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Identification of Digital Library Indicators in Metaverse Environment

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ABSTRACT

The objective of the research is to identify the indicators of the digital library in the Metaverse environment. The current research is applied in terms of objective, and a multi-step quantitative Delphi method was used. The statistical population of this research consists of experts in the field of metaverse, digital libraries, information science and epistemology, and information technology engineering. To determine the sample, the judgmental sampling method and the opinions of 10 experts in this field were used. In order to identify the indicators of the digital library in the field of Metaverse, researchers first extracted 75 indicators by reviewing the literature and research background, and then, through a semi-structured questionnaire, the experts were asked to determine the effect of the indicators based on the five-point Likert scale. 75 indicators were identified through background checks and interviews with experts in the fields of metaverse, digital libraries, information science and epistemology, and information technology engineering. These indicators were screened by distributing questionnaires among experts and using the Delphi method, and 28 indicators were selected for the final analysis. This research was categorized by considering 5 dimensions, including economic, human, political, managerial, and technological dimensions. The presence of digital libraries in the Metaverse environment significantly changes the way of providing services, interacting with users, and managing resources. These changes are effective in improving the user experience, increasing the quality of services, and improving the overall performance of digital libraries in this new world. In fact, in the Metaverse environment, digital libraries are permanently available and allow users to access the resources they need at any time and from any place without time and place limitations.

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Introduction

The rapid development of information technology has accelerated the emergence of diverse and new technical tools, which provide both significant opportunities and great challenges for library service innovation (Wang & Au, 2023). Using old technology or information systems such as databases or how to use software requires computer literacy. While new digital technologies are user-oriented and self-directed and do not require computer knowledge. Also, these technologies combine the user's perception of the real environment with digital content. Therefore, an interactive space is formed that affects people's cognitive performance. Digital technology studies in the country are few and mostly done to measure the usage of augmented reality in libraries. One of the challenges facing libraries today is the new types of library services and their use in their facilities, and this can be solved by introducing digital technologies (Malgerd et al., 2022).

The concept of the metaverse first appeared in the 1992 science fiction novel Snow Crash by American novelist Neal Stephenson. Snow Crash characters become avatars and work in a 3D virtual reality (3D) called the Metaverse. Metaverse refers to virtual reality that exists beyond reality. This word is composed of meta meaning transcendence and virtuality and world meaning the world. This term refers to the digitized earth as a new world that is expressed through digital media such as smart phones and the Internet (Rezai Noor & Karimian, 2024; Kim, 2022).

Metaverse, as an evolving paradigm of the next-generation Internet, aims to create a fully immersive, trans-spatio-temporal, and self-sustaining virtual common space for humans to play, work, and socialize. The Metaverse has moved from science fiction to a future reality due to recent advances in emerging technologies such as augmented reality, artificial intelligence, and blockchain. However, severe privacy invasions and security breaches (inherited from the underlying technologies or emerging in the new digital environment) of the Metaverse could hinder its widespread deployment. At the same time, a series of fundamental challenges (e.g., scalability and interoperability) can arise in metauniverse security due to the inherent characteristics of the Metaverse, such as immersive realism, hyper-space-time, stability, and heterogeneity (Wang et al., 2023).

In fact, Metaverse is a three-dimensional digital space that combines the online life of a person with his real and simulated life using technologies such as virtual reality and augmented reality. By means of this technology, the internet that we are using today will be available in a virtual reality space. Through its hardware and software interfaces, Metaverse integrates and engages human senses such as vision, hearing and even touch with the Internet. In this virtual world, many things in the real world can be done in a simulated form. Education, business, construction and entertainment are examples of these applications. Computer science innovations play an important role in everyday life as they change and enrich human interactions, communication and social transactions. From the perspective of end users, three main waves of technological innovation have been recorded around the introduction of personal computers, the Internet, and mobile devices, respectively. Currently, the fourth wave of computational innovation is expanding around spatial and immersive technologies such as virtual reality (VR) and augmented reality (AR) (Stilianos Mistakidis, 2022; Kamino, 2021).

