IJoL International Journal of Librarianship

ISSN: 2474-3542 Journal homepage: https://journal.calaijol.org

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To cite this article:

Pasipamire, N. & Zinyeredzi, T. P. (2025). Bridging The Gap: Assessing the Skills and Knowledge of Academic Librarians in Zimbabwe in the Era of the Fourth Industrial Revolution. *International Journal of Librarianship, 10*(3), 3-18.
https://doi.org/10.23974/ijol.2025.vol10.3.458

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INTERNATIONAL JOURNAL OF LIBRARIANSHIP, 10(3), 3-18
ISSN: 2474-3542

Bridging The Gap: Assessing the Skills and Knowledge of Academic Librarians in Zimbabwe in the Era of the Fourth Industrial Revolution

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ABSTRACT

The advent of the Fourth Industrial Revolution (4IR) is challenging the skills, expertise, and knowledge of librarians. The growing interest in disruptive technologies among library patrons, coupled with the limited adoption of these technologies by Zimbabwean libraries, has highlighted a significant skills gap among library personnel. This study investigated the skills and knowledge of academic librarians in Zimbabwe in the context of the 4IR. A sample of academic librarians affiliated with the Zimbabwe Library Association was selected using simple random sampling. Data was collected through online questionnaires and analyzed using frequency counts. Results show that while academic librarians in Zimbabwe exhibit strong competencies in several key areas, particularly in IT**,** leadership**,** and information management**,** there are notable gaps in specific skills such as website designing and grant writing. Moreover, the study reveals that librarians exhibit a relatively high awareness of 4IR technologies, including the Internet of Things and 3D printing. The findings of this study also highlight the complexities and challenges associated with the adoption of 4IR technologies in academic libraries in Zimbabwe. The adoption of these technologies is hindered by a lack of skills, knowledge, and expertise, as well as inadequate funding. Additionally, librarians' attitudes towards embracing 4IR technologies significantly impact their adoption. This study recommends that librarians develop a keen interest in technological innovations and stay up-to-date with the latest technologies through training, seminars, and conferences. Lastly, librarians should acquire and update their ICT skills to remain relevant in the 4IR era.

Keywords: Academic librarians, Fourth industrial revolution (4IR), Knowledge, Skills, Zimbabwe

BACKGROUND

The Fourth Industrial Revolution (4IR), a term popularized by Klaus Schwab (2016), it signifies a transformative era characterized by the integration of advanced technologies such as artificial intelligence, blockchain, and the Internet of Things into everyday life and work processes. This revolution is reshaping industries and redefining roles, particularly within academic libraries, where the skills and expertise of librarians are being rigorously tested. As the landscape of

information access and management evolves, academic librarians must adapt to remain relevant and effective in their roles. In this rapidly changing environment, the adaptability of librarians is crucial. Omagbemi (2022), states that academic libraries must keep pace with the shifting expectations of clients and patrons, as well as the continuous advancements in technology. This sentiment is shared by Saunders (2020), who argues that librarians must engage in a cycle of unlearning, learning, and relearning to navigate the complexities of the 4IR effectively. The ability to embrace new technologies and methodologies is not merely beneficial; it is essential for librarians to fulfill their roles as information facilitators in a digital age.

Chigwada and Chisita (2021) further highlight the necessity for a fundamental rethink of librarians' competencies to ensure they can deliver efficient services that meet the diverse and evolving information needs of their patrons. As academic institutions strive to enhance research and academic productivity through digital technologies, the importance of reskilling and upskilling library staff becomes increasingly apparent. The skills gap among library personnel, particularly in Zimbabwe, underscores the urgency of this need. The traditional skill set is no longer sufficient; librarians must now be equipped with digital literacy, data management, and technological proficiency.

The emergence of disruptive technologies has not only transformed user expectations but has also illuminated a pressing skills gap among library personnel in Zimbabwe. It is essential to recognize that the future of librarianship hinges on their ability to adapt, innovate, and embrace the challenges posed by technological advancements. The journey toward a fully integrated digital library environment is fraught with obstacles, yet it also presents librarians with the opportunity to redefine their roles and enhance their professional legitimacy. In this context, the imperative for academic librarians to develop and refine their skills is not just a matter of professional survival; it is essential for the continued relevance of libraries in an increasingly information-driven world. The question arises: do academic librarians possess the requisite skills and knowledge to thrive in the 4IR? This inquiry is of paramount importance, as it not only highlights the challenges librarians face but also underscores the immense opportunities for growth and professional development in the evolving library landscape. As noted by Botha (2021), both digitization and the 4IR are a solution for libraries to continue service delivery uninterruptedly even during times of disruption. The following research question were instructive in examining the skills and knowledge of librarians working in academic libraries.

Research questions

1. What competencies are essential for academic librarians in Zimbabwe to remain relevant in the 4IR era?

2. To what extent are academic librarians in Zimbabwe aware of the emerging technologies associated with the 4IR?

3. What strategies are being implemented by libraries in Zimbabwe to support the professional development of their staff in the context of the 4IR?

