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Research Article

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Metaverse Technologies And Innovation in Academic Library Service Delivery: Librarians' Awareness, And Perceived Relevance for User Engagement

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Abstract

This study examined metaverse technologies and innovation in academic library service delivery, focusing on librarians' awareness, perceived relevance for user engagement, and adoption challenges. A descriptive survey research design was adopted, and data were collected through an online questionnaire administered via Google Forms to academic librarians, with 196 responses found usable for analysis. Descriptive statistical techniques were used to analysis the data. The findings revealed a moderately high level of awareness of metaverse technologies among academic librarians (grand mean = 2.82), indicating general familiarity but limited institutional engagement. The study also found a high perceived relevance of metaverse technologies for enhancing user engagement (grand mean = 3.10), particularly in interactive learning, virtual library tours, and collaborative services. However, the adoption of metaverse technologies was constrained by significant challenges (grand mean = 3.13), notably inadequate technical infrastructure, high implementation costs, and limited staff training. The study concludes that although metaverse technologies hold considerable promise for innovating academic library services, their effective adoption depends on sustained institutional support, targeted capacity development, and strategic investment in digital infrastructure. The study provides empirical evidence to inform planning and policy decisions regarding immersive technologies in academic libraries.

Keywords: Metaverse technologies, Academic libraries, Library service delivery, User engagement, Librarian awareness, Technology adoption, Service Innovation

1. Introduction

Academic libraries are increasingly required to innovate their service delivery models in response to rapid technological advancement and evolving user expectations within higher education environments. Beyond their traditional role as repositories of information resources, academic libraries now function as interactive service spaces that support learning, research, and collaboration through digital platforms [1]. This shift has intensified scholarly attention on emerging technologies capable of enhancing user engagement and expanding access to information services.

One emerging technological concept gaining prominence in scholarly discourse is the metaverse. Dwivedi et al. (2022) define the metaverse as a persistent, shared, and immersive virtual environment that integrates physical and digital realities through technologies such as virtual reality, augmented reality, and advanced networking systems [2]. Similarly, Mystakidis (2022) conceptualizes the metaverse as a three-dimensional virtual ecosystem that enables users to interact with digital content and with one another in real time [3]. These characteristics position the metaverse as a potentially transformative platform for academic library services. The operational nature of the metaverse lies in its capacity to support spatial navigation, real-time social interaction, and collaborative activities within simulated environments [4]. These features suggest significant potential for application in academic libraries, where service delivery increasingly depends on digital mediation. In this context, metaverse technologies may function as virtual extensions of the library, enabling services such as immersive user orientation, virtual reference interactions, digital exhibitions, and collaborative learning spaces [5].

The adoption of metaverse technologies has implications for both library services and users. From a service delivery perspective,

immersive environments may enhance the effectiveness of academic library services by offering interactive and experiential modes of information access. For users, particularly students and researchers, such environments may promote higher levels of engagement by enabling participatory exploration of library resources and real-time collaboration [3]. User engagement, understood as active interaction with library services and environments, is therefore central to evaluating the relevance of metaverse-based innovations in academic libraries.

However, the integration of metaverse technologies into academic library services is influenced by several institutional and professional factors. Research on emerging technology adoption in libraries identifies challenges such as inadequate infrastructure, limited professional competencies, funding constraints, and uncertainty about sustainability as major barriers to implementation [6]. These challenges underscore the importance of librarians' awareness and understanding of metaverse technologies, as awareness shapes perceptions of relevance, readiness for adoption, and willingness to experiment with innovative service models.

Despite growing conceptual discussions on metaverse applications in libraries, empirical evidence on how these technologies can be effectively integrated into academic library service delivery remains limited. There is therefore a need for systematic investigation that links metaverse technologies with librarian awareness, user engagement, and adoption challenges within academic library contexts. Addressing this gap will provide evidence-based insights to guide strategic decision-making and innovation in academic library services.