One of the types of libraries that can be imagined in the field of virtual reality or Metaverse is digital libraries. It is a new type of traditional library in which time and place do not matter,

and it allows users who need information to find the resources they need in any situation. Digital libraries, like traditional libraries, should be involved in things such as information collection, organization, storage and distribution. With the progress of science and the increase of electronic resources, the need to create digital libraries is felt to collect, organize and publish these types of resources. With the growth of electronic resources, the management of such resources has gained special importance (Rahmani, 2022; Rezaei-Noor & Karimian, 2024).

Due to the importance, role and position of the digital library, several definitions have been provided about it, each of which includes different concepts, but there has been no consensus on the existing definitions. Considering the interdisciplinary nature of the field of digital libraries and the role of various fields such as computer science, library and information science, sociology, etc., the existence of different views towards digital libraries seems natural. Computer science experts consider digital library as databases and information retrieval system. In terms of digital library systems, integration can be defined as a collection of information organized for use. Science and information professionals consider digital libraries to be more than a database and information retrieval system, in which elements that require information, end users, intellectual property, and more information acceptance. In fact, the digital library should be able to provide information to specific users, be based on an organization, logic and fabric, provide access to information resources, from human resources (librarians) and technologies to provide services. Provide the possibility of quick access and use of information resources, provide the possibility of free access (for their users) and have the possibility of ownership and control of their resources (Alipour Hafizi, 2013; Rezai Noor & Karimian, 2024).

In other words, the digital library can be described as: "a controlled environment that provides integrated access to a wide range of information services through appropriate legal and commercial frameworks and regardless of the storage location, information form, and authentication domain." In another definition, digital libraries are considered as organizations that provide resources including expert staff for selecting, organizing, accessing, interpreting, distributing, maintaining and ensuring the durability of digital works collections so that these resources are readily and economically available for Usage can be accessed by a specific person or a set of groups. In fact, a digital library is a library where documents are stored electronically instead of on paper or other local media. The basis of these libraries is the storage of documents in electronic form as well as electronic use. So that any person in any part of Iran and even the world can access all the information of a huge library using a normal computer and a telephone line. Therefore, it is enough to collect these books and place them in memory units in this type of library (Sharif Abadi, 2011, p. 101).

One of the reasons for the formation of digital libraries was that they will deliver information in a better way than what was possible in the past. Today, computers and social networks and new technologies such as Metaverse have changed the ways of communication between people. It can be argued that a specialist or scientist or ordinary users sitting behind a personal computer connected to a communication network will receive better services than when visiting a library. Especially in the Metaverse environment, they have the ability to enter the 3D space and easily pick up their favorite resources from the shelf and study them. Information that was only available to specialists at the beginning is now directly available

to everyone. Therefore, the current research seeks to identify digital library indicators in the Metaverse environment.

Literature Review

In the current research, for the background of the research, keywords such as Metaverse, digital libraries, 3D space, virtual reality, human, managerial, technological, economic and political indicators are used in internal (Normex, Mogiran, Alamnet, Ganj) and external (Scopos, WebOscience, Google) databases. Scholar and...) was the object of recovery and investigation. Despite the best researchers and authors, few studies have been conducted on new technologies in the digital library, and most studies have focused on the usability of augmented reality or its application in libraries. Therefore, the closest studies have been selected as research in this study.

Mohammad Khani, Haj Zain al-Abidini (2022) have paid attention to Metaverse and its application for librarians and libraries in research. From a review method to collect articles and information about the Metaverse, the role and services that libraries have used in the Metaverse. The findings of the research showed that librarians have been pioneers in the use of virtual space and awareness of new tools and platforms has always been important for information professionals. Libraries, as the main center for promoting information and science, can use the advantages and facilities of Metaverse to keep up with the digital generation and meet their needs. With the disappearance of physical presence, users who have created avatars in the Metaverse environment can freely travel anywhere and visit different places. Libraries can also take advantage of this possibility, including the activities that can be done: accepting the virtual presence of users even at the international level, sharing their resources, holding conferences and educational workshops. The results showed that libraries need to be present in Metaverse in order to keep up with the speed of technology development and emphasize their role in it.

