accomplished. AI was designed in the fields of electrical engineering, mechanical engineering and computer science, common language processing, speech recognition, expert systems and fuzzy system (Gade & Singh, 2016). Other scholars view that AI field was invented in the 1950s regarded as fiction used in film making and book writing (Ajakaye, 2022). Whilst today AI is coined in the daily lives of the people implicated in numerous fields to include law, health, commerce education, transport, pharmaceuticals, housekeeping, rescuing, manufacturing, finance, public services and industries. In librarianship, AI was adapted in the 1990s to detect, understand behavioural patterns and respond to operational activities in libraries (Ajakaye, 2022). Therefore, AI in librarianship is still a new emerging technology in developing countries though it has proven a breakthrough in other developed countries. Thus, academic libraries should embrace to find novel means for AI competitive advantage (Hamidi & Jahanshaheefard, 2019).

Artificial intelligence in library context, over years has been an important virtue transforming library fields through concerted and coordinated international information sharing phenomena. It brings together the world in which people work together and network to learn organization and provision of library products and services to the library users. AI has enabled academic libraries to remotely perform library scheduling, budgeting, collection development, referencing, storage and retrieval (Vijayakumar & Sheshadri, 2019). In particular, libraries are able to preserve, conserve, access and retrieve information in a friendly and sophisticated manner. AI helps librarians in creating awareness to library users to improve utilization of library products. It provides information needs for academic achievement and lifelong learning of the library users (Anafo, 2014). Thus, AI complements the core mission of academic libraries of provision of library resources and services for society's development.

The importance of AI in academic libraries reinforces human beings adapt it to fit into the modern world. The study by Adejo and Misau (2021) conducted in Nigeria views that AI could be applied in academic libraries to perform tasks which among others include reference services, indexing, acquisition and behavioural pattern recognition. The study by Asemi et al. (2020) reviewed literature on the use of AI in academic libraries, found that there are possibilities to apply AI to improve provision of library resources and services. While Mei, Chen, Jiang and Cheng (2017) proposed a framework to align AI in academic libraries. Extant studies to include the studies by Okunlaya, Abdullah and Alias (2022) show that several academic libraries establish AI centres in Malaysia. Academic libraries should embrace to the application of AI. They should endeavour to envision AI would prospectively change the operations and confront the challenges. In recent years AI raised debates on its application in education and academic libraries in particular (Okunlaya, Abdullah & Alias, 2022). This is because AI is more than imitating human intelligence to add value to the teaching and learning processes (Zhang, Li & Zhang, 2015).

Despite the endeavours, there are few studies to incorporate AI in academic libraries in Tanzania. The fact that extant literature on AI in academic libraries are from western world. The study by Adejo and Misua (2021) confirm that there decimal or no literature or documents on the application of AI in academic libraries in developing countries. Besides, incorporation of AI in strategic plans is yet to be realised by academic libraries (Wheatley & Hervieux, 2019). Also, the proposed framework by Mei, Chen, Jiang and Cheng (2017) is

still inadequate to guide on a critical gap on how academic institutions can apply AI in academic libraries (Okunlaya, Abdullah & Alias, 2022).

It is evident that information stakeholders are not aware of the AI's contribution in the light of their opportunities and challenges (Okunlaya, Abdullah & Alias, 2022). There is a missing link between academic libraries and AI incorporation in strategic plans (Wheatley & Hervieux, 2019). Academic libraries lack consciousness on AI's significance which brings about a critical gap (Wheatley & Hervieux, 2019). This situation necessitates to embark on the study on Assumptions of the Future of Artificial Intelligence in Tanzanian Academic Libraries.

Therefore, this study is guided by the objective to determine the application of Artificial Intelligence in Academic libraries in Tanzania. This study gears to fill the gap towards innovative academic libraries compliant to AI. Also, the study establishes an intimacy, awareness, unforeseen assumptions, opportunities, challenges on the use of AI in academic libraries. Also, the study enlightens alternative innovations in the lenses of technologies for the survival and thrive of academic libraries for the necessary measures for them to remain relevant in the global system.

2 Methodology

This study surveys and examines empirical literature as a review method on the assumptions of the use of AI in academic libraries in Tanzania. The surveyed literature includes books, journals, theses, electronic databases (Sage, Taylor and Francis, Emerald, Google Scholar, ResearchGate among others) and reports. The literature search employed various terms such as “technologies”, “robotics”, “artificial intelligence” and “academic library”. Also, keywords were combined to search for the literature such as “technologies and academic libraries”, “robotics and academic libraries”, “artificial intelligence and robotics”. The literature related to “assumptions, opportunities and challenges of the use of interactive and engaging applications of AI in academic libraries” world over were selected. The literature reviewed was analysed in the light of UTAUT variables and constructs tandem with four patterns of “technologies”, “robotics”, “artificial intelligence” and “academic library” compared and contrasted to build the gaps for further studies. The study presented a practical application of technologies, robotics, intelligence in academic library's operations and services. Content analysis of the collected literature was used to present the related phenomena under the study objective in a narrative form.

