IJoL International Journal of Librarianship

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

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This study investigates the potential integration of the metaverse into future library services, focusing on the skill gaps among librarians and the necessity of sustainable energy infrastructure, particularly in developing nations. It highlights the need for librarians to acquire technical and soft skills, such as digital literacy, data management, and critical thinking, to effectively operate in metaverse environments. The study reveals both enthusiasm and concerns among librarians regarding metaverse adoption, noting challenges like technology anxiety among senior staff. The authors advocate for continuous skill development and sustainable energy solutions to support the metaverse's implementation in libraries.

To cite this article:

Enakrire, R. T., Oladokun, B. D., Morodi, L. & Ajani, Y. A. (2025). A Skill Gap Analysis among Librarians and Sustainable Energy in the Metaverse Future Libraries. *International Journal of Librarianship*, *10*(1), 103-113.
https://doi.org/10.23974/ijol.2025.vol10.1.397

INTERNATIONAL JOURNAL OF LIBRARIANSHIP, 10(1), 103-113
ISSN: 2474-3542

A Skill Gap Analysis among Librarians and Sustainable Energy in the Metaverse Future Libraries

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ABSTRACT

This study investigates the potential integration of the metaverse into future library services, focusing on the skill gaps among librarians and the necessity of sustainable energy infrastructure, particularly in developing nations. It highlights the need for librarians to acquire technical and soft skills, such as digital literacy, data management, and critical thinking, to effectively operate in metaverse environments. The study reveals both enthusiasm and concerns among librarians regarding metaverse adoption, noting challenges like technology anxiety among senior staff. The authors advocate for continuous skill development and sustainable energy solutions to support the metaverse's implementation in libraries.

Keywords: Metaverse, Sustainable Energy, Libraries, Skill Gap, Librarians

INTRODUCTION

Libraries in the metaverse or the incorporation of the metaverse into future library organization have gained prominence, particularly due to persisting knowledge gaps in libraries worldwide. Reflecting on the potential penetration of the metaverse into future libraries prompted the authors of this study to address not only skill gaps among librarians but also the crucial role of sustainable energy in enabling the metaverse to flourish within library operations, especially in developing nations where access to electricity and sustainable energy remains a significant challenge. For example, Africa, with its fifty-four countries and abundant mineral resources such as crude oil, gold, copper, salt, iron, and ore, faces issues with electricity access, with only twelve countries boasting functional and stable electricity or sustainable energy infrastructure (Enakrire, 2021; Enakrire & Ngoaketsi, 2020). Leveraging Africa's mineral wealth to produce sustainable energy could potentially address these challenges and support educational systems across the continent (Hunter-Gault, 2006; Enakrire & Ngoaketsi, 2020; Enakrire, 2021). By ensuring access to sustainable energy, the integration of the metaverse into future library services becomes more viable and sustainable. The authors were motivated to conduct this study by questions surrounding

the challenges faced by libraries in developing countries, particularly regarding the availability of functional, active, and stable electricity or sustainable energy despite abundant sunlight that could be harnessed for solar energy conversion on the continent. Additionally, they sought to explore the planning and readiness efforts concerning skill gap analysis among librarians. These inquiries underscore the importance of addressing issues such as functional, active, and stable electricity or sustainable energy, especially in the context of integrating the metaverse into future libraries. Indeed, reliable solar energy infrastructure could serve as a crucial foundation for supporting immersive technologies within the metaverse, ensuring optimal functionality without interruptions.