4. What challenges do academic librarians in Zimbabwe face in adapting to the changes brought about by the 4IR?

LITERATURE REVIEW

The 4th IR technologies in Libraries

Internet of things (IoT)

IoT refers to any device which can be linked to the internet, this includes mobile devices, wearable devices and washing machines (Moos, 2021). These devices, equipped with electronics, software, sensors, and network connectivity, enable data collection and exchange. Connaway (2015) as cited by Kirkwood (2021) suggests that IoT offers libraries innovative service improvements and resource integration. Applications include self-checkout, inventory management, and access control. IoT enhances collection management by identifying resource locations and proposing solutions like virtual library cards and RFID tagging (Pujar & Satyanar-Ayana, 2015 as cited in Jain 2021). Additionally, IoT significantly impacts security management, privacy, and library automation, underscoring its potential in academic libraries.

Blockchain technology in libraries

Blockchain is one of the trending technologies with potential application to the library (Sanjay & Hasan, 2020). In LibChain's system, the user exchanges information via Blockchain and libraries can know who is holding the book at any time. Anyone desiring to borrow a book can find out in whose possession the book is at any time and can alert that person to pass it on to them after using it (Ayinde & Kirkwood, 2020). According to San Jose State University School (2021), by using blockchain framework, libraries can partner with museums, universities and government agencies to share MAchine-Readable Cataloging (MARC) records, authority control, and user-generated content. An innovative application is Libchain, which allows patrons to transfer books directly to one another without returning them to the library first. In Libchain's architecture, libraries and users exchange information via blockchain, enabling users to locate books and track transactions.

Artificial intelligence (AI)

AI is emerging as a transformative trend in library systems, impacting various functions such as cataloging, indexing, reference services, and information retrieval. Nwakunor (2021) views AI as the computer-controlled robots that think intelligently like human beings. Corke (2013) as cited by Omame & Alex-Nmecha (2020) highlight the development of intelligent systems, including library robots, that can mimic librarian behaviors. The International Federation of Library Associations (IFLA) states that AI and Machine Learning (ML) can enhance knowledge management processes in libraries, including organization and storage. Viera (2023) is of the view that, the future of artificial intelligence in library operations lies in the idea of a 'Smart Library' that is available to patrons without being directly staffed. Chandrashekara and Mulimani (2023) concur with Viera as they point that artificial intelligence uses AI-driven virtual assistants and chatbots which can provide instant support to users, answer reference inquiries, assist with circulation services, and offer personalized recommendations based on user preferences. Kirkwood (2021) asserts that while AI may not replace librarians, it will standardize library processes, enhancing efficiency and service delivery.

Humanoid robots in libraries

Humanoid robots also known as social robots, represent the next generation of robotics capable of perceiving their environment, recognizing faces, reading emotions, and communicating with humans (Nguyen, 2020). These robots can locate sound sources, perform face recognition for

gender, age, and mood, and even detect breath. They are programmed to engage users by providing information about themselves, the weather, and special dates like birthdays. In public libraries, humanoid robots serve various roles, such as teaching coding and library instructions. For instance, Libby, a robot at the University of Pretoria Libraries, assists users by searching for items, turning pages, and guiding students to the right bookshelves (Norwin, 2020). Additionally, these robots aim to attract and entertain visitors, fostering a sense of community within the library (Nguyen, 2020).

3D Printing technology

3D printing, also known as additive manufacturing, is defined as a process in which a digital file is used to create a three-dimensional solid object (Ashtari, 2022). This technology can be utilized in academic libraries to produce models, prototypes, and visual aids for teaching and research, allowing users to transform digital concepts into tangible items. The most common type of 3D printer is the Fused Deposition Modeling (FDM) printer, which uses molten plastic to build objects layer by layer. Libraries can leverage 3D printing for creating anatomical models, architectural designs, and even rare artifacts for their collections (Ally & Wark, 2020). However, libraries must consider the costs and maintenance associated with acquiring 3D printers before investing in this technology.

Skills needed in the 4IR by academic librarians

The advent of the 4IR is revolutionizing the library landscape, necessitating librarians to acquire a diverse array of digital skills to remain relevant. These skills encompass Information and Communication Technology (ICT) competencies, critical thinking, and the ability to discern between reliable and unreliable information (Kirkwood, 2021). As cyber-physical systems become integral to library operations, librarians must enhance their communication and collaboration skills to effectively navigate this evolving environment (Jacobs, 2021). To thrive in this digital era, librarians must possess technological proficiency, including computer self-efficacy, to effectively utilize modern technologies such as Online Public Access Catalogues (OPAC) (Saunders, 2020). Moreover, librarians require a range of essential skill sets, including hardware and software skills, content management, programming, and reference management (Omagbemi, 2022). Higher cognitive skills, such as advanced literacy, critical thinking, and complex information processing, are also crucial, with demand for these skills predicted to increase significantly (Ayinde & Kirkwood, 2020).

