

Assumptions of the Future Application of Artificial Intelligence in Tanzanian Academic Libraries: A Review of Literature

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Abstract

This paper insight into the assumptions, opportunities and challenges of the use of interactive and engaging applications of Artificial Intelligence (AI) 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 in Tanzania. The inclusion criteria of the literature were assumptions, opportunities and challenges towards AI in academic libraries. The literature was searched from databases including Sage, Taylor and Francis, Emerald, Google Scholar, Research Gate and PDF Drive. The results were analysed, evaluated, compared, contrasted and discussed through the lenses of UTAUT theory. The results revealed that AI brings the world together in which people work and network in the integral function of providing library resources and services to library users. AI is an enabler for academic libraries to create library spaces, store, process, preserve, conserve, access and retrieve library resources and services timely with fewer costs. Also, AI lessens the inadequacy of funds to purchase printed materials in academic libraries, the lack of digital devices and limited spaces in libraries. AI has transformed the complex attitude and behaviors of library staff and users. Though, AI has created fears about employment opportunities for workers and library staff in particular. Besides, it was realised that library staff are mismatched with the AI in academic libraries due to the lack of awareness, inadequate qualifications and limited infrastructure in academic libraries. This review contributes to the practices, knowledge, theory and literature on the use of AI in academic libraries. The study proposed that there should be step by step towards interventions to introduce AI 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

Introduction

The 4th Industrial Revolution (4IR) is a transformation of digitisation that invented a new paradigm in the real world. Artificial Intelligence (AI) is among the 4IR with broad applications in the fields of human life and is more prominent in academic libraries. AI is a computational science that replaces operations that would be attended to 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 application (Vijayakumar & Sheshadri, 2019; Han & Conti, 2020). AI invention follows the central question if humans can utilise available resources, reason and decide to address problems why cannot AI do so (Anyoha, 2022).

Overview of Artificial Intelligence in academic libraries

AI is traced to 1920 out of Rossum's Universal Robots play by Karel Capel. It is a Czech word 'Robota' referring to drudgery or boring but must be accomplished. AI was designed in the fields of law, electrical engineering, mechanical engineering, computer science, common language processing, speech recognition, expert systems and fuzzy system (Gade & Singh, 2016). Other scholars view that the AI field was invented in the 1950s regarded as fiction used in film making and book writing (Anyoha, 2017; Ajakaye, 2022). Whilst today AI is coined in the daily lives of people implicated in numerous fields including law, health, commerce education, transport, pharmaceuticals, housekeeping, rescuing, manufacturing, finance, public services and industries. AI was adopted in the 1990s to detect and understand behavioral patterns and respond to operational activities in academic libraries (Ajakaye, 2022).

AI is 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 organisation and provision of library products and services to 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 can preserve, conserve, access and retrieve information in a friendly and sophisticated manner. AI helps librarians in creating awareness among library users to improve the utilisation of library products.

The study by Khanzode and Sarode (2020), on the importance of AI in libraries, pointed out that it facilitates dialogues between the library users and robotics,

directs the library users to specific locations as per their needs, addresses queries and scanning system through Comprehensive Access to Printed Materials (CAPM) for academic achievement and lifelong learning of the library users. Thus, AI complements the core mission of academic libraries to provide resources and services for society's development.

The importance of AI in academic libraries reinforces human beings adapting it in academic libraries 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 to include reference services, indexing, acquisition and behavioural pattern recognition. The study by Asemi *et al.* (2020) on the use of AI in academic libraries found possibilities to apply AI to improve the provision of library resources and services. Besides, Mei, Chen, Jiang and Cheng (2017) proposed a framework to align AI in academic libraries. An extant study by Okunlaya, Abdullah and Alias (2022) shows that several academic libraries establish AI centers in Malaysia. Thus, academic libraries should embrace finding novel means for AI applications for competitive advantage (Hamidi & Jahanshaheefard, 2019). They should endeavor to envision AI for prospective change in academic library operations and services. However, AI has proven a breakthrough in academic libraries in developed countries. Whilst, in developing countries and Africa in particular, AI is still a new emerging technology posing challenges that how can humans work with AI in the light of ethical issues and security consciousness between them (Bostrom & Yudkowsky, 2022).