Energy resources have long been recognised as essential for human development and societal well-being (Afgan, Al Gobaisi, Carvalho, & Cumo, 1998). They have played pivotal roles since the onset of the first industrial revolution, significantly influencing the trajectory of modern civilisation, particularly in terms of technological advancements (United Nations Development Programme, 2000). As societal and population growth has surged, there has been a heightened reliance on energy sources (Ki-Moon, 2011). Sustainable energy refers to energy generated from sources that can be replenished indefinitely without posing risks of depletion, danger, or expiration. It can satisfy present energy needs without jeopardizing the needs of future generations (Gunnarsdóttir, IDavidsdottir, Worrell, & Sigurgeirsdóttir, 2021). The advancement of environmental and societal development has spurred libraries to contemplate integrating the metaverse into their future services, particularly amidst the emergence of artificial intelligence in the present knowledge economy. In this context, sustainable energy plays a pivotal role, especially as libraries explore the possibilities of the metaverse. Sustainable energy infrastructure is essential for supporting librarians during practical training sessions that involve the use of digital tools and sophisticated electronic devices within the metaverse or virtual reality realm. The stability provided by sustainable energy sources, such as electricity or solar power, is crucial for ensuring uninterrupted operations in the virtual reality technologies of the metaverse. Consequently, addressing the skill gap among librarians becomes imperative in the era of artificial intelligence, as librarians must navigate enhanced working operations across various library contexts while utilizing virtual reality technologies.

A skill gap analysis involves assessing the disparity between the required knowledge and skills necessary to effectively function within a specific work environment. Drawing on the study by Broo, Kaynak, and Sait (2022), the authors of this study emphasize the importance of human-centric design, resilience, hands-on data fluency, and management, as well as human-machine/robot interface interactions for operating proficiently within the future library space of the metaverse (Broo, Kaynak, & Sait, 2022). Furthermore, the authors identify additional skill gaps deemed essential for librarians in future metaverse libraries, particularly concerning interactions with computers. These skills encompass technical proficiencies such as process optimization, troubleshooting and device maintenance, data analytics, Internet of Things (IoT), programming, and language, along with soft skills including creativity, communication, entrepreneurship, networking, open-minded thinking, active listening, innovative solutions, teamwork, conflict management, critical thinking, problem-solving, and resilience (Ghassoul & Messaadia, 2023).

In the realm of the metaverse, analytical and critical thinking, resilience, stress tolerance, and flexibility are essential attributes, as highlighted by Barrot (2023). Given that the metaverse

involves the convergence of physical and computer-generated spaces accessed through computers and immersive technologies such as virtual reality, augmented reality, and mixed reality, factors identified by Barrot (2023), Ghassoul and Messaadia (2023), and Broo et al. (2022) gain significant importance in the context of future metaverse libraries. Incorporating these attributes is crucial for developing economies seeking to progress alongside their developed counterparts in embracing the potential of metaverse technologies.

Recent studies conducted in the speciality of a metaverse in libraries (Dunavant-Jones, n.d) were quite interesting for consideration and critical for the present study and future debate in the metaverse world. The authors of this study emphasized that these areas of research cannot be overlooked, laying major issues to Facebook, Meta, the metaverse and libraries by Fernandez (2022), libraries in the metaverse: the need for metaliteracy for digital librarians and digital age library users by Tella et al. (2023), developmental direction of the metaverse libraries for the Future by Noh (2023), application scenario construction of the university metaverse libraries by Jing (2022), metaverse: making libraries more intelligent by Jianzhong (2023), beyond reality: metaverse technologies revolutionizing libraries and elevating user engagement by Margam (2024), theoretical progress, practical problems and future prospects of the Metaverse library by Dan et al. (2023), intelligent libraries: using metaverse as an enabling technology by Daradkeh (2023), virtual-reality combining: realization of smart library scenario from the perspective of metaverse by WangYebin (2022), metaverse librarians: a new profession for intelligent libraries by Daradkeh (2023), imagining the prospects and possibilities of metaverse in library and information services by Gupta and Walia (2023), metaverse libraries in academic environment by Namdas (2024), exploring the impact of the gamified metaverse on knowledge acquisition and library anxiety in academic libraries by Sureephong et al. (2024), unlocking the potential of the metaverse: a path towards intelligent libraries by Daradkeh (2023), metaverse and digital libraries: ensuring safe and secure access to information by Sinha (2023), metaverse-infused academic libraries: a glimpse into the future by Amzat and Adewojo (2023), scope of metaverse technology in central library, Rajiv Gandhi University by Pandey (2022), metaverse academic library: would it be patronized by Adetayo et al. (2023), de-contextual communication: factors influencing usage intentions of metaverse technology in digital library services by Sediyaningsih et al. (2023), moving into the metaverse: libraries in virtual worlds by Oladokun et al. (2023), and dark side of the metaverse and its insights for library applications by Ke et al. (2023). While the mentioned areas of study that scholars/researchers have explored are interesting when dealing with metaverse in future library services using digital virtual reality technologies, ensuring security through cyberspace becomes fundamental.