Furthermore, librarians must possess social and emotional skills, including advanced communication, empathy, and adaptability, to effectively engage with users and develop business and programming initiatives (Kirkwood, 2021). Technological skills, encompassing basic IT skills to advanced data analysis and engineering, are also essential for interacting with computer-based technologies (Ayinde & Kirkwood, 2020). By acquiring these diverse skill sets, librarians can effectively navigate the challenges and opportunities presented by the 4IR, ultimately enhancing the quality of library services and supporting academic excellence

The integration of automation and artificial intelligence (AI) is expected to accelerate the shift in required skills within the workforce. As exemplified, artificial intelligence (AI) algorithms possess the capacity to expedite and enhance the identification of pertinent sources in comparison to conventional search methodologies, owing to their proficiency in analyzing extensive datasets (Hill, 2020). Therefore, librarians must focus on acquiring higher cognitive, social, emotional, and technological skills to thrive in the 4IR (Chigwada & Chisita, 2020).

4IR and staff development for librarians

In response to the evolving job landscape, organizations are implementing strategies like automation, outsourcing, and insourcing to adapt. The future of librarian positions is secure for those who have the skills to outperform robots (Tella et al., 2020). Academic librarians are expected to be more informed about how to seek information and to make sure their skills ARE current in order to help the researchers. For organizations to thrive, continuous staff development programs benefit both younger and older librarians; when work requirements are not met, job output suffers, their workforce must be skilled, competent, and confident (Chigwada & Chisita, 2021). Continuous professional development (CPD) is essential for library professionals, with conferences serving as a key platform for growth. The Zimbabwe Library Association (ZIMLA) hosts annual conferences that promote collaboration among information practitioners and provide training programs to enhance skills (Nyabadza, 2019). These conferences allow professionals to explore emerging trends, share best practices, and network with peers. Additionally, external training programs offered by organizations like the Library Association of South Africa (LIASA) and the International Federation of Library Associations (IFLA) provide valuable opportunities for librarians to engage in practitioner-led training and share experiences. Such initiatives are crucial for fostering a skilled workforce capable of navigating the challenges posed by the 4IR (Saunders, 2020).

Challenges faced by librarians in the 4IR

4IR presents numerous challenges for academic librarians in Zimbabwe. One significant concern is job loss. As technologies such as AI, robotics, and cloud computing are adopted, fewer staff may be needed, potentially leading to increased unemployment and poverty in developing countries (Dregger, 2022). Another challenge is the lack of skills and competencies. The demands for social and analytical skills are rising, necessitating flexible, team-based decision-making to meet patron needs (Chigwada & Chisita, 2020). As organizations redefine roles, many librarians face steep learning curves, especially older staff who may struggle to adapt to new technologies (Coalition, 2020). Government policy also poses a challenge. Effective governmental policies are crucial for adapting to new technologies. Government policies dictate how libraries operate, making this a significant challenge for librarians. As libraries adopt more technology, their attack surface grows, and many libraries in Zimbabwe are not adequately prepared to address these threats (Matizamhuka, 2022). Finally, data sensitivity is an emerging challenge. The rise of new technologies raises concerns about data protection and intellectual property rights. Current data governance laws in Zimbabwe restrict data sharing, which is essential for AI implementation, thus complicating the integration of these technologies (IFLA, 2020).

Previous studies

Ajab (2022) conducted research in Malaysia, discovering that innovative technologies have notably influenced librarians' perceptions, thinking skills, and mind-sets. This suggests that while awareness and skills may be lacking in some regions, the impact of technology on librarianship is recognized elsewhere, indicating a need for targeted training and development to enhance librarians' capabilities in adapting to the 4IR. A study by Ogunjimi et al. (2021) on librarians in Cross River State, Nigeria, revealed that 78.3% of respondents were unaware of fourth industrial revolution (4IR) technologies relevant to library services, with only 21.7% acknowledging awareness of the 4IR itself. Furthermore, 90.8% of librarians lacked proficiency in the skills necessary to operate effectively in this new technological landscape. This survey research

highlights a significant gap in awareness and preparedness among librarians. Similarly, Akparobore et al. (2020) found low awareness of technological innovations associated with the 4IR among librarians in Southern Nigeria. Their study emphasized that possessing strong ICT skills is crucial for delivering effective library services in this era. In a different context,

METHODOLOGY

This study employed a survey methodology to investigate the skills and knowledge of academic librarians in Zimbabwe within the context of the Fourth Industrial Revolution (4IR). The survey targeted members of the Zimbabwe Library Association (ZimLA), specifically academic librarians who are navigating the complexities and opportunities presented by the 4IR. A national WhatsApp group comprising 114 members, including 60 academic librarians, served as the sampling frame. A simple random sample of 30 academic librarians was selected from the ZimLA group, with eligibility criteria requiring participants to be Zimbabwean academic librarians employed at a university or higher education institution. Data collection was facilitated through online questionnaires using Google Forms, ensuring efficient and convenient data collection and storage. Informed consent was obtained through an introductory letter outlining the study's purpose and objectives. To ensure geographical representation, the study targeted librarians from various ZimLA branches, including Masvingo, Matabeleland, Midlands, and Mashonaland. Quantitative data analysis was performed using Microsoft Excel, where basic statistics were performed, including the use of tables, pie charts, frequencies, and counts to summarize and describe the data. The analysis provided an overview of the demographic characteristics of the respondents, as well as their perceptions and experiences related to the 4IR. The results are presented in the subsequent sections, providing insights into the skills and knowledge of academic librarians in Zimbabwe within the context of the 4IR.