In recent years, AI raised debates on the application of AI in education and academic libraries in particular (Okunlaya, Abdullah, & Alias, 2021). This is because AI is more than imitating human intelligence to add value to academic libraries and enhance teaching and learning processes (Zhang, Li & Zhang, 2015). Despite endeavours, there are few studies to incorporate AI in academic libraries in Tanzania. The study by Adejo and Misau (2021) confirms that there is decimal or no literature or documents on the application of AI in academic libraries in developing countries. Besides, the incorporation of AI in strategic plans is yet to be realised by academic libraries (Wheatley & Hervieux, 2019). In addition, the proposed framework by Mei, Chen, Jiang and Cheng (2017) is still inadequate to guide a critical gap in how academic institutions can apply AI in academic libraries (Okunlaya, Abdullah, & Alias, 2021).

Information stakeholders are not aware of AI's contribution in light of opportunities and challenges (Okunlaya, Abdullah, & Alias, 2021). There is a missing link between academic libraries and AI incorporation in strategic plans (Wheatley & Hervieux, 2019). Academic libraries lack consciousness of AI's significance which brings about a critical gap (Wheatley & Hervieux, 2019). This situation necessitates embarking on the study of Assumptions of the Future of AI in Tanzanian academic libraries. Therefore, this study is guided by the objective to determine the application of AI in Academic libraries in Tanzania. This study gears to fill the gap toward innovative academic libraries compliant with AI. Also, the study establishes an intimacy, awareness, unforeseen assumptions, opportunities and challenges in the use of AI in academic libraries. Also, the study enlightens alternative innovations through the lenses of technologies for the survival and thriving of academic libraries for the necessary measures for them to remain relevant in the global system.

Methodology and Scope

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”. In addition, keywords were combined to search for the literature such as “technologies and academic libraries”, “robotics and academic libraries” and “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” the world over was selected. The literature reviewed was analysed in the light of UTAUT variables and constructs in 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 and intelligence in academic library operations and services. Content analysis of the collected literature was used to present the related phenomena under the study objective in a narrative form.

Theoretical Framework

There are several theories and models which can be used to inform studies related to AI in libraries. These are 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). This study is underpinned by the Unified Theory of Acceptance and Use of Technology (UTAUT). The fact that in 2003, Viswanath Venkatesh, Michael Morris, Gordon Davis and Fred Davis consolidated IDT, TAM, TRA, MPC, SCT and TPB into 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 60 percent while UTAUT has 70 per cent 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', Attuquayefio and Addo (2014) on 'Using the UTAUT model to analyse 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 in tandem with such constructs such behavioural intention and actual technology used to determine whether individuals 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 behavior' 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.

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 attitudes toward technologies determine individual behaviours. In reciprocity, it predicts intentions and acceptance of the use of technology (Dwivedi, Rana, Jeyaraj & Williams, 2017). Performance expectancy, social influences, innovativeness and effort expectancy determine behavioral intentions toward the use of technologies and innovations (Slade, Dwivedi, Piercy & Williams, 2015). This study explains technologies in the context of substantive

antecedents for individuals to accept and use robotics and AI technologies in academic library environments. Through its variables, the model forms integral patterns for to use of robotics and AI technologies in academic libraries.

UTAUT integrates variables and constructs to the attitudes and behaviors 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 the 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 the acquisition of knowledge, skills, experiences and information for their academic endeavours and lifelong learning. Figure 2 presents the UTAUT model.