It is believed that using metaverse technologies is pivotal in shaping future libraries, especially in this era when users no longer show much interest in visiting the physical library building to source information resources in print and electronic format. Nonetheless, of the mentioned studies, the issue of a skill gap analysis among librarians and sustainable energy of electricity and solar being the backbone in the metaverse future libraries were not researched or discussed hence the author's interest in carrying out this study, to fill the knowledge gap in the areas of metaverse where consideration is given to how would librarians be prepared to fill the skill gap. This raises a lot of questions among the authors such as: (i) Are the librarians supposed to embark on further studies or enrol in short courses like certificate programs or attend seminars/workshops or in-house training to fill this skill gap; (ii) In what areas of skills are the

librarians supposed to be trained? (iii) what is the opinion of librarians towards metaverse in future library services? (iv) Will infusing metaverse into future library services limit librarians from continuous library practices considering the immersive technologies required to function in metaverse reality? (v) Will the metaverse technologies cause librarians' phobia in adjustment for future library services, especially among aged/senior colleagues? These were some of the issues the authors would like to address in this study. Using interpretive content analysis on literature/articles harvested from Google Scholar, the paper debates issues surrounding libraries in the metaverse or the integration of the metaverse into future library structures.

SHOULD LIBRARIANS EMBARK ON FURTHER STUDIES OR ENROL IN SHORT COURSES OR IN-HOUSE TRAINING TO FILL THIS SKILL GAP?

Librarians are encountering new challenges and opportunities as they strive to meet the evolving needs of their patrons. A crucial aspect of this transition lies in acquiring the skills necessary to navigate the digital landscape effectively. As noted by Giddens (2022), engaging in further studies, such as pursuing advanced degrees or specialized certifications in emerging technologies, equips librarians with a comprehensive understanding of the digital technologies and concepts shaping this emerging landscape. This assertion aligns with the perspective of Chewe and Zulu (2020), who argue that advanced academic programs provide theoretical foundations, research opportunities, and exposure to cutting-edge developments. However, Sambo et al. (2022) highlight that the time and financial commitments associated with further studies may present challenges for librarians balancing professional responsibilities and personal obligations. Baro et al. (2019) advocate for the utilization of short courses as a methodology employed by libraries to train librarians in today's data-driven society. They highlight the benefit of short courses in enabling librarians to acquire specific competencies relevant to emerging technologies. Tang (2021) further underscores the value of such training, emphasizing its practical, hands-on nature tailored to the needs of working professionals, particularly in the realm of virtual reality. These short courses may cover a range of topics including virtual reality (VR) development, augmented reality (AR) integration, digital curation in virtual environments, and digital literacy. Conversely, Ekstrom (2021) found that in-house training programs offered by libraries afford librarians opportunities to develop digital-related skills within their workplace environment. According to Ezema et al. (2014), these programs are customized to address specific skill gaps identified within the library context, ensuring practical relevance and immediate applicability.

IN WHAT AREAS OF SKILLS ARE THE LIBRARIANS SUPPOSED TO BE TRAINED?

Considering the continuous development of emerging technologies, the role of librarians remains pertinent (Baro et al., 2019; Oladokun et al., 2023). To stay relevant, librarians must continually acquire new skills to meet the diverse needs of patrons and adapt to emerging technologies. As emphasized by Baro et al. (2019), proficiency in digital literacy is paramount for librarians to assist patrons in utilizing digital tools, accessing online databases, and navigating digital platforms. The authors argue that librarians' strong information literacy skills enable them to navigate the vast array of digital resources and effectively evaluate information for accuracy, relevance, and credibility. Additionally, Khan and Parveen (2020) suggest that librarians can benefit from

learning about integrating technology into library services, including familiarity with library management systems and emerging technologies such as big data analytics, the Internet of Things (IoT), virtual reality (VR), augmented reality (AR), and artificial intelligence (AI) (Daradkeh, 2023; Tang, 2021). Moreover, librarians are equipped with skills in data management and analysis to effectively organize, analyze, and interpret large datasets (Khan & Masrek, 2017). Furthermore, Sambo et al. (2022) highlight the importance of librarians' knowledge of cybersecurity threats, users' privacy, and data storage protocols in this era of information explosion. These skills are essential for ensuring the security and integrity of digital resources and protecting patrons' privacy in an increasingly digital environment.