3 Theoretical framework

There are a number of theories and models which can be used to inform studies related to AI in libraries. These are such as Innovation Diffusion Theory (IDT), Technology Acceptance Model (TAM), Theory of Reasoned Action, Model of Personal Computer (MPC), Social Cognitive Theory and Theory of Planned Behaviour (TPB) (Dwivedi, Rana, Jeyaraj & Williams, 2017). But this study is underpinned by Unified Theory of Acceptance and Use of Technology (UTAUT). The fact that in 2003, Viswanath Venkatesh, Michael G. Morris, Gordon B. Davis and Fred D. Davis consolidated IDT, TAM, TRA, MPC, SCT and TPB to the Unified Theory of Acceptance and Use of Technology (UTAUT). It was believed that the consolidation would appropriately explain and predict the use of technologies. In comparison, other theories/models have sixty percent (60%) while UTAUT has seventy percent (70%) of application variation and behavioural intention for the individuals to use technologies (Attuquayefio & Addo, 2014).

UTAUT theory is believed to be widely used to inform many studies related to the use of AI. These include studies by Thomas, Singh and Gaffar (2013), on ‘The utility of the UTAUT model in explaining mobile learning adoption in education’, Attuquayeflo and Addo (2014), on ‘Using the UTAUT model to analyze students’ ICT adoption’ and Han and Conti (2020), on ‘The use of UTAUT and post acceptance models to investigate the attitude in education settings. Therefore, UTAUT is believed to be more useful to underpin the use of AI as it predicts behavioural patterns in academic settings (Han & Conti, 2020). UTAUT’s variables include performance expectancy, efforts expectancy, social influence and facilitating conditions tandem with constructs such as behavioural intention and actual technology use determine individuals to use technologies or not. Other UTAUT relationship moderators are age, gender, experience and volunteerism (Venkatesh, Thong & Xu, 2016). Furthermore, the study by Al-Qeisi (2009), on ‘Analyzing the use of UTAUT model in explaining online behaviour’ observes that UTAUT though initiated in the western countries, its variables and constructs are applicable in other countries to include developing countries with slight variations.

3.1 UTAUT variables and constructs and the use of AI in library settings

The application of UTAUT theory into the library settings is based on the acceptance and use of AI by the library staff and users. UTAUT states that individual attitude towards technologies determine individual behaviours. In reciprocity, it predicts intentions, acceptance of the use of technological innovations (Dwivedi, Rana, Jeyaraj & Williams, 2017). Performance expectancy is UTAUT variable, social influences, innovativeness and effort expectancy determine behavioural intentions to the use of technologies and innovations (Slade, Dwivedi, Piercy & Williams, 2015). In this study, the UTAUT explains technologies in the contexts of substantive antecedents for the individuals to accept and use robotics and artificial intelligence technologies in academic library environments. Through its variables, the model forms integral patterns to use robotics and artificial intelligence technologies in academic libraries.

UTAUT integrate variables and constructs to the attitudes and behaviours which are the most influential for individuals to use AI in academic libraries. UTAUT’s variables such as performance expectancy, social influence, efforts expectancy and facilitating conditions tandem with constructs such as behavioural intention build up intrinsic and extrinsic motivation to use AI in academic libraries. They enable academic librarians and their users to adapt and use AI to access library resources and services. This increases acquisition of knowledge, skills, experiences and information for their academic endeavours and lifelong learning. Figure 2 presents UTAUT model.

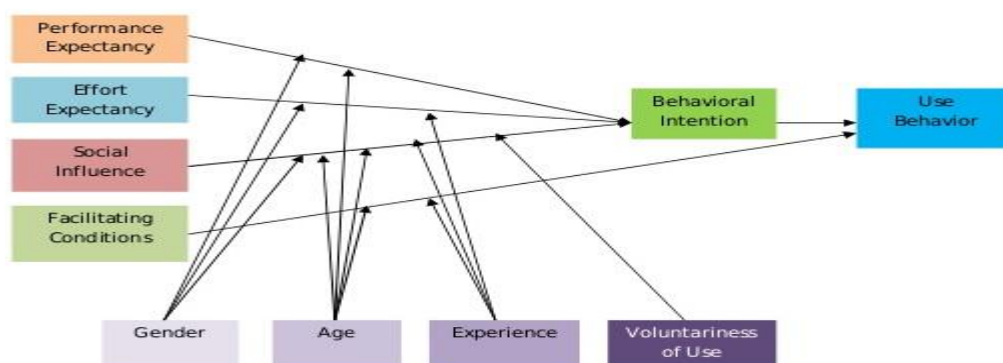


Figure 1: UTAUT Model (Venkatesh et al., 2003)