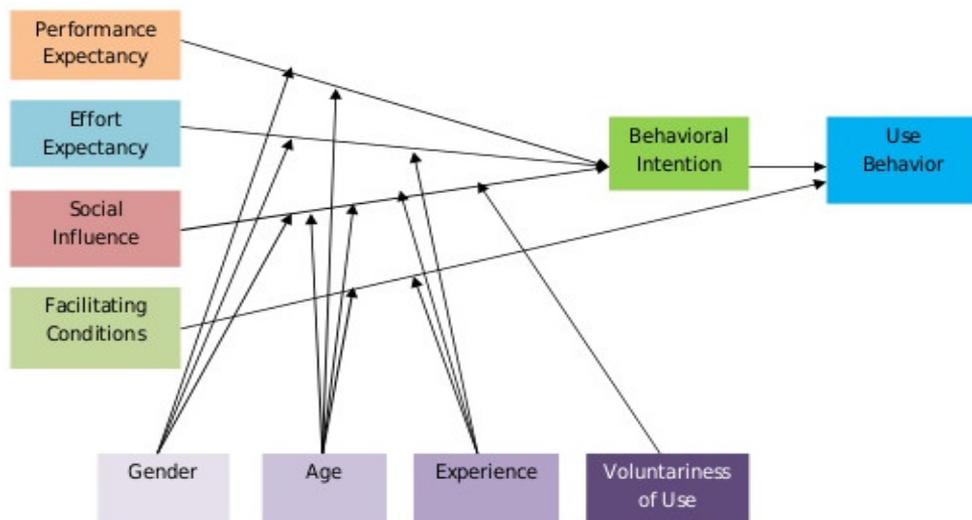


Figure 1: UTAUT Model (Venkatesh et al., 2003)

Figure 1 demonstrates UTAUT's variables and constructs as enablers of the use of AI in academic libraries. They are in line with the assumptions that the use of AI in academic libraries is a process that involves individuals' beliefs that there are benefits in using AI (Attuquayeflo & Addo, 2014). It entails that the use of AI is not determined by the 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 as

interrelated attitude and behavioural patterns and intentionally directed motivations that lead to permanent repeated use of AI in academic libraries. The outputs 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 to 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.

Results

Assumptions of the application of AI in academic libraries

Assumptions of the application of AI in academic libraries AI has grasped the use of computers and networked infrastructures to control various activities intelligently like human beings. For instance, robots are predominantly used to perform activities as they are electronically controlled by mirroring the competencies of human minds (Adejo & Misau, 2021). With AI, it is possible to precisely keep operating records and analyse all the actions performed by the user. AI 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, AI accredits planning ability, learning processes, reasoning ability, problem-solving, mobility and creativity. This endeavour has not yet been realised in most academic libraries of developing countries where Tanzania is inclusive.

Cox (2022) considers AI as an umbrella terminology for multiple technologies. In this, broad and core interconnected AI technologies are involved. 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 AI technologies among other fields are presumed to play role in academic library reference services, technical services, indexing, acquisition, natural language processing, pattern recognition and robotics functions (Adejo & Misau, 2021). Figure 2 presents the general components of AI.