In his research, Mohammadian (2022) analyzed library data in Metaverse using artificial intelligence strategies, creating a new frontier in the management and optimal use of information. This approach, with the help of advanced technologies, provides new opportunities to discover knowledge and hidden patterns in huge data sets. The use of artificial intelligence in order to process and analyze information improves capabilities such as quick identification of patterns, modeling of knowledge structure and prediction of users' needs. Vast volumes of library data can be analyzed using data mining and machine learning techniques, leading to the discovery of new resources and the improvement of library services. In the Metaverse, which is an interactive and extensive digital environment, these processes can significantly increase the capabilities of digital libraries. Intelligent data analysis in Metaverse helps users communicate more effectively with resources and benefit from more optimal immersive experiences. The results of this research showed that the use of artificial intelligence methods can significantly improve the deeper understanding of needs. Information and improving the efficiency and service quality of libraries to be effective.

Rezai noor, Karimian (2024) in research have identified the development barriers of Metaverse in digital libraries. And the implementation method of this research is qualitative and based on the basic theory. Therefore, the statistical population includes 10 university specialists who were selected by purposeful sampling. The sample size was calculated based on the

principle of theoretical saturation. The research tool is semi-structured interviews about metaverse barriers in digital libraries. Open, central and selective coding method based on grounded theory was used for data analysis.

The findings of the research showed that 53 central themes in the form of causal conditions including "existence of a problem or problem", "individual factors", "management", "organizational", "technology", "political", "social, "institutional" background conditions including "technology development", "user understanding", "library goals", "socio-economic status", "technology literacy level", "cultures and values", "background and experience", "user needs". Intervening conditions include "limited resources", "high speed of technological change", "uncertainty in the future of the metaverse", "human factors". Strategies include "education and awareness", "collaboration with technology companies", "development of technology infrastructure", "research and development" consequences include "reduction of access to information", "non-compliance with standards", "security and privacy risks", "non-acceptance by users. The results of this research showed that said metaverse depends on several factors.

As a result, with the development of Metaverse, libraries will have new opportunities to provide services to their users. By thinking creatively about how to use this technology, libraries can become valuable educational and social platforms.

Pandey (2022) in his research on Metaverse technology at Rajiv Gandhi University Central Library points out that it is time to move from Web 0.2 to Web 0.3. With the advent of the pandemic, there has been a push towards access to technology in the education sector, one such technology being the future of the Internet of Things is Metaverse. Technology can be best integrated with technologies to reach the last miles of the country. It is important to know how we can connect to student communities in the virtual world, how it will benefit students, and what obstacles will be in our way.

Sinha (2023) in research entitled Metaverse and digital libraries has discussed ensuring safe access to information. The researcher refers to the role of cybersecurity in protecting these virtual environments and users' personal and financial information. The results of the research show that cybersecurity measures implemented in digital library environments discuss authentication protocols, encryption and firewalls. Also, understanding the relationship between virtual space and cybersecurity in the field of digital libraries ensures the continuous growth and success of these common virtual spaces and the security of access to the information contained in them.

Anna et al. (2023) in the research "Are there libraries in the metaverse?" They have investigated the existence of metaverse or 3D virtual libraries and how they use metaverse to expand library services. The results of their research showed that there are some virtual reality or metaverse platforms that a virtual library or community can use to build their own 3D virtual world. However, these designs are still in the prototype stage and are used for exhibitions and projects.

Sedianingsieh et al. (2023) in research investigated non-textual communication: factors influencing the goals of using metaverse technology in digital library services. The purpose of this research is to investigate the factors affecting the goals of using Metaverse technology in digital library services in higher education institutions using the integrated system information theory. To achieve this goal, an online survey was conducted among university staff and students using the attachment scale measurement. The results of this study showed

that users' intention to use Metaverse technology in digital library systems is influenced by the perception of system use, perceived interaction, perceived usefulness, and perceived ease of use. Notably, these effects vary depending on the user's intended task. These findings provide valuable insights into the factors influencing the adoption and use of Metaverse technology in the context of digital library services in higher education institutions. This research helps to enhance understanding and guide future strategies for effective use of metaverse technology in educational settings.