Figure 1 demonstrates UTAUT's variables and constructs as enablers to the use of AI in academic libraries. They in line with the assumptions that the use of AI in academic libraries a process which involves individual's beliefs that there are benefits in using AI (Attuquayeflo & Addo, 2014). It entails that the use of AI is not determined by gender or age of the library staff and users. The scenarios create positive attitudes and behavioural intentions and repetitions of individuals to actual (practical) use of AI. It recognises the process as an interrelated attitude and behavioural patterns and intentional directed motivations that lead to permanent repeated use of AI in academic libraries. The output process of the UTAUT theory variables and constructs are conversely to the perceived usefulness and the actual coordinated practice. Hence library staff and users observe the extent in which other people perceive the usefulness and benefits of AI in academic libraries and devote time to volunteer to use AI as part of behavioural patterns.

4 Assumptions of Artificial Intelligence (AI) in academic libraries

The artificial intelligence has grasped the use of computer and networked infrastructures to control various activities intelligently like human beings. For instance, robots have been perceived and predominantly used to perform activities as they are electronically controlled through mirroring the competences of human capital mind (Adejo & Misau, 2021). With artificial intelligence, it is possible to precisely keep the operating records and analyse all the action performed by the user. Artificial intelligence reflects the programming and development of hardware and software that intelligently perform human tasks through speech recognition, decision-making, visual perception, language translation, talking and emotional feelings (Adejo & Misau, 2021). In this regard, artificial intelligence accredits for planning ability, learning processes, reasoning ability, problem solving, mobility and creativity. This endeavour has not yet realised in most academic libraries of the developing countries where the United Republic of Tanzania is inclusive.

Various scholars including Cox (2022) considers artificial intelligence as an umbrella terminology for multiple technologies. In this, a broad and core interconnected artificial intelligence technologies are perceived. These include; business analytics and data science, natural language processing, speech recognition and text to speech, machine and deep learning, computer vision, neural networks, machine reasoning, decision making and algorithms, robots and sensors (Vijayakumar & Sheshadri, 2019; Cox, 2022). The interconnected artificial intelligence technologies among other fields, are presumed to play role in academic library reference services, technical services, indexing, acquisition, in natural language processing, pattern recognition and robotics functions (Adejo & Misau, 2021). Figure 2 presents the general components of artificial intelligence.

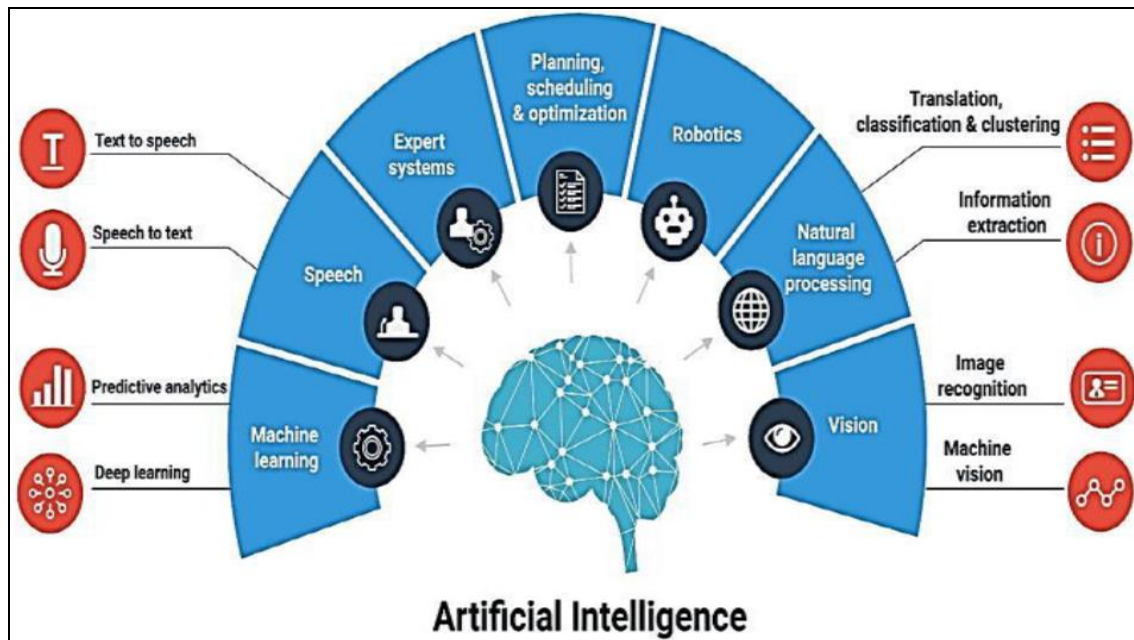


Figure 2: Artificial Intelligent Components (Vijayakumar & Sheshadri, 2019)