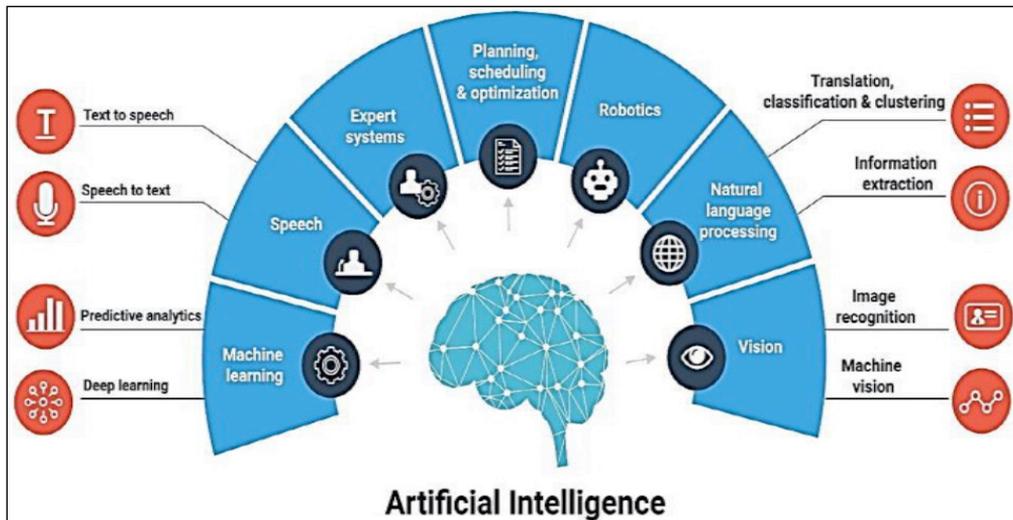


Figure 2: Artificial Intelligent Components (Vijayakumar & Sheshadri, 2019)

An expert system refers to a computer-based framework that simulates human decision-making. The system can be integrated with any information system for the quality, accuracy and performance of information services. In light of this, 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 obtain relevant information. In this system, functions related to expert advice, decision-making and solutions to different problems are addressed. The system is, therefore, composed of an integrated knowledge base, inference engine and user interface for interaction (Vijayakumar & Sheshadri, 2019; Adejo & Misau, 2021). Currently, technology has advanced to the extent that natural language can be processed by a computerised system to bring meaningful phrases and speech for understanding. AI has provided a built-in natural language interface with limited vocabulary and syntax for translation (Echedom & Okuonghae, 2021).

Among others, a computerised AI is composed of the main elements of a natural language processing interface which can be able to synthesise a speech and 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 to facilitating reference services. It involves

carrying out automated tasks through AI 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, such few African countries as South Africa and Nigeria have shown such initiatives of using these robots in reference services and the technology which in Tanzania's academic libraries is not well comprehended.



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

The expert system comprises AI that can assist in supplying users with recommended sources for reference. It 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 and online services such as computer-assisted instruction modules and knowledge-based systems (Adejo & Misau, 2021). Answerman is a knowledge-based system that forms a component of an expert system that provides 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, a subject-based information retrieval guide, information about reference sources and most information about patrons (Vijayakumar & Sheshadri, 2019; Adejo & Misau, 2021).

Further endeavours of an expert system are visualized in classification and cataloging processes. In classification, the system bears a Coal SORT AI 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 them to a given category of subjects or topics (Chibuike & 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 a knowledge-based approach. The expert system provides opportunities for cataloging services (Echedom & Okuonghae, 2021). It has two interfaces for cataloging. A human-machine interface provides for capturing the intellectual efforts and processes them between the intermediary and support system to provide a catalog package. The second interface provides a full cataloging capability that links to the e-publishing system where an e-text is captured and processed through the knowledge-based system for cataloging with less concern for the intermediary efforts on intellectual inputs (Vijayakumar & Sheshadri, 2019; Adejo & Misau, 2021).

The expert system finds other AI applications in indexing. The system identifies concepts and translates them into verbal descriptions. The latter are further selected and assigned controlled terminologies that are conceptualised to equate the verbal descriptions. Indexing with an 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, AI applies to speech recognition.

The artificially 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 LibriSpeech, a transcription database on which the artificially intelligent system can transcribe to text format (Zhang *et al.*, 2022). On the other hand, AI 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 about itself. Robots, pattern recognition, text data mining, chatbots and big data are among the examples of machine learning tools (Ali, Naeem, & Bhatti, 2020). The machine learning tools assist in organising the library collection and provide logical extension and accessibility so that library users can navigate the entire collection in the shortest time possible rather than searching a library catalog to locate the individual item (Cox, 2022).