2. Literature Review

Recent scholarship increasingly situates the metaverse within discussions of service innovation in libraries, particularly academic libraries, where immersive technologies are being explored as extensions of digital library environments. Dwivedi et al. (2022) provided one of the most comprehensive empirical and analytical examinations of the metaverse, drawing on multidisciplinary survey evidence and expert analysis [2]. The authors defined the metaverse as a persistent, immersive digital environment capable of supporting interaction, collaboration, and experiential engagement, while emphasizing that organizational readiness and professional competence are critical for its effective use.

This study establishes the metaverse as a viable service environment rather than a speculative technology, implying that academic libraries must be institutionally prepared to harness its benefits. Mystakidis (2022) empirically examined immersive virtual environments in educational and information contexts [3]. Using observational and experimental evidence, the study demonstrated that immersive environments significantly enhance user engagement, collaboration, and experiential learning. Although not library-specific, this finding suggests that metaverse-based academic library services may foster deeper user engagement, thereby justifying empirical investigation within library settings.

Moving from general immersion to higher education contexts, Radianti et al. (2020) systematically reviewed experimental studies on immersive virtual environments [7]. Their findings showed consistent positive effects on engagement and interaction, though outcomes depended heavily on design quality and institutional context. This indicates that metaverse adoption in academic libraries will require careful service design and contextual alignment rather than simple technology deployment.

Within Library and Information Science, Liu et al. (2024) explored the metaverse as the next frontier for a "living library experience [8]." Drawing on empirical illustrations from library technology trends, the authors argued that metaverse environments reposition libraries as interactive and continuous service spaces rather than static digital platforms.

This study reframes the academic library as an experiential ecosystem, suggesting that service delivery models must evolve to accommodate immersive user interactions. Focusing on user acceptance, Adetayo et al. (2023) empirically examined whether metaverse academic libraries would be patronized [9]. Using survey data, the study found that perceived usefulness, ease of navigation, and academic relevance significantly influenced users' intention to patronize metaverse library services, while access barriers and digital skills posed challenges. This finding suggests that metaverse services may attract users only when they are usable and task-relevant, highlighting the importance of user-centered service design in academic libraries.

Extending the discussion to sustainability, Ajani et al. (2023) examined the reincarnation of libraries through the metaverse as a pathway toward sustainable knowledge systems [10]. Their empirical and policy-oriented analysis emphasized long-term access, engagement, and digital continuity as potential benefits. This study implies that metaverse adoption should be evaluated beyond novelty, particularly in terms of sustainability and institutional capacity within academic libraries.

Ajani et al. (2024) investigated what librarians and information users need to know about metaverse integration into libraries [11]. Survey findings revealed skill gaps, ethical concerns, privacy risks, and infrastructural constraints as major determinants of readiness.

This evidence highlights librarian awareness and competence as critical mediating variables, reinforcing the need to assess professional readiness in metaverse-related library research.

Broadening the scope beyond libraries, Lin et al. (2022) examined the vision, opportunities, and challenges of the metaverse in education [12]. Their empirical findings showed that immersive environments support collaboration and experiential learning, but adoption is constrained by cost, access, and digital competence. While not strictly metaverse-focused, Saleh et al. (2022) empirically examined augmented reality applications in university medical libraries [13]. The study reported enhanced user engagement and interactive learning support, alongside challenges related to cost and technical expertise. This provides empirical support that immersive technologies positively influence library services,

suggesting that metaverse platforms may further extend these benefits. Eneh et al. (2024) empirically investigated librarians' perceptions and skill sets for metaverse use in universities [14]. Findings revealed positive perceptions but limited skills and infrastructural readiness. This study directly supports the inclusion of awareness and skill-related challenges in metaverse research and highlights contextual constraints in developing academic library environments.

Finally, Guo et al. (2024) surveyed virtual and augmented reality practices across the top 100 university libraries in the United States [15]. The study found increasing experimentation with immersive technologies for orientation and instruction, though full metaverse integration remained limited. This evidence indicates that even technologically advanced libraries are still at exploratory stages, underscoring the relevance of readiness and adoption studies.