Expert system refers to a computer-based framework that simulates human decision making. The system can be integrated with any information system for quality, accuracy and performance of information services. In light of this, the developed academic libraries or smart libraries have in place the Expert System Librarian (ESL) for smart information services (Asemi, Ko & Nowkarizi, 2020). The expert system operates as a gateway or an interface through which the academic libraries and particularly the reference service section can be able to provide access to the database and obtaining relevant information. In this system, functions related to expertise advice, decision making and solutions to different problems is addressed. The system is therefore composed of integrated knowledge base, inference engine and user interface for interaction (Vijayakumar & Sheshadri, 2019; Adejo & Misau, 2021). Currently the technology has advanced to the extent that natural language can be processed by a computerised system to bring a meaningful phrases and speech for understanding. The artificial intelligence has provided a built-in natural language interface with limited vocabulary and syntax for translation (Echedom & Okuonghae, 2021).

Among others, a computerised artificial intelligent is composed of the main elements of natural language processing interface which can be able to synthesize a speech, translate the language a person uses, understands and that which is generated. It is similarly composed of linguistic services, information recovery, extraction and speech recognition (Vijayakumar & Sheshadri, 2019). The application of robots in academic libraries has contributed in facilitating reference services. It involves carrying out automated tasks through artificial intelligence technology which can be directly controlled by librarians or through predetermined programs. Mostly, wheeled, legged or humanoid robots are common in providing reference services to users (Chibuike & Emeka, 2021). However, few African countries such as South Africa and Nigeria have shown such initiatives of using these robots in reference services, the technology which in Tanzania academic libraries is not well comprehended.



Plate 1: Legged Robot in a library (Chibuiké & Emeka, 2021)

The expert system comprises of artificial technologies that can assist in supplying users with recommended sources for reference. Aids in improving reference skills to reference librarians, users and information specialists. It has a pointer for directing users to reference resources also online reference assistance which provides for directional transactions on library location, online services such as computer assisted instruction modules and knowledge-based system (Adejo & Misau, 2021). *Answerman* is a knowledge-based system that forms a component of expert system which provide answers to the users' questions on a given topic. It is regarded as a consultation system or a front end to external databases and CD-ROM reference tools. Furthermore, the expert system consists of plexus a referral facility that aids in providing knowledge about the reference processes, subject based information retrieval guide, information about reference sources and mostly information about patrons (Vijayakumar & Sheshadri, 2019; Adejo & Misau, 2021).

Further endeavors of expert system are perceived and visualized in classification and cataloguing processes. In classification, the system bears a Coal SORT artificial intelligence tool that provides for searching or indexing. The tool composes the frame-based semantic network which forms the expert knowledge and the software for portions display of the searched or indexed item. The BIOSIS facility of the expert system uses the knowledge based of items to automatically assign it to a given category of subjects or topic (Chibuiké & Emeka, 2021). It operates as an indexer assistance tool. Furthermore, the expert system has an Environmental Pollution Expert (EP-X) which performs in-line with Coal SORT to enhance interfaces through knowledge-based approach. The expert system provides opportunities for cataloguing service (Echedom & Okuonghae, 2021). It has two interfaces for cataloguing. A human machine interface provides for capturing of the intellectual efforts and processes them in between the intermediary and support system to provide a catalogue package. The second interface provides a full cataloguing capability that links to the e-publishing system where an e-text is captured, processed through the knowledge-based system for cataloguing with less concern of the intermediary efforts on intellectual inputs (Vijayakumar & Sheshadri, 2019; Adejo & Misau, 2021).

The expert system finds other artificial intelligent application in indexing. The system identifies concepts and translate them into verbal descriptions. The latter are further selected and assigned controlled terminologies that are conceptualized to equate the verbal

descriptions. Indexing with expert system improves consistency and quality of intellectual aspects. The expert system consists of a med-index interface embedded with the knowledge-based system for the function it performs (Vijayakumar & Sheshadri, 2019; Adejo & Misau, 2021). Furthermore, artificial intelligence applies in speech recognition. The artificial intelligent system is installed with special machines which can be able to convert spoken words into text format. In libraries for instance, audio books can be collected and managed by the LibriSpeech, a transcription database on which the artificial intelligent system can transcribe to text format (Zhang et al., 2022). On the other hand, the artificial intelligence provides a further use of machine learning where the system is enabled to automatically learn and improve from experience without being explicitly programmed. In this, the system has to be configured in such a way that it can access data and use it to learn on itself. The robots, pattern recognition, text data mining, Chatbot and big data are among the examples of machine learning tools (Ali, Naeem & Bhatti, 2020). The machine learning tools assists in organizing the library collection and provide for logical extension and accessibility that library users can navigate the entire collection in a shortest time possible rather than searching a library catalogue to locate individual item (Cox, 2022).