Deep learning forms a category of machine learning where large amounts of data are dealt with at once. It incorporates artificial neural networks and algorithms inspired by the human brain. With deep learning; interconnected, unstructured and diverse data sets are made possible and complex issues on these data can be solved. 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 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 accession numbers or barcodes from which the pattern recognition closely related to AI 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. Pattern recognition is further integrated with Radio Frequency Identification (RFID) which replaces the security gates in protecting library resources from theft and vandalism (Ali, Naeem & Bhatti, 2020).

Opportunities of AI in academic libraries

The opportunities for the adoption and application of AI technologies in developing countries including the African region academic libraries are proliferating, but the policy response to this endeavour is in the preliminary stages (Echedom & Okuonghae, 2021). As it is revolutionary in the industrial sector, it is most likely that academic libraries have the opportunity to dynamically advance to the 4th Library Intelligence Revolution (4LIR). The universal trends in librarianship demand deployment of the advanced technologies which incorporate emerging endeavours where among others AI stand to remain the

future opportunity throughout its existence in the modern environment (Gwagwa *et al.*, 2020). Academic librarians have visualised the fact that AI is a new technological opportunity to the driving force for the development of the 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 the information explosion in our present society has led to the incorporation of modern technologies. AI 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 find a way to the quality of library services and information management. Similarly, there are possibilities of the opportunity to influence the connectivity of information technology for active and reliable information used 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 AI and keeping pace with the 4IR and in 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 for African countries yet their efforts on AI and skills development are not directly featured in the global penetration statistics (See Figure 4) (Zhang *et al.*, 2022). The United Nations Educational, Scientific and Cultural Organisation (UNESCO) was surveyed in 2020 to realise the deployment opportunities and use of Artificial Intelligence for African national development plans. The survey indicated that out of 32 African countries, only 21 deployed and use AI for development. Globally, the 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 the global readiness index despite the support invested in AI initiatives (Gwagwa *et al.*, 2021).

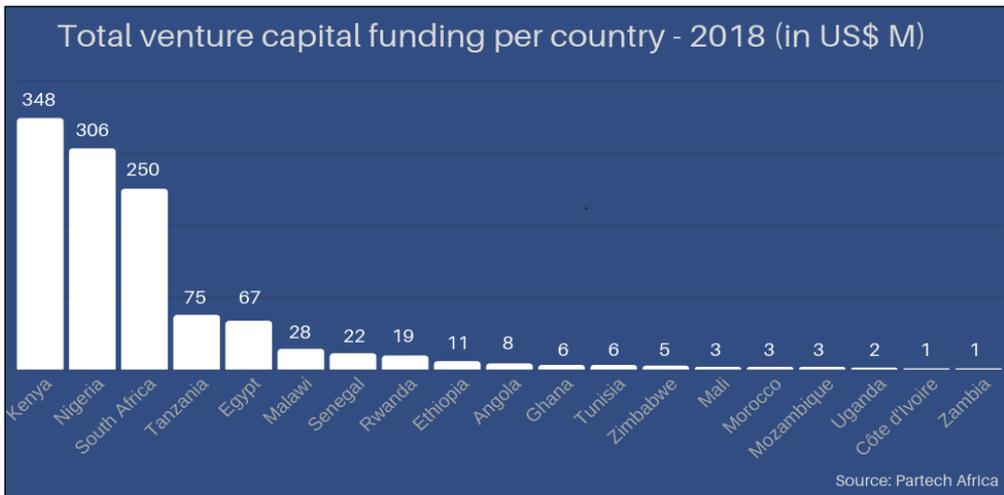


Figure 3: Total venture capital funding per country (World Economic Forum, 2019)

The Indians and the United States of America indicate advancement in the use of AI in various fields of the region’s economy. The regions have invested in developing AI skills among various occupations and thus contributed to the skills penetration. The latter describes the intensity with which employees use AI in their duties (Zhang *et al.*, 2022). The AI 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).