Tela et al. (2023) investigated the need for literacy for digital librarians and library users in the digital age in research on libraries in the global world. They point out that libraries have the potential to play a vital role in this virtual world. However, digital librarians and library users in the digital age must develop metaliteracy skills to effectively navigate and evaluate digital information in the metaverse. The main purpose of this article is to explore the link between libraries and the outside world, define hyperliteracy and highlight its importance for librarians and library users.

The challenges of developing metaliteracy skills in the metaverse as well as the need for continuous training and support are discussed. In their research, they examine the role of libraries and librarians in the metaverse and provide recommendations for increasing literacy skills. Therefore, the research results show that with the continued evolution of the virtual world, libraries and librarians must adapt and develop the necessary skills to continue providing valuable resources and services to their communities in virtual environments.

Gupta and Vali (2023) have studied research entitled imagining the prospects and possibilities of Metaverse in library and information services and information services. In their research, they have pointed out the layers and technologies related to the metaverse, the potential applications of metaverse in library and information services, and its inherent challenges. The results show that libraries can use Metaverse technology to provide more effective and comprehensive virtual services such as virtual tours, virtual exhibitions, virtual reference services, virtual learning spaces, organizing LIS facilities and events, providing more effective LIS education and training, and providing better services.

Oladaken et al. (2023), in the research "Moving to the Outer Worlds: Libraries in Virtual Worlds" have investigated the role of metaverse in virtual libraries. The results show that virtual libraries have the potential to transform the ways people access, share, and interact with knowledge, while fostering a sense of community across geographic boundaries.

Method

The current research is applied in terms of the objective and multi-stage quantitative Delphi method was used. In the current research, first by reviewing the literature in the field of digital libraries, Metaverse, the general indicators were determined, and then, in order to identify the most important indicators that are effective on the development of digital libraries in the Metaverse environment and experts agree on them, the Delphi method was used. In fact, the Delphi method was first presented by Dalkey and Helmer in 1963.

This technique is a survey method based on experts' opinions and has three main features, which are: response by name, repetition and controlled feedback, and finally statistical group response. This technique is a systematic way to collect and coordinate the informed judgments of a group of experts about a particular question or issue.

In many real situations, the judgment of experts cannot be expressed and interpreted in the form of definitive quantitative numbers; In other words, definitive data and numbers are insufficient to model real-world systems due to ambiguity and uncertainty in decision-makers' judgments. In this regard, in order to overcome this problem, which was presented by Lotfizadeh in 1965, "Fuzzy set theory" is a suitable tool to deal with ambiguity and uncertainty in the decision-making process.

Therefore, in this research, the fuzzy Delphi method has been used to verify and screen the indicators identified in the field of digital libraries in the Metaverse environment. This method is a combination of the Delphi method and the theory of fuzzy sets presented by Ishikawa et al. The steps of the fuzzy Delphi method in this research are (Mousavi et al., 2015):

1- Identification of research indicators using a comprehensive review of the theoretical foundations of research in the field of digital libraries in the Metaverse environment.

2- Collecting the opinions of decision-making experts: in this step, after identifying the indicators of the digital library in the Metaverse environment, a decision-making group consisting of experts related to the research topic is formed and questionnaires are used to determine the relevance of the identified indicators to the main topic.

Research and screening is sent to them, in which the linguistic variables of Table 1 are used to express the importance of each indicator. Triangular fuzzy numbers are used in this research.

Table 1. *linguistic expressions and fuzzy Delphi numbers (Mirspasi et al., 2015; Mousavi et al., 2014)*

Language expressions	Triangular fuzzy numbers
very little	(0,0,0.25)
Low	(0,0.25,0.5)
average	(0.25,0.5,0.75)
a lot	(0.5,0.75,1)
Too much	(0.75,1,1)

3- Verification and screening of indicators: This work is done by comparing the acquired value of each indicator with the threshold value of $\tilde{S}$. The threshold value is determined by the decision-maker's mental inference and will directly affect the number of factors that are screened. There is no simple and legal way to determine the threshold value. In this research, the value of 0.7 is considered as the threshold value (Rahadari & Nasr, 2016).