Deep learning forms a category of machine learning where large amounts of data are dealt at once. It incorporates the artificial neural networks and algorithms inspired by human brain. With deep learning; interconnected, unstructured and diverse data sets are made possible and complex issues on these data can be solved. The natural language processing, image processing and neural networking are the operational tools in deep learning. Natural language processing is important in subject index designing, bibliometric and information retrieval from various databases and thus finds crucial in the library digitisation (Ali, Naeem & Bhatti, 2020). The user can use natural language for information retrieval from any database and in the end, deep learning through the natural language processes transcribes to the communicable language (Asemi, Ko & Nowkarizi, 2020). Furthermore, the library collection is assigned with accession numbers or barcodes from which the pattern recognition closely related to artificial intelligence and machine learning that operates through data mining and knowledge discovery from various databases assist in securing information resources and in library users check in and out with a single sweep. The pattern recognition is further integrated with the Radio Frequency Identification (RFID) which replaces the security gates in protecting library resources from theft and vandalism (Ali, Naeem & Bhatti, 2020).

5 Opportunities of AI in academic libraries

The opportunities for adoption and application of AI technologies in developing countries including the African region academic libraries is proliferating, but the policy response to this endeavour is at preliminary stages (Echedom & Okuonghae, 2021). As it is revolutionary in the industrial sector, it is most likely that the academic libraries have the opportunity to dynamically advance to the 4th Library Intelligence Revolution (4LIR). The universal trends in librarianship demands deployment of the advanced technologies which incorporates the emerging endeavors where among others the artificial intelligence stand to remain the future opportunity throughout the existence in the modern environment (Gwagwa et al., 2020). The academic librarians have visualized the fact that AI is a new technological opportunity to the driving force for the development of intelligent library. The libraries are positioning themselves to take advantage of the application of cognitive computing in general and AI in particular for their potential effectiveness as a tool for refining the quality of library services (Adejo & Misau, 2021). The intensive pressure on librarians to provide high quality services to library users due to information explosion in our present society have led to incorporation of modern technologies. Artificial intelligent has found its way into the library as a panacea

in various information resources management and services. With AI, opportunities of replacing human power with machines finds way to the quality of library services and information management. Similarly, there are possibilities of the opportunity to influence connectivity of information technology for active and reliable information usage throughout the universe (Vijayakumar & Sheshadri, 2019; Adejo & Misau, 2021).

The World Economic Forum in Africa is pioneering at ensuring the region is moving up to the global through artificial intelligence and keep pace with the Fourth Industrial Revolution (4IR) and on other fields including education. In 2018, the forum through the European Investment Bank funded 19 African countries for technological start-up projects in artificial intelligence (See Figure 3). Tanzania is among the benefited countries with 75 million USD, while Kenya was privileged to 348 million USD, followed by Nigeria with 306 million USD and South Africa funded with 250 million USD (World Economic Forum, 2019). Unfortunately, with this opportunity to African countries yet their efforts on artificial intelligence and skills development are not directly featuring on the global penetration statistics (See Figure 4) (Zhang et al., 2022). The United Nations Educational, Scientific and Cultural Organization (UNESCO) conducted a survey in 2020 to realise the deployment opportunities and use of artificial intelligence for African nation development plans. The survey indicated that out of 32 African countries only 21 deployed and use artificial intelligence for development. Globally, there top five African countries featured in the 2020 global Government AI Readiness Index. These countries are; Mauritius ranked the 45th followed by South Africa - 59th, Seychelles - 68th, Kenya - 71st and Rwanda - 87th. The United Republic of Tanzania did not feature in global readiness index despite the supports invested on AI initiatives (Gwagwa et al., 2021).