RESULTS

All 30 respondents (100%) completed and returned the questionnaires, ensuring comprehensive representation from all ZimLA branches. The results show that the Matabeleland branch had the highest representation, accounting for 40% (12) of the participants. The Mashonaland and Midlands branches each had 20% (6) representation, while the Manicaland and Masvingo branches had 10% (3) each. Notably, a ZimLA member based in the United Arab Emirates participated in the study through the ZimLA WhatsApp group, making the study inclusive of academic librarians from various institutions and regions beyond Zimbabwe.

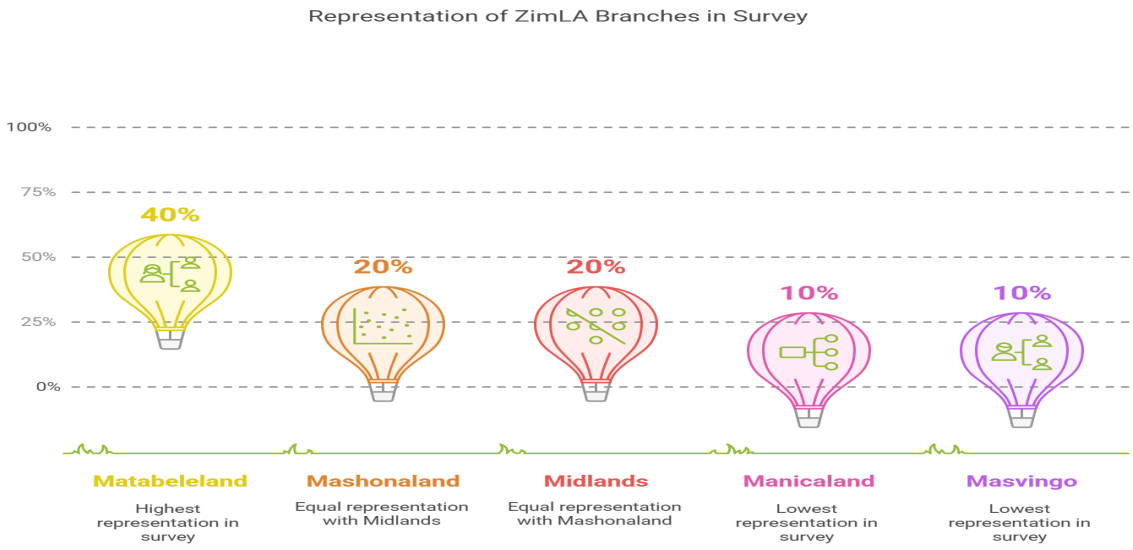

Figure 1: Representation of ZimLA in the survey

Experience of academic librarians

The study's population consisted mainly of experienced individuals, with 60% of participants having over five years of work experience. In contrast, 40% had less than four years of experience. Analysing the participants' work experience provided valuable insights into the skills and knowledge of seasoned librarians versus those still developing their expertise. This helped identify the strengths and areas for improvement to enhance the effectiveness of librarians in the 4th Industrial Revolution era.

Table 1: Work experience of the academic librarians

Years	**Frequency**	**Percentage**
0 – 4 years	12	40%
Above 5 years	18	60%
Total	**30**	**100%**

Skills possessed by academic librarians in Zimbabwe

The results showed that academic librarians in Zimbabwe possessed the core knowledge and specialized skills as listed by Saunders (2020). Responses gathered from the questionnaires indicated that academic librarians in Zimbabwe exhibit strong competencies in several key areas, particularly in **IT, leadership**, and **information management**, there are notable gaps in specific skills such as **website designing** and **grant writing**. Figure 1depcit these results.