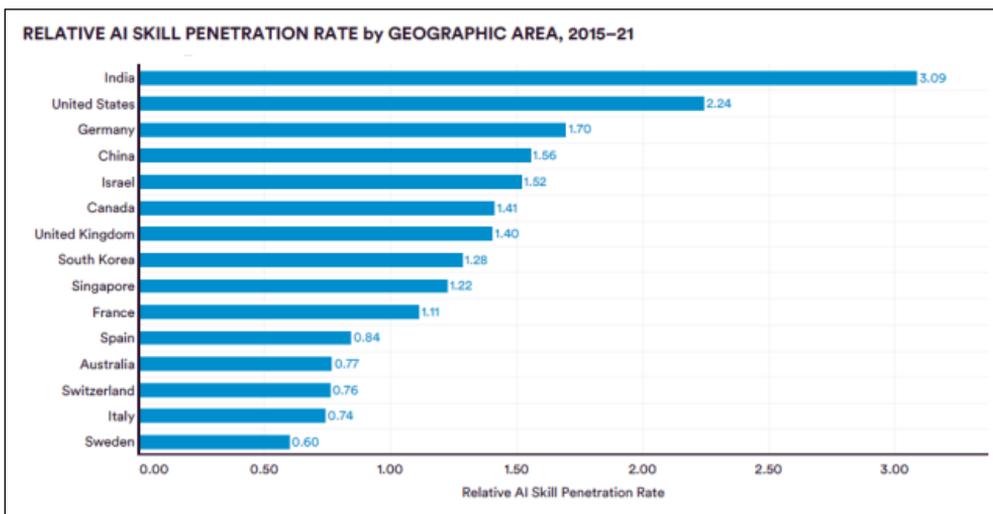


Figure 4: Relative AI skill penetration rate by geographical area (Zhang *et al.*, 2022)

The African regions including the United Republic of Tanzania had this opportunity of adopting and raising AI skills. Nevertheless, surprisingly 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 of the contribution of AI in Tanzania.

The AI assumption and opportunities in Tanzania academic libraries

Efforts on AI in Tanzania academic libraries are 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 concerning agricultural facilities and farm management. The platform provides Chatbot and Short Messaging Services (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 been realised in the academic library of the institution (Sahara Ventures, 2019; Masanja & Mkumbo, 2020). Furthermore, St. Joseph University of Tanzania (SJUIT) despite its efforts on promoting AI has similarly advanced by initiating a policy that guides 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 themselves to the provision of non-financial resources such as facilities, IT infrastructures and experts for AI initiatives (Masanja & Mkumbo, 2020).

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

The Unified Theory of Acceptance and Use of Technology (UTAUT) benchmarks the best approach an AI technology is harnessed for information management and quality library services. The determinants of the behavioral

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 not yet have thought of incorporating AI technologies for library functions, even though 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, academic libraries have to consider the indirect and direct determinants that entail the usage of the technology. The indirect determinants are postulated by the performance and effort expectancy and social influence whereas the direct determinants are based on the usage behavior controlled by intention to use and facilitating conditions. The moderating variables of gender, age, voluntariness and experience determine both the direct and indirect determinants of the information professionals on the usage behavior of AI technology (Venkatesh *et al.*, 2003). Always the indirect determinants build the interest of information professionals towards AI technology usage. However, as indicated in the reviewed literature, the majority of academic library information professionals have little knowledge and skills in the application of AI technologies in information management and library services (Venkatesh *et al.*, 2003; Kripanont, 2007; Sahara Ventures, 2019).

Performance expectancy or perceived usefulness is the degree to which information professionals believe that the deployed AI technology assists in achieving the intended goals in information management and quality services. Unfortunately, plans for deploying AI technology in academic libraries are not strategically contented and have 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 newly deployed technology, they are most likely to develop an interest in technology usage provided that it is also easy to use.