For this purpose, first, the triangular fuzzy values of experts' opinions should be calculated, then to calculate the average of the opinions of n respondents, their fuzzy average was calculated. The fuzzy number τ was calculated for each of the indicators using the following relations (Rahadari and Nasr, 2016; Saifuddin et al., 2016).

3.1 $\tilde{\tau}_{ij}=(a_{ij},b_{ij},c_{ij})$, i=1,2,…,n j=1,2,…,m

3.2 $a_j = \sum \frac{a_{ij}}{n}$

3.3 $b_j = \sum \frac{b_{ij}}{n}$

3.4 $c_j = \sum \frac{c_{ij}}{n}$

In the above relationships, the index *i* refers to the expert and the index *j* refers to the decision-making index. Also, the dephased value of the average fuzzy number is obtained from the following relationship (Rahadari & Nasr, 2016).

3.5 $Crisp = \frac{a+b+c}{3}$

4- The general algorithm of fuzzy Delphi method is as follows:

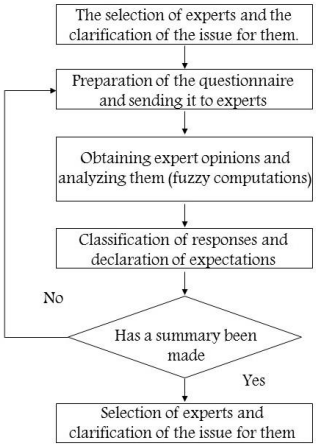

Figure 1. *Implementation algorithm of fuzzy Delphi method*

The statistical population of this research is made up of experts in the field of metaverse, digital libraries, science and knowledge, engineering information technology. For example, the judgmental sampling method and the opinions of 10 experts in this field are used. The experts of this research have at least 4 years of experience in this field and education related to new technologies.

To identify the indicators of the digital library in the field of Metaverse, first, using a review of the literature and research background, they observed 75 indicators, and then, through a semi-structured questionnaire, the experts were asked to identify the indicators on a five-point Likert scale.

Findings

In this part, the research data is analyzed. First, the indicators of the digital library in the Metaverse environment, which are extracted from the literature review and available sources, are confirmed by the fuzzy Delphi method. Then, following the fuzzy Delphi method, the indicators are confirmed and screened.

In order to get to know the number of respondents to the paired comparison questionnaire, the demographic characteristics of the respondents will be described in terms of gender, age, work experience and education.

Table 2. *Frequency distribution related to gender*

Gender	Abundance	Abundance percentage
man	8	80
woman	2	20

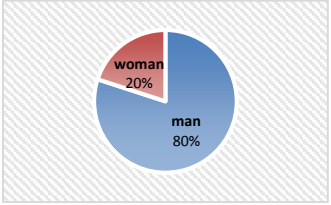

Figure 2. *Gender of respondents*

According to Table 2, 80% of the respondents were male and 20% were female.

Table 3. *Frequency distribution related to age*

Age	Abundance	Abundance percentage
30-40	5	50
40-50	2	20
Above 50	3	30

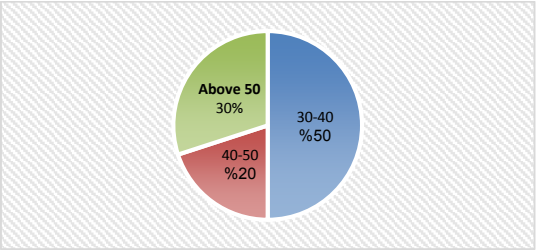

Figure 3. *Age of respondents*

According to Table 3, most of the respondents were related to the age group of 30 to 40, and the lowest frequency was related to the age group between 40 and 50 years, which constitute only 20% of the respondents.