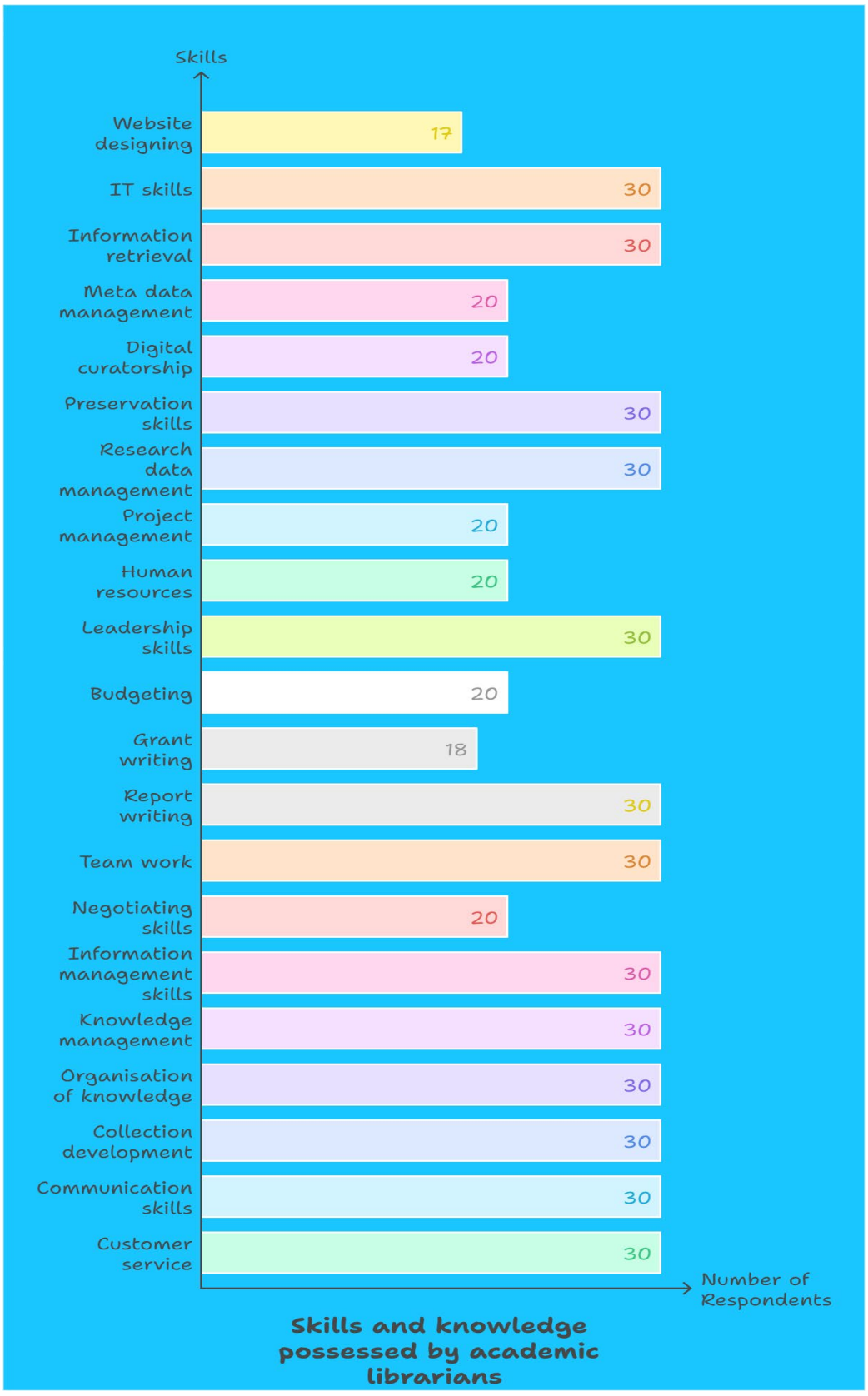

Figure 1: Skills and knowledge possessed by academic librarians in Zimbabwe

Relevance of skills and knowledge possessed to the 4IR

The survey conducted among academic librarians in Zimbabwe revealed diverse perceptions regarding the relevance and effectiveness of their skills in the context of the (4IR). Specifically, 11 librarians, representing 36.7% of the participants, indicated that their skills were relevant for survival in the 4IR, highlighting a significant recognition of the importance of these skills in adapting to the evolving landscape of library services. Conversely, 4 librarians (or 13.3%) expressed that while their skills were relevant, they are not effective for survival, suggesting a gap between possessing skills and being able to apply them effectively in practice. Additionally, 10 librarians, accounting for 33.3%, stated that their skills are not relevant for thriving in the 4IR, raising concerns about the adequacy of current skill sets in meeting the challenges posed by technological advancements. Furthermore, 5 librarians (representing 16.7%) described their skills as partially relevant, indicating that while some skills may have some applicability, they are not fully adequate for the demands of the 4IR. Figure 2 depicts this results.