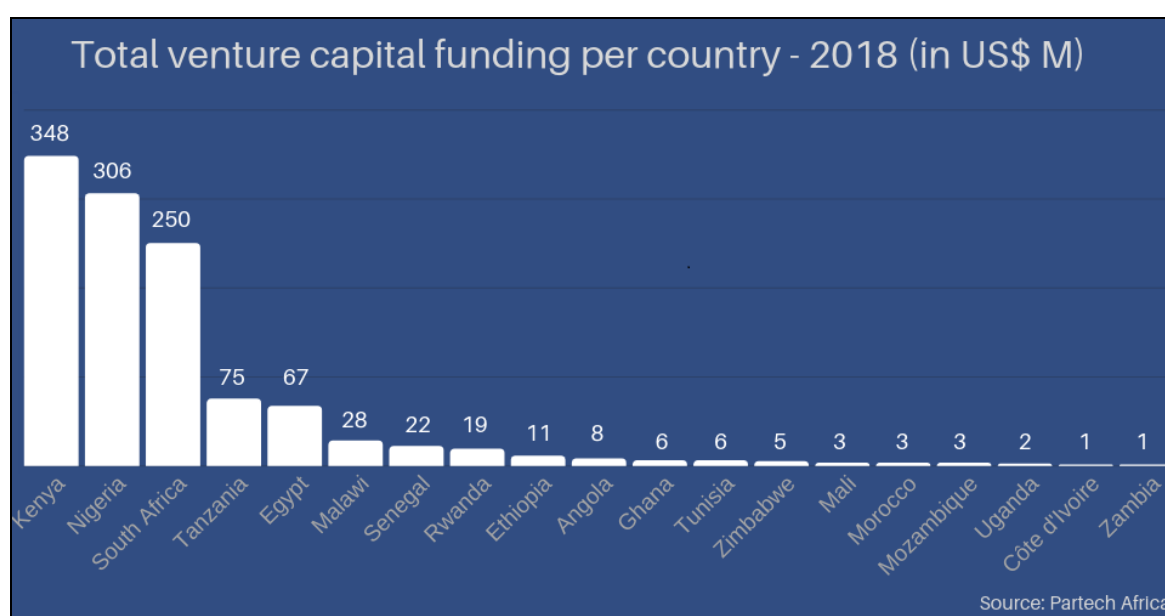


Figure 3: Total venture capital funding per country (World Economic Forum, 2019)

The Indians and United States of America indicate advancement in the use of artificial intelligence in various fields of the region's economy. The regions have invested in developing artificial intelligence skills among various occupations and thus contributed to the skills penetration. The latter describes the intensity with which employees use artificial intelligence in their duties (Zhang et al., 2022). The artificial intelligence skills penetration rate is globally compared by measuring the sum of the penetration of each artificial skill across occupations in a given country or region, divided by the global average across the

same occupations in a given time frame. In Figure 3, India led the globe at a rate of 3.09 times the global average from 2015 to 2021 (Zhang et al., 2022).

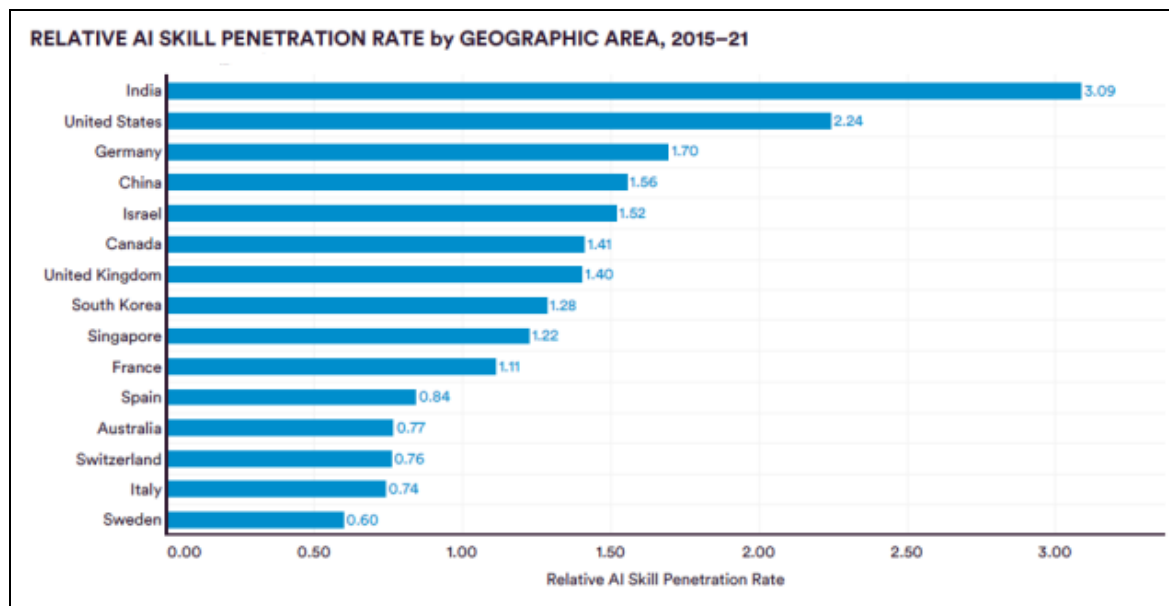


Figure 4: Relative AI skill penetration rate by geographical area (Zhang et al., 2022)

The African regions including the United Republic of Tanzania had this opportunity of adopting and rising the artificial intelligence skills but surprising enough the sum of the penetration of each artificial skill across occupations such as Librarians was not indicated for global measurement and comparison. This is a very important area for further investigation on the contribution of artificial intelligence in Tanzania.