Empirical studies conducted by Chewe and Zulu (2020) and Khan and Masrek (2017) have revealed that librarians require a diverse skill set to effectively respond to the ever-changing needs of users exploring information across multifarious databases. These skills include proficiency in network and system security, the ability to implement security measures such as firewalls and filtering routers and ensuring access to digital content through password protection (Sambo, Imran, & Akanbi, 2022). Librarians also need information technology skills, knowledge of social media tools, web design and development, integrated library systems (ILS), and virtual reference technologies. Moreover, Ylipulli et al. (2023) emphasize the importance of training librarians in community engagement strategies to foster meaningful connections with patrons and address the unique needs of diverse communities. Foster (2018) further underscores the necessity for librarians to possess cultural competency to effectively cater to the needs of patrons from various backgrounds. Additionally, Moonasar (2024) highlights the significance of librarians engaging in continuing education and professional development activities to stay abreast of emerging trends, technologies, and best practices in the field. This includes attending conferences, workshops, and webinars, as well as pursuing advanced degrees or certifications (Daradkeh, 2023). These ongoing learning opportunities are crucial for librarians to enhance their skills and adapt to the evolving landscape of information management and user services.

WHAT IS THE OPINION OF LIBRARIANS TOWARDS METAVERSE IN FUTURE LIBRARY SERVICES?

Studies by Noh (2024) and Tella et al. (2023) discover that many librarians express enthusiasm that the metaverse offers for expanding access to information, fostering digital literacy, and engaging patrons in immersive learning experiences. Oladokun et al. (2023) reveals that the metaverse serves as a platform for creating virtual libraries that transcend physical boundaries and allow patrons to explore digital collections, attend virtual events, and participate in interactive educational programs from anywhere in the world. In support of this, Guo et al. (2023) state that librarians recognize the potential of the metaverse to enhance accessibility for patrons with disabilities or those who face barriers to accessing traditional library services. Virtual environments are designed with accessibility features such as customizable avatars, text-to-speech functionality, and virtual reality experiences tailored to diverse learning styles and preferences (Ylipulli et al., 2023). Furthermore, Khader (2022) notes that librarians leverage the metaverse platform to provide innovative services that meet the diverse needs and aspirations of users. In so doing, Qamar et al. (2023) reveal that the metaverse presents for enhancing library experiences and promoting lifelong learning. Despite these numerous benefits of the metaverse, Eneh et al (2024) point out that some librarians express concerns about the ethical and technical challenges

associated with the integration of metaverse into library services. The authors reveal that issues such as privacy and data security, digital equity considerations, and disparities in access to technology are among the key concerns raised by librarians.

WILL INFUSING METAVERSE INTO FUTURE LIBRARY SERVICES LIMIT LIBRARIANS FROM CONTINUOUS LIBRARY PRACTICES CONSIDERING THE IMMERSIVE TECHNOLOGIES REQUIRED TO FUNCTION IN METAVERSE REALITY?

The integration of the metaverse into library services presents new avenues for innovation, allowing librarians to engage patrons in immersive learning environments (Eneh et al., 2024). The authors contend that these immersive technologies enhance access to information and provide users with unique opportunities to explore and discover information in the immersive era. Sureephong et al. (2024) identify one of the benefits of metaverse integration into library services. They assert that metaverse libraries cater to users from diverse backgrounds and locations, offering unrestricted access to resources and services. This inclusivity ensures that all categories of users can benefit from the resources and services provided by metaverse libraries.