However, the effort expectancy of the information professionals on AI technology is unmarked as to date there are fewer 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 as more important than any other one could imagine the technology (Venkatesh *et al.*, 2003). In other words, information professionals' intention to use AI technology is expected to be high if such professionals expect their peers to look positively at them if they use the technology successfully. Again, the social influence of this endeavor is fairly realized as much of the AI technology and the related opportunities are rarely addressed in Tanzania academic libraries.

Moreover, Kripanont (2007) and Venkatesh *et al.* (2003) define facilitating conditions as the degree to which information professionals believe in the fact that academic libraries and technical infrastructure exists to support the use of the deployed AI technology. On this, the information professionals postulates 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.

Challenges of AI deployment in academic libraries

AI has transformed the scope of resources, services, operations, formats, accessibility, preservation and retrieval systems in academic libraries. Nonetheless, AI in academic libraries pauses several challenges to academic libraries the 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 the environments, cultures, traditions and policies of the countries. Library staff, users and other informed 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 employment 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 the paid activities could be replaced by AI. The report by Sahara Venture (2019) conducted in Tanzania revealed that 57 per cent 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, cataloging, 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 that were previously done by human beings. This is because AI has the advantage to sort out complex tasks faster and easier, in a short time with a high success ratio and efficiency with less space, size and minimal errors than human beings (Khanzode & Sarode, 2022). The study by UKEssays (2018) conducted in Tanzania identifies challenges of adapting AI in libraries including AI illiteracy, awareness, inadequate 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.

Khanzode and Sarode (2022) view that AI poses challenges to apply in librarianship as it demands lots of time and funds to adapt, limits human creativity and feelings, promotes laziness and increases technological dependence. In the health sector, the report by Sahara Ventures (2019) conducted at the 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 the adaption of AI in their daily lives. There are negative remarks about AI in libraries attracting a lot of attention and unsolicited statements. This might be because of the AI incompetence of library staff to the technical know-how of dissecting AI in an 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 the development of AI in libraries, but opportunities and challenges of AI in libraries are not in priority. Furthermore, organisational management in many cases including library management is very slow and strict on the policy which jeopardises attempts of libraries to stay abreast with AI (Kaal & Vermeulen, 2017). There is a need to consider 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, behaviors, attitudes and motivation of library users towards AI in academic libraries (IFLA, 2018).

However, there is still room for library staff and users to address the challenges of 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 adopted in some strategic sectors in Tanzania such as health and agriculture. This is a shred of evidence that the AI application process is promising in the future. Library staff and their users should endeavor to acquire the necessary skills in big data and organisms to apply AI in librarianship (Arlitsch & Newell, 2017). This would actively support and improve easing information search and provision to address the needs of library users. Conversely, 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. This should be an endless intervention until knowledge, skills and significance are realised by the stakeholders of libraries. The process would bridge partnerships between human beings and AI in academic libraries.

Conclusions

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 of library services, information delivery, marketing library products and assessment and evaluation of library services. In reality, AI has benefited libraries in terms of saving time and costs in the course of the provision of library resources and services. There are challenges as ‘Librarianship is at stake’ being replaced by digital devices and loss of the value of the profession. This created mixed feelings to include the end of librarianship against 4IR. However, Echedom and Okuonghae (2021) opine that challenges such as the lack of adequate infrastructure and the 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 realised that AI in academic libraries informs the future of librarians to work collaboratively to complement each other in academic libraries.

Recommendations

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

- i. Academic libraries should determine the expertise, skills and knowledge that library staff are supposed to possess to work with AI in Tanzania.
- ii. Library associations should introduce AI in academic libraries curricular to engage all sectors for national development.

- iii. There should be the inclusion of librarianship in the development and implementation of cross-sectoral agenda on AI (IFLA, 2018).
- iv. Academic libraries should introduce AI in all operating 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 to ensure the application of AI in academic libraries.
- vii. There should be interventions on budgetary allocations to purchase AI expertise and devices (Adejo & Misau, 2021).

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