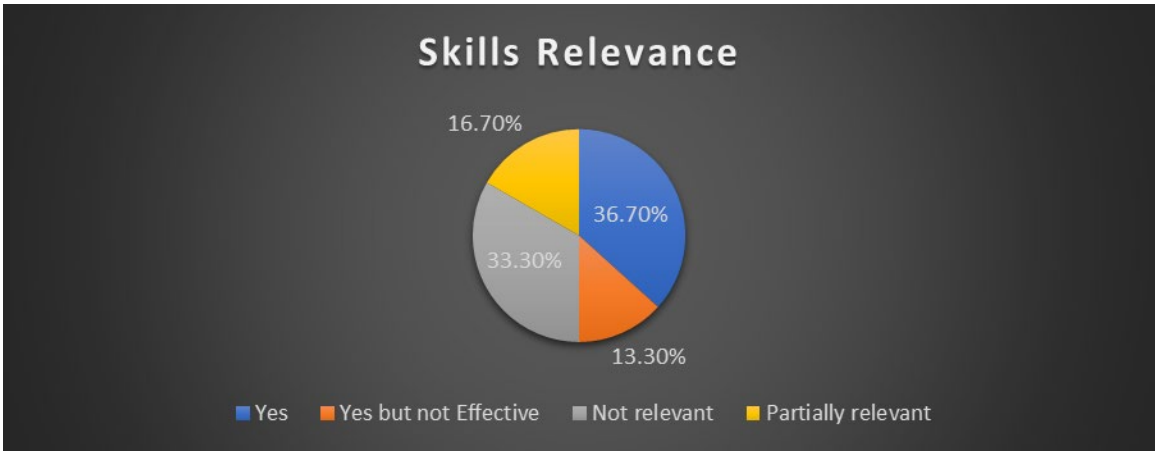

Figure 2: Relevance of skills possessed by academic librarians in Zimbabwe in the 4IR

Level of agreement on ICT skills required in the 4th industrial revolution

Respondents were asked to rate their level of agreement with statements regarding the essential skills and knowledge for librarians in the 4IR era, using a scale of "strongly agree", "agree", "disagree", or "strongly disagree". The results revealed that digital literacy, cybersecurity, and digital repository management were unanimously endorsed as necessary skills by all 30 respondents. Conversely, web development and linked data and semantic web elicited mixed responses, with some respondents disagreeing on their relevance to librarians in the 4IR. The figure below illustrates the skills that garnered agreement and disagreement among respondents. Figure 3 provides the comprehensive scores for ICT skills.

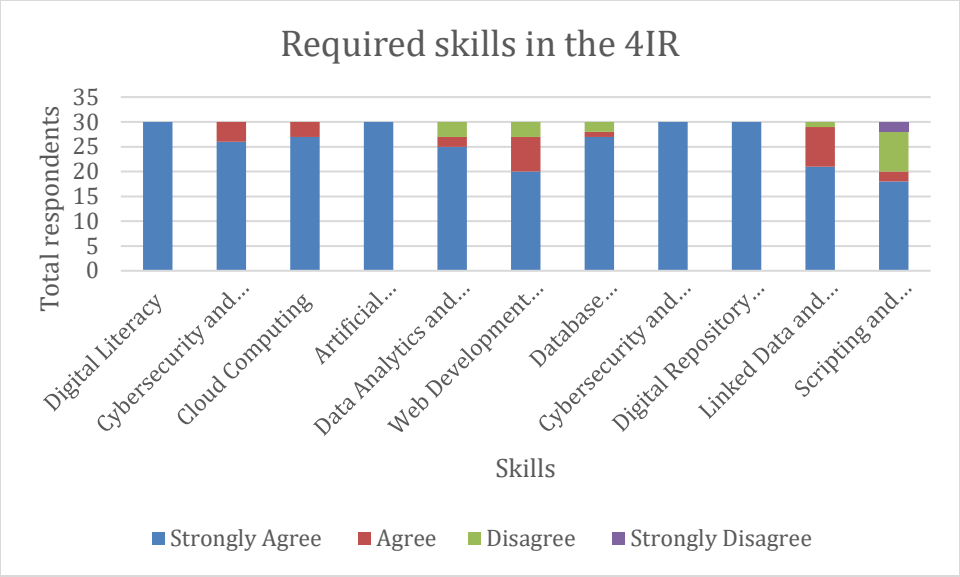

Figure 3: ICT skills needed by academic librarians

Extent of awareness of the existence of the 4IR technologies

The results of the study revealed that academic librarians in Zimbabwe demonstrated varying levels of awareness regarding the existence of 4th Industrial Revolution (4IR) technologies. The top three technologies that librarians were most aware of the Internet of Things (IoT), Information Repositories, and 3D Printing Technology, with over half of the respondents mentioning these technologies. Conversely, Artificial Intelligence (AI) and Blockchain Technology were among the least familiar technologies, with only 16.7% of respondents demonstrating awareness of each. Figure 4 provides a detailed breakdown of the awareness levels for each 4IR technology among academic librarians in Zimbabwe.