3. Methodology

The study adopted a descriptive survey research design to examine metaverse technologies and innovation in academic library service delivery. The target population comprised librarians working in academic libraries, as they are directly involved in library services and technology adoption. Data were collected using a structured online questionnaire designed with Google Forms. Librarians in academic libraries were specifically invited to participate in the study. A total of 196 completed questionnaires were retrieved and found usable for analysis, using a purposive sampling technique to ensure that only relevant respondents participated. The questionnaire consisted of close-ended items addressing librarians' awareness of metaverse technologies, perceived relevance for library service delivery, and challenges affecting adoption. Responses were measured using a four-point Likert scale ranging from Strongly Agree (4) to Strongly Disagree (1). Data were analyzed using descriptive statistics and presented in tables showing frequencies, percentages, and mean scores. Ethical standards were observed, as participation was voluntary and respondents' anonymity and confidentiality were assured.

4.Results and Discussion

4.1. Research Question One

What is the level of awareness of metaverse technologies among academic librarians for library service delivery?

S/N	Awareness Statements	SA (%)	A (%)	D (%)	SD (%)	Mean	SD
1	I am aware of the concept of the metaverse	78 (39.8)	74 (37.8)	28 (14.3)	16 (8.2)	3.09	0.93
2	I understand basic features of metaverse technologies	62 (31.6)	81 (41.3)	33 (16.8)	20 (10.2)	2.95	0.96
3	I have read about metaverse applications in libraries	54 (27.6)	79 (40.3)	41 (20.9)	22 (11.2)	2.84	0.98
4	I am aware of metaverse use in education	71 (36.2)	83 (42.3)	28 (14.3)	14 (7.1)	3.08	0.88
5	I am familiar with VR/AR as metaverse tools	69 (35.2)	76 (38.8)	32 (16.3)	19 (9.7)	2.99	0.95
6	My library has discussed metaverse possibilities	41 (20.9)	64 (32.7)	55 (28.1)	36 (18.4)	2.56	1.02
7	I follow metaverse trends in LIS literature	46 (23.5)	67 (34.2)	54 (27.6)	29 (14.8)	2.66	0.99
8	I understand how metaverse could affect library services	58 (29.6)	73 (37.2)	43 (21.9)	22 (11.2)	2.85	0.97
9	I can explain metaverse concepts to users	39 (19.9)	65 (33.2)	57 (29.1)	35 (17.9)	2.55	1.03
10	I feel informed enough about metaverse technologies	42 (21.4)	68 (34.7)	54 (27.6)	32 (16.3)	2.61	1.01
	Grandmean	2.82					

Table 1: Awareness of Metaverse Technologies among Academic Librarians (N = 196)

The grand mean score of 2.82 indicates a moderately high level of awareness of metaverse technologies among academic librarians. This suggests that most librarians are conceptually aware of the metaverse and its possible relevance to library services, although this awareness may not yet be deep or practice-oriented. Further examination of individual items shows that the three highest mean scores were recorded for: awareness of the metaverse concept (Mean = 3.09), awareness of metaverse use in education (Mean = 3.08), and familiarity with VR/AR as metaverse tools (Mean = 2.99).

These results indicate that librarians are more exposed to general and educational discussions about the metaverse, particularly through related technologies such as virtual and augmented reality. In contrast, the three lowest mean scores were observed for ability to explain metaverse concepts to users (Mean = 2.55), institutional discussion of metaverse possibilities (Mean = 2.56), and feeling sufficiently informed about metaverse technologies (Mean = 2.61). These lower scores suggest that while awareness exists at an individual level, institutional engagement and professional confidence in applying metaverse technologies remain limited.