6 The AI assumption and opportunities in Tanzania academic libraries

Efforts on AI in Tanzania academic libraries is not significantly addressed but rather fairly earmarked in some sectors related to health and agricultural services. For instance, *e-Shangazi* is a knowledge-based platform coupled with AI technologies for educating, informing and advising youths on Sexual Reproductive Health Rights (SRHr). On the other hand, an *Agrobot* is a famous platform incorporated with AI technologies to assist farmers access to information and advice in respect to agricultural facilities and farm management. The platform provides for Chatbot and Short Messaging Service (SMS) (Sahara Ventures, 2019). Higher learning institutions including the University of Dodoma under the College of Informatics and Virtual Education (CIVE) in collaboration with other stakeholders such as Parrot AI and Pythontz have been working to integrate most of the institution databases with python, machine and deep learning tools, probabilistic machine learning and projects related to machine learning approaches. However, these efforts have not yet realized in the academic library of the institution (Sahara Ventures, 2019; Masanja & Mkumbo, 2020). Furthermore, St. Joseph University of Tanzania (SJUIT) despite the efforts on promoting AI has similarly advanced through initiating the policy which guide issues related to AI development. Efforts have been in establishing intelligent robots that could be used in health sectors on improving the diagnosis and treatment performance of heart related diseases (Masanja & Mkumbo, 2020). Similarly, some initiatives are earmarked with higher learning institutions in teaching courses related to AI but also in solving challenges and problems through AI technologies. For instance, the University of Dodoma and Dar es Salaam have devoted in provision of non-financial resources such as facilities, IT infrastructures and experts for AI initiatives (Masanja & Mkumbo, 2020).

7 The UTAUT model on assumption of AI in Tanzania academic libraries

The Unified Theory of Acceptance and Use of Technology (UTAUT) benchmarks on the best approach an AI technology is harnessed for information management and quality library services. The determinants of behavioural intention of AI are controlled by understanding the drivers of AI technology acceptance. The drivers assist in proactively designing interventions that include planning for adopting the AI technology and training the information professionals and library users on the deployed technology (Venkatesh et al., 2003). As discussed earlier on, Tanzania academic libraries seem to be not yet thought of incorporating the AI technologies for the library functions, despite the fact that this invention has been rarely practiced in other sectors such as agriculture and health services (Masanja & Mkumbo, 2020). However, in achieving the dream of AI technology, the academic libraries have to consider the indirect and direct determinants that entails on usage of the technology. The indirect determinants are basically postulated by the performance and effort expectancy and social influence whereas the direct determinants are based on the usage behaviour controlled by intention to use and facilitating conditions. The moderating variables of gender, age, voluntariness and experience determines both the direct and indirect determinants of the information professionals on the usage behaviour of the AI technology (Venkatesh et al., 2003). Always the indirect determinants build interest of information professionals toward AI technology usage. However, and as indicated in the reviewed literature, majority of the academic library information professionals have little knowledge and skills on the application of AI technologies in information management and library services (Kripanont, 2007; Sahara Ventures, 2019; Venkatesh et al., 2003).

Performance expectancy or perceived usefulness is the degree to which information professionals believe that the deployed AI technology assist in achieving the intended goals in information management and quality services. Unfortunately, plans for deploying AI technology in academic libraries is basically not strategically contented and has contributed to information professionals unaware of the technology and ultimately poor performance expectancy. Venkatesh et al. (2003) describes effort expectancy as the degree of easiness to use the deployed AI technology in academic libraries. Suppose information professionals are successfully trained on the new deployed technology, they are most likely to develop interest in technology usage provided that it is also easy to use. However, effort expectancy of the information professionals on the AI technology is absolutely unmarked as to date there are less documented AI technology initiatives invested in Tanzania academic libraries. On the other hand, social influence explains the degree to which information professionals perceive AI technology and its opportunities important than any other one could imagine on the technology (Venkatesh et al., 2003). In other words, information professionals' intention to use the AI technology is expected to be high if such professionals expect their peers look positively at them if they use the technology successfully. Again, the social influence to this endeavour is fairly realized as much of the AI technology and the related opportunities is rarely addressed in Tanzania academic libraries.

Moreover, Kripanont (2007) and Venkatesh et al. (2003) define facilitating conditions as the degree at which information professionals believe on the fact that the academic libraries and technical infrastructure exists to support the use of the deployed AI technology. On this, the information professionals' postulate that the usage of AI technology depends on the availability of an empowering environment for its application. However, the issue of academic libraries' infrastructures, human capital in terms of expertise, financial resources and institution management impedes the facilitation of new technologies in Tanzania academic libraries.