Table 4. *Frequency distribution related to work experience*

Service history	Abundance	Abundance percentage
5 to 10 years	30	30
10 to 15 years	5	50
More than 15 years	2	20

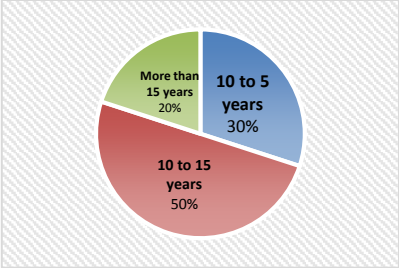

Figure 4. *Respondents' work history*

According to Table 4, most respondents have work experience between 10 and 15 years, and the lowest frequency is related to work experience of more than 15 years with 20%.

Table 5. Frequency distribution related to education

Education	Abundance	Abundance percentage
Bachelor	5	50
Master's degree	4	40
Ph.D.	1	10

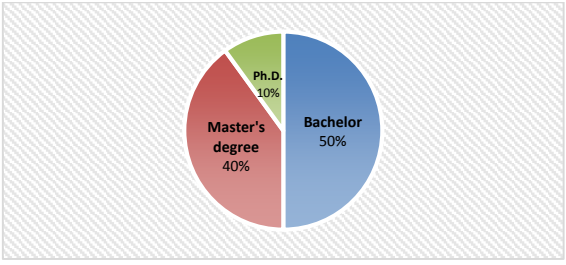

Figure 5. *Work education of the respondents*

According to Table 5, the highest frequency of respondents has a bachelor's degree with 50%, and the lowest frequency is related to a doctorate degree with 10%.

The results of fuzzy Delphi method

Fuzzy Delphi method has also been used to extract digital library indexes in Metaverse environment. In this research, fuzzy Delphi has been done in several stages. Which is given below.

The results of the first phase of fuzzy Delphi

At this stage, a questionnaire containing 75 indicators was given to the members of the expert group, and they were asked to express their opinion about each criterion in the form of verbal variables included in the questionnaire. The preliminary results of expert opinions are given in Table 6.

Table 6. *The results of expert opinions*

Row	Component	Very little	Low	Average	A lot	Too much
1	High costs of smart hardware and software equipment	1	1	2	3	3
2	Access to fees for the implementation of Metaverse plans	0	2	1	1	6
3	Access to the costs of artificial intelligence-based systems	1	1	6	0	2
4	The cost of high-speed internet	1	1	1	1	6
5	Operating expenses	0	1	1	8	0
6	Employment and employment	2	1	4	0	3
7	Financial innovations	1	1	1	0	7
8	Analysis of financial flows	1	2	7	0	0
9	Match structure in exchanges	3	6	1	0	0
10	Financial incentives	0	0	5	1	4
11	Monetization in Metaverse by library	1	2	0	0	7
12	Metaverse implementation costs	1	0	2	4	3
13	Social interaction	0	0	2	7	1
14	User experience	1	1	2	0	6
15	Attention to intellectual property	0	2	1	0	7
16	Attention to cataloging	0	0	2	2	6
17	User support	1	1	1	2	5
18	Optimal access and sharing of information	1	1	1	1	6
19	Creativity and innovation	0	0	2	7	1
20	A sense of psychological security	1	1	1	0	7
21	Education	0	1	1	1	7
22	entertainment	0	0	1	2	7
23	accessibility	0	0	1	2	7
24	personalization	4	2	4	0	0
25	Motivation and participation	0	2	1	7	0
26	sense of presence	0	0	2	8	0
27	User satisfaction	3	0	1	0	6
28	Flexibility	0	3	3	2	2
29	Creating legal regulations	0	4	0	0	6
30	The role of governments and institutions on the content of digital libraries in Metaverse	0	1	0	9	0
31	Creating optimal rules for the implementation of Metaverse	0	1	0	9	0
32	Strict government regulations in the technology sector	0	2	0	2	6
33	Protection of intellectual property rights	0	1	1	1	7
34	Diversity and inclusion	0	0	0	10	0
35	Avatars and their legal challenges	0	0	0	4	6
36	Privacy protection	0	0	0	0	10
37	Confidentiality of information	0	0	1	2	7
38	Data security	0	0	3	5	2
39	Information protection and security	2	7	0	0	0
40	Political promotion and education	0	1	2	5	2
41	Using technologies by management to make decisions	0	4	6	0	0
42	Strengthening the technical knowledge of managers	0	1	4	4	1
43	Gathering information and statistics	1	0	1	2	6
44	Having management stability	0	0	2	2	4
45	Creating coordination between different departments of management	0	1	2	1	6
46	Creating an operational competition of intelligence among managers	0	1	1	6	2
47	Existence of regulatory norms in operational policies	7	2	1	0	0
48	Financial maturity and budget	0	2	1	7	0
49	Quality and credibility of resources	0	0	2	7	1
50	Education and resource development	0	0	2	4	3
51	Data management and analysis	0	1	9	0	0
52	Content management	0	2	1	0	7
53	Cooperation and communication with other institutions	0	0	1	6	3