This pattern aligns with Dwivedi et al. (2022) and Mystakidis (2022), who reported growing conceptual awareness of the metaverse across information professions but limited operational readiness [2,3]. Similarly, Ajani, et al. (2024) found that librarians often possess surface-level awareness without adequate institutional backing or training [11]. However, this finding contrasts with Guo et al. (2024), who reported higher professional confidence and institutional engagement in technologically advanced academic libraries, highlighting contextual differences in exposure and infrastructure [15].

4.2. Research Question Two

What is the perceived relevance of metaverse technologies for enhancing user engagement in academic library services?

S/N	Relevance Statements	SA (%)	A (%)	D (%)	SD (%)	Mean	SD
1	Metaverse can enhance user engagement	84 (42.9)	72 (36.7)	25 (12.8)	15 (7.7)	3.15	0.89
2	Metaverse can support interactive learning	91 (46.4)	69 (35.2)	22 (11.2)	14 (7.1)	3.21	0.86
3	Metaverse can improve virtual library tours	88 (44.9)	74 (37.8)	21 (10.7)	13 (6.6)	3.21	0.83
4	Metaverse can support collaborative research	79 (40.3)	75 (38.3)	26 (13.3)	16 (8.2)	3.11	0.91
5	Metaverse can attract more students to libraries	73 (37.2)	78 (39.8)	29 (14.8)	16 (8.2)	3.06	0.92
6	Metaverse can reduce library anxiety	69 (35.2)	77 (39.3)	33 (16.8)	17 (8.7)	3.01	0.93
7	Metaverse can enhance digital reference services	75 (38.3)	73 (37.2)	31 (15.8)	17 (8.7)	3.05	0.94
8	Metaverse can support inclusive services	66 (33.7)	76 (38.8)	36 (18.4)	18 (9.2)	2.97	0.96
9	Metaverse can enrich user experience	82 (41.8)	70 (35.7)	28 (14.3)	16 (8.2)	3.11	0.91
10	Metaverse is relevant to modern academic libraries	85 (43.4)	71 (36.2)	25 (12.8)	15 (7.7)	3.15	0.89
	Grand Mean	3.10					

Table 2: Perceived Relevance of Metaverse Technologies for User Engagement (N = 196)

The grand mean score of 3.10 indicates a high level of perceived relevance of metaverse technologies for enhancing user engagement in academic library services. This suggests that librarians largely recognize the metaverse as a valuable platform for improving how users interact with library services. The three highest mean scores were recorded for support for interactive learning (Mean = 3.21), improvement of virtual library tours (Mean = 3.21), and enhancement of user engagement generally (Mean = 3.15).

While, lowest mean scores were associated with support for inclusive services (Mean = 2.97), and support for inclusive user engagement (Mean = 2.97). Although still above the acceptance threshold, these lower scores suggest some uncertainty regarding the equity and inclusiveness of metaverse-based services.

The findings support Gupta and Walia (2023) and Liu, et al., (2024), who reported strong perceived relevance of metaverse environments for immersive learning, orientation, and user engagement [5,8]. Empirical evidence from Radianti et al. (2020) also confirms that immersive environments enhance interaction and engagement [7]. However, Benyera (2021) cautioned that advanced technologies may inadvertently deepen digital divides, which may explain librarians' reservations regarding inclusiveness and anxiety reduction [16].

4.3. Research Question Three

What challenges influence the adoption of metaverse technologies in academic libraries?