8 Challenges on AI deployment in academic libraries

It is evident that AI has transformed the scope of resources, services, operations, formats, accessibility, preservation and retrieval systems in academic libraries. However, AI in academic libraries pose a number of challenges to academic libraries world over. The challenges of AI adoption and use in academic libraries vary from country to country. Whilst in some incidences there are similarities reflected in environments, cultures, traditions and policies of the countries. Library staff, users and other information stakeholders around the world are scared of the 4IR and AI in particular (Hussain, 2020). They fear that AI in academic libraries will replace their employments and leave them miserably jobless. They assume that all library operations prior done by the library staff will now be taken over by the AI. Likewise, employers will prefer AI devices as they save the running costs of salaries and other benefits in comparison. This is a reality in many sectors (Hussain, 2020) and it is believed that half of paid activities could be replaced by AI. The report by Sahara Venture (2019) conducted in Tanzania revealed that 57 percent of the respondents' view that AI would take over their jobs. In the health field, the radiologists to check cancer symptoms related diseases would be replaced by AI (Mühleisen, 2018).

In the library context, it means that library operations, circulation services, classification, cataloguing, shelving and shelf-reading are going to be replaced by AI technologies in robotics. The scenarios create fear that AI embedded technologies will take over jobs which were previously done by human beings. The study by UKEssays (2018) conducted in Tanzania identifies challenges of adapting AI in libraries to include AI illiteracy, awareness, inadequate of funds in academic libraries to purchase AI devices and expertise, to train library staff and users, infrastructure in a majority of academic libraries, bandwidth, qualified library staff and limited resources. Other challenges are negative attitudes and behavioural patterns of library stakeholders towards AI. This leads to library staff and users distancing themselves from getting involved with AI in libraries.

In health sector, the report by Sahara Ventures (2019) conducted at University of Dodoma in Tanzania affirms that 53 percent of the respondents revealed that they would prefer human doctors to AI robots. In context, people including library staff are reluctant over the adaption of AI in their daily lives. There are negative remarks towards AI in libraries attracting a lot of attention and unsolicited statements. This might be because of AI incompetence of library staff to technical know-how of dissecting AI in academic library. Library staff and users find it difficult to grasp AI and it is slowly adapted in Africa and Tanzania in particular. It seems that extant studies deal with development of AI in libraries but opportunities and challenges of AI in libraries are not in priority. Furthermore, organizational management in many cases including library management are very slow and strict on policy which jeopardise attempts of libraries to stay abreast with AI (Kaal & Vermeulen, 2017). Considering the protocols to meet regulatory challenges in the areas of human-robot collaboration, robot monitoring, and AI driverless machines in academic libraries. Other challenges include failure to recognition of copyright, information ethics, human creativity, behaviours, attitudes and motivation of library users towards AI in academic libraries (IFLA, 2018).

However, there still a room for library staff and users to address the challenges pertaining to the application of AI in academic libraries in Tanzania. There are endeavours to use AI in various fields including academic libraries in Tanzania. The report by Sahara Ventures (2019) shows that AI is being adapted in some strategic sectors in Tanzania such as health and agriculture. This is evidence that AI application process is promising in the future. Library staff and their users should endeavour to acquire necessary skills on big data, algorithms to

apply AI in librarianship (Arlitsch & Newell, 2017). This would actively support and improve to easing information search and provision to address the needs of library users. However, the opportunities and challenges of applying AI in libraries should lead to more investigations to align the traditions, cultures, environments, employment creation and policies in our country Tanzania with the use of AI in academic libraries. There should be step by step strategies and interventions for the library staff and users to adopt AI (Gade & Singh, 2016). The process would bridge partnerships between human beings and AI in academic libraries. This should be an endless intervention until knowledge, skills and significance are realised by the stakeholders of libraries.

9 Conclusion

This study presented an overview of the key phenomena including assumptions, opportunities and challenges of AI in librarianship. In particular, academic libraries have adapted AI in at least all areas pertaining to library services, information delivery, marketing library products, assessment and evaluation of library services. In reality AI has benefited libraries in terms of saving time and costs in the course of provision of library resources and services. There are challenges as 'Librarianship is at stake' being replaced by digital devices and loose of the value of the profession. This created mixed feelings to include the end of librarianship against 4IR. However, issues related to lack of adequate infrastructure and erratic power supply still hinder many academic libraries to employ AI in developing countries. These challenges in reciprocity explore discoveries and new areas for further studies. In tandem, the study realized that AI in academic libraries inform the future of librarians to work collaboratively to complement each other.

10 Recommendations

Basing on the literature reviews, this study makes the following recommendations:

- i. Academic libraries should determine expertise, skills, knowledge which library staff are supposed to possess to work with AI in Tanzania;
- ii. Library associations should introduce AI in academic libraries in curricular to engage all sectors for national development;
- iii. There should be inclusion of librarianship in development and implementation of cross sectoral agenda on AI (IFLA, 2018);
- iv. Academic libraries should introduce AI in all operational systems for easy library operations and effective resources and services delivery;
- v. Academic libraries and library associations should train and retrain library staff and users on the application of AI in academic libraries;
- vi. Academic libraries should allocate budgets for AI initiatives and;
- vii. There should be interventions on budgetary allocations to purchase AI devices and expertise costs (Adejo and Misau, 2021).

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