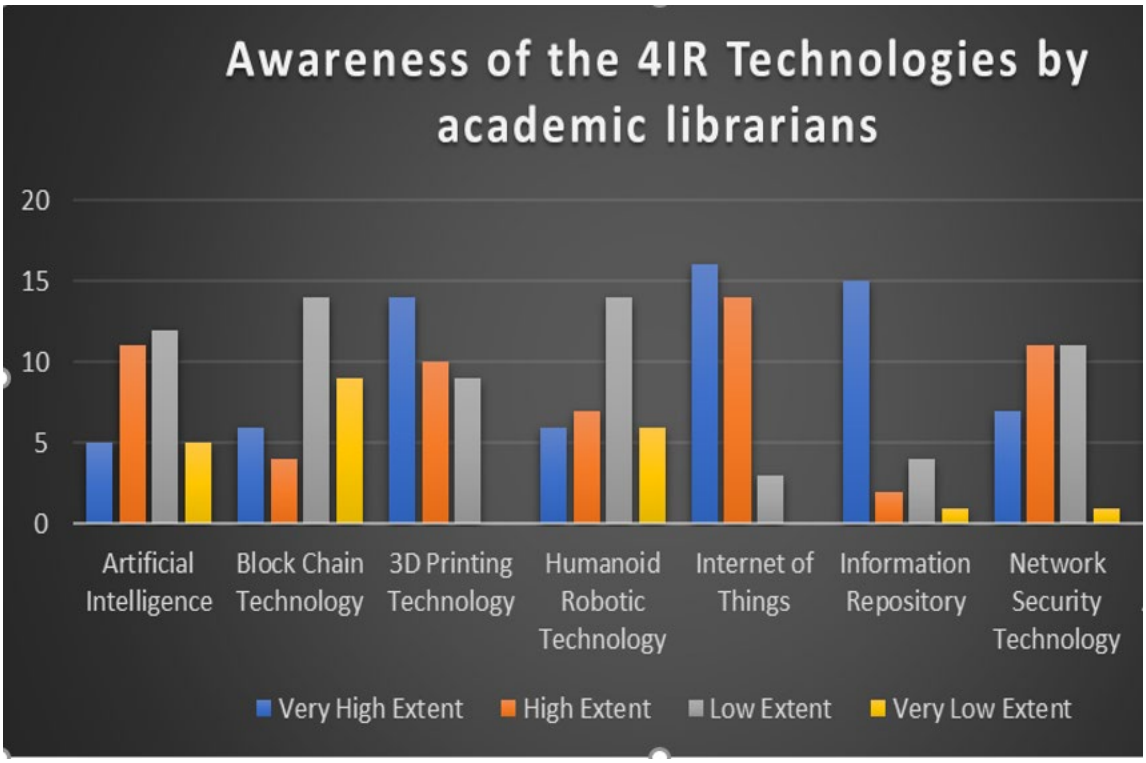

Figure 4: Extent of awareness of the 4IR technologies by academic librarians in Zimbabwe

Academic libraries and staff development

Academic libraries have a crucial responsibility to establish staff development programs. The study's findings, as illustrated in Figure 4.7, reveal that an overwhelming majority (96.7%) of participants, totalling 29 respondents, confirmed that academic libraries in Zimbabwe are indeed involved in staff development initiatives. Only one participant indicated that their library does not participate in such programs.

The study through open-ended question on the questionnaire identified various staff development initiatives implemented by academic libraries, including:

- Attending virtual and physical conferences
- In-house training
- On-job training programs
- Workshops
- Providing funding for further education
- Seminars
- Refresher courses.

The findings highlight the importance of monetary resources in supporting staff development initiatives. Additionally, the results show that academic libraries typically conduct staff development programs throughout the year, with a maximum frequency of three times per year.

Respondents offered several suggestions to support the professional development of academic librarians, including:

- Joining professional organizations
- Enhancing workshops on digital literacy

- Providing incentives and recognition to encourage professional growth
- Offering school grants and loans for further education

Challenges faced by academic librarians in the 4IR

The adoption of emerging technologies, particularly AI and Humanoid Robotic Technology, in Zimbabwean academic libraries faces significant challenges. A lack of expertise, skill, and knowledge (20%) hinders librarians from effectively operating and utilizing these technologies. Additionally, funding constraints (20%) limit libraries' ability to acquire, install, and maintain these technologies, restricting their potential benefits. Furthermore, attitudinal barriers (30%) pose a significant obstacle, as some librarians are reluctant to update their skills, hindering the adoption of these technologies and the library's ability to adapt to the 4IR. Figure 5 shows these results.