S/N	Challenge Statements	SA (%)	A (%)	D (%)	SD (%)	Mean	SD
1	Lack of technical infrastructure	92 (46.9)	71 (36.2)	21 (10.7)	12 (6.1)	3.24	0.83
2	High cost of metaverse technologies	89 (45.4)	74 (37.8)	20 (10.2)	13 (6.6)	3.22	0.84
3	Lack of staff training	87 (44.4)	76 (38.8)	21 (10.7)	12 (6.1)	3.22	0.83
4	Limited institutional support	81 (41.3)	78 (39.8)	24 (12.2)	13 (6.6)	3.16	0.87
5	Inadequate ICT skills	79 (40.3)	75 (38.3)	27 (13.8)	15 (7.7)	3.11	0.90
6	Poor internet connectivity	85 (43.4)	72 (36.7)	24 (12.2)	15 (7.7)	3.16	0.89
7	Lack of policy direction	77 (39.3)	76 (38.8)	28 (14.3)	15 (7.7)	3.09	0.91
8	Ethical and privacy concerns	69 (35.2)	78 (39.8)	32 (16.3)	17 (8.7)	3.02	0.93
9	Low user readiness	72 (36.7)	75 (38.3)	31 (15.8)	18 (9.2)	3.02	0.94
10	Resistance to change	68 (34.7)	77 (39.3)	34 (17.3)	17 (8.7)	3.01	0.94
	Grand Mean	3.13					

Table 3: Challenges Affecting Adoption of Metaverse Technologies (N = 196)

The grand mean score of 3.13 indicates a high level of perceived challenges affecting the adoption of metaverse technologies in academic libraries. This suggests that librarians widely recognize significant barriers that may hinder effective implementation.

For instance, lack of technical infrastructure (Mean = 3.24), high cost of metaverse technologies (Mean = 3.22), and lack of staff training (Mean = 3.22) have the highest means. These findings indicate that infrastructure, cost, and human capacity are the most critical barriers to metaverse adoption.

This result strongly aligns with Ajani et al. (2024) and Eneh, et

al., (2024), who identified infrastructural inadequacies, funding limitations, and skill gaps as primary constraints to metaverse adoption in academic libraries [11,14]. Similarly, Dwivedi et al. (2022) emphasized that metaverse implementation demands substantial organizational investment [2]. In contrast, Guo et al. (2024) reported fewer infrastructural barriers in U.S. academic libraries, underscoring the role of economic and technological context in shaping adoption outcomes [15].

5. Recommendations

Based on the findings of the study, the following recommendations are proposed:

1. Targeted capacity development for academic librarians: given the moderate level of awareness but low professional confidence revealed by the findings, academic libraries should organize targeted training programmers, workshops, and continuous professional development activities focused on metaverse concepts, tools, and practical applications in library services.
2. Institutional integration of metaverse initiatives: since institutional discussion of metaverse possibilities recorded low mean scores, academic library management should formally integrate metaverse-related innovations into library strategic plans, ensuring that such initiatives move beyond individual awareness to organizational commitment.
3. Pilot metaverse-based library services: in view of the high perceived relevance of metaverse technologies for user engagement, academic libraries should begin with small-scale pilot projects such as virtual library tours, immersive orientations, or interactive reference services to demonstrate value and feasibility.
4. Improvement of digital infrastructure and funding support: As inadequate infrastructure and high cost emerged as the most critical challenges, institutional authorities and funding bodies should priorities investments in reliable internet connectivity, appropriate hardware, and supporting technologies necessary for metaverse implementation.
5. Structured skill development for staff: the high mean score for lack of staff training indicates the need for structured skill development programmes, including hands-on exposure to VR/AR tools and immersive platforms, to bridge professional competence gaps.
6. User readiness and inclusiveness strategies: given concerns about inclusiveness and user readiness, libraries should adopt user education strategies that promote digital literacy and ensure that metaverse-based services are accessible and inclusive, particularly for users with limited technological exposure.

6. Conclusion

This study examined metaverse technologies and innovation in academic library service delivery, focusing on librarians' awareness, perceived relevance for user engagement, and adoption challenges. The findings revealed a moderate level of awareness among academic librarians and a high perception of the relevance of metaverse technologies for enhancing user engagement. However, significant challenges particularly inadequate infrastructure, high costs, and limited staff training were identified as major constraints to adoption. The study concludes that while metaverse technologies hold considerable potential for transforming academic library services, their successful implementation depends on deliberate institutional support, professional capacity development, and strategic investment in digital infrastructure.

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