The study conducted by Noh (2024) highlighted that integrating the metaverse into libraries could potentially impact librarians' ability to maintain their usual library practices, particularly due to the need for a deeper understanding of natural language processing, a skill typically associated with computer experts. While it's not impossible for librarians to acquire such knowledge, it may pose a significant challenge for them. Guo et al. (2023) further emphasize that the adoption of immersive technologies in libraries necessitates library professionals to acquire skills and knowledge in emerging technologies like virtual reality (VR), augmented reality (AR), and 3D modelling. This shift towards immersive technologies could potentially divert attention away from traditional library activities, as noted by Eneh et al. (2024). Additionally, Tang (2021) suggests that librarians may encounter difficulties in integrating new skills and expertise while simultaneously managing essential library tasks such as reference services, technical services, and collection development. This underscores the potential challenges and adjustments that librarians may face in adapting to the integration of immersive technologies into library workflows and practices. Daradkeh (2023) observes that implementing metaverse technologies requires significant investments in hardware, software, and training to equip librarians with the necessary competencies to operate in virtual environments. Ylipulli et al. (2023) further argue that while integrating metaverse technologies into a library, it is expected that the principles of intellectual freedom, copyright and inclusivity are carefully considered.

WILL THE METAVERSE TECHNOLOGIES CAUSE LIBRARIANS' PHOBIA IN ADJUSTMENT FOR FUTURE LIBRARY SERVICES, ESPECIALLY AMONG AGED/SENIOR COLLEAGUES?

The likelihood of metaverse technologies causing anxiety and reluctance among librarians, particularly among aged or senior colleagues, is significant (Qamar et al., 2023; Sureephong et al., 2024). As noted by Khader (2022), aged librarians may experience technology anxiety or resistance due to factors such as limited prior exposure to digital technologies, unfamiliarity with

immersive environments, and apprehension about acquiring new skills late in their careers. Furthermore, Surrephong et al. (2024) reveal that the rapid pace of technological change contributes to resistance or reluctance among senior library professionals to embrace metaverse technologies. A prevalent concern among aged or senior librarians is the fear of becoming obsolete in an increasingly digital-centric profession (Eneh et al., 2024). Supporting this, Brooks (2021) found that aged or senior librarians often feel marginalized or overlooked in a culture that prioritizes digital fluency and adaptation, leading to feelings of isolation and alienation. Generational disparities in attitudes towards technology exacerbate anxiety and tension among library professionals in the age of emerging technologies (Lyons & Kuron, 2014).

CONCLUSION

The study delves into the skill gaps that librarians need to address, their attitudes towards the metaverse, and the potential impact of immersive technologies on their ongoing library practices. To bridge these skill gaps, the study suggests several approaches, including further studies, short courses, or in-house training. While further studies offer a comprehensive understanding of emerging technologies, they may present challenges in terms of time and financial commitments. Conversely, short courses provide targeted training, but their effectiveness may be limited compared to formal academic programs. In terms of skills training, the study underscores the importance of information literacy, digital literacy, technology integration, data management, information security, community engagement, and professional development for librarians. These skills are crucial for librarians to effectively navigate the digital landscape and meet the diverse needs of their patrons in the metaverse era. The study reveals that many librarians hold positive views towards the metaverse, seeing it as broadening access to information, enhancing digital literacy, and providing patrons with immersive learning experiences. However, some librarians express reservations regarding the ethical, social, and technical challenges inherent in its integration into library services. Additionally, the study examines the possibility of metaverse technologies causing anxiety and reluctance among librarians, particularly among aged or senior colleagues. While the integration of immersive technologies presents opportunities for innovation, it may also evoke feelings of insecurity and fear of obsolescence among senior librarians.

The study underscores the necessity for librarians to continually update their skills and embrace new technologies to effectively meet the evolving needs of patrons in the metaverse era. It stresses the significance of providing targeted training and encouraging continuous practice, as it is observed that many librarians may not consistently apply the knowledge they acquire after training. Support for librarians, particularly aged or senior colleagues, is crucial to facilitate a smooth transition to future library services, especially as library organizations continue to evolve daily. By offering ongoing support and resources, organizations can empower librarians to adapt to new technologies and navigate the changing landscape of library services effectively. Since the potential of the metaverse in future libraries cannot be undermined, the role of sustainable energy in enabling the metaverse to flourish within library operations, especially in developing nations be prioritized, where alternative power supply through government subsidiaries and philanthropic organizations be provided.

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