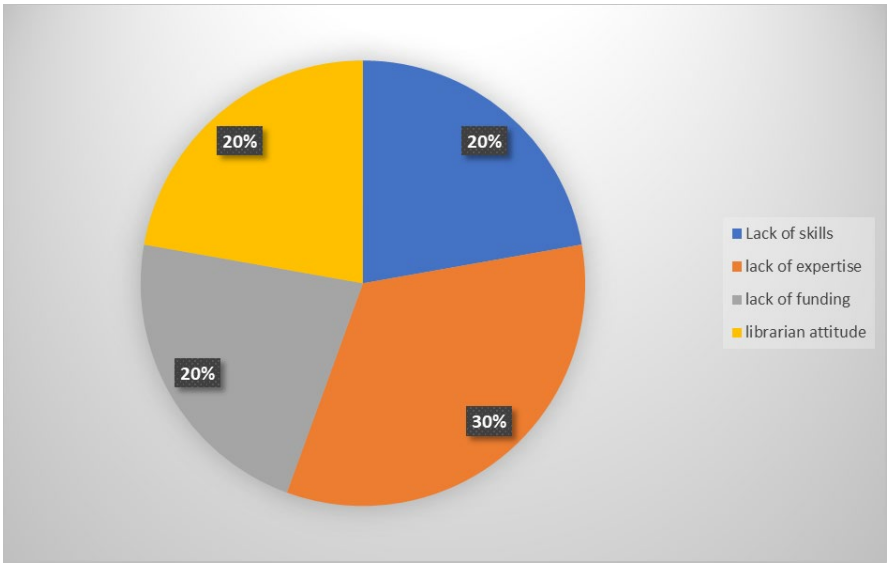

Figure 5: Challenges faced by academic librarians

DISCUSSION

The findings of this study highlight the complexities and challenges associated with the adoption of 4IR technologies in academic libraries in Zimbabwe. The results show that academic librarians in Zimbabwe possess a range of skills, including communication, research, and information literacy, which are essential for navigating the 4IR landscape as noted by Saunders (2020). However, the study also reveals that the adoption of 4IR technologies is hindered by several challenges, including a lack of expertise, skill, and knowledge, as well as funding constraints. These findings are consistent with the results of previous studies (Ajab, 2022; Akparobore et al., 2020), which identified similar barriers to the adoption of 4IR technologies in libraries. The attitude of academic librarians towards the adoption of 4IR technologies is also a significant challenge. The study found that some librarians are resistant to change and may be hesitant to adopt new technologies, which is consistent with the findings of Hussain (2019). This highlights the need for academic libraries to invest in staff development programs, including training and education on 4IR technologies, to enable librarians to acquire the necessary skills and knowledge to effectively adopt and implement these technologies. The study's findings also underscore the

importance of funding and resource allocation in supporting the adoption of 4IR technologies in academic libraries. The results show that academic libraries in Zimbabwe face significant funding constraints, which limit their ability to acquire, install, and maintain 4IR technologies. This highlights the need for libraries to explore alternative funding models and partnerships to support the adoption of 4IR technologies.

CONCLUSION

In conclusion, this study highlights the complexities and challenges associated with adopting 4IR technologies in Zimbabwe's academic libraries. The findings emphasize the need for staff development programs, funding, and resource allocation to support the adoption of 4IR technologies. The study reveals that academic librarians in Zimbabwe possess the necessary skills to survive and effectively serve their patrons in the 4IR era. However, the adoption of 4IR technologies is hindered by lack of expertise, funding, and negative attitudes towards new technologies. The study concludes that academic librarians in Zimbabwe are aware of 4IR technologies, IoT, Information repositories, and 3D printing technology. Nevertheless, there is a need for ongoing training and development to ensure librarians remain competent. To bridge the skills gap, academic librarians must change their attitude towards embracing new technologies. The government should also support academic libraries, recognizing their critical role in the education system. Ultimately, the successful adoption and implementation of 4IR technologies in Zimbabwe's academic libraries require a multifaceted approach addressing the challenges of lack of expertise, funding constraints, and negative attitudes towards new technologies.

Contribution

The findings of this study contribute significantly to the literature on academic librarianship and the 4IR advancing knowledge on the awareness, adoption, and utilization of 4IR technologies in academic libraries in Zimbabwe. The study's findings and recommendations provide practical guidance for academic librarians, informing professional practice and staff development initiatives. By highlighting the critical role of librarians in supporting teaching, learning, and research in the digital age, this study enhances understanding of the librarian's role in the 4IR. Furthermore, the study's implications for policymakers, library administrators, and other stakeholders influence policy and decision-making, informing investments in 4IR technologies, staff development, and library services. Ultimately, this study informs staff development and training, service innovation and design, and leadership and management in academic libraries, underscoring the need for ongoing investment in the skills and knowledge of librarians to effectively navigate the challenges and opportunities of the 4IR.

Recommendations

- ✓ Librarians should cultivate a positive attitude towards utilizing sophisticated technologies, enabling them to unlearn and relearn new skills.
- ✓ Librarians should engage in ongoing training, seminars, and conferences to acquire and update necessary ICT skills and remain relevant in the 4IR era.
- ✓ Academic librarians should join professional organizations to advance their careers, stay informed about industry developments, and promote career growth.

- ✓ Library management should prioritize staff training and retraining, ensuring librarians are conversant with emerging 4IR technologies.
- ✓ Library management should provide ongoing professional development initiatives to support librarians in remaining effective and competent.
- ✓ Academic libraries should adopt emerging technologies to support librarians in their duties during the 4IR period.
- ✓ Library management should encourage professional associations to stay current with industry issues and promote career growth.

Recommendation for further researcher

This study provides a foundation for further research in the area of academic librarianship and the 4IR. Future studies can build upon this research by exploring the following areas:

- Examine the strategies employed by academic libraries in Zimbabwe to adopt and implement 4IR technologies for effective service delivery.
- Investigate the ways in which 4IR technologies can be leveraged to improve library services and support academic excellence in Zimbabwe.
- Investigate the 4IR technologies and tools being used in academic libraries in Zimbabwe to support service delivery.

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