54	Accountability and monitoring	0	0	4	5	1
55	Having standard smart equipment	0	0	5	5	0
56	Having the right framework in the field of technology	0	0	6	4	0
57	Necessary standards for digital content production	0	0	0	0	10
58	Attention to processing and software infrastructure	0	0	2	8	0
59	Attention to the organization of computer networks	0	3	7	0	0
60	Attention to computing technologies	0	4	6	0	0
61	Monitoring and continuous technical support	0	2	4	4	0
62	Attention to the technical infrastructure in the digital library	0	0	2	2	6
63	The presence of devices such as Holons	0	0	2	2	6
64	Designing a graphic world outside of physical reality	0	2	1	1	6
65	interactive and finally authentication technologies	0	1	4	4	1
66	Pay attention to the update	0	0	1	7	2
67	Access to virtual reality headsets	0	0	2	4	4
68	Having virtual reality smart glasses	0	0	2	3	5
69	Having national and international high-speed internet	0	0	1	6	3
70	Ability to search and discover	0	4	4	0	0
71	Virtual reality (VR) and augmented reality (AR)	1	1	2	2	4
72	User interaction level	1	0	2	4	3
73	Expandability	2	3	5	0	0
74	User interface design	0	1	1	2	6
75	Technical support	0	0	1	2	7

Table 6 shows the number of experts' opinions on research indicators. To fuzzify the numbers, we first convert them into fuzzy numbers according to Table 1, then semi-fuzzy points are obtained based on relations 2-3 to 4-3, and then semi-fuzzy to definite numbers by relation 5-4. The results of all fuzzification calculations in the first stage of Delphi are given in Table 7.

In this research, the threshold value of 0.7 is considered, and the results indicate the important indicators that are given in Table 7 of the important results.

Table 7. *Results of the first stage of fuzzy Delphi*

Components	Fuzzy average			Definite average	Status
High costs of smart hardware and software equipment	0.425	0.650	0.825	0.633	Rejection
Access to fees for the implementation of Metaverse plans	0.525	0.775	0.875	0.725	Confirmation
Access to the costs of artificial intelligence-based systems	0.300	0.525	0.725	0.517	Rejection
The cost of high-speed internet	0.525	0.750	0.850	0.708	Confirmation
Operating expenses	0.425	0.675	0.925	0.675	Rejection
Employment and employment	0.325	0.525	0.700	0.517	Rejection
Financial innovations	0.550	0.775	0.850	0.725	Confirmation
Analysis of financial flows	0.175	0.400	0.650	0.408	Rejection
Match structure in exchanges	0.025	0.200	0.450	0.225	Rejection
Financial incentives	0.475	0.725	0.875	0.692	Rejection
Monetization in Metaverse by library	0.525	0.750	0.825	0.700	Confirmation
Metaverse implementation costs	0.475	0.700	0.875	0.683	Rejection
Social interaction	0.475	0.725	0.950	0.717	Confirmation
User experience	0.500	0.725	0.825	0.683	Rejection
Attention to intellectual property	0.550	0.800	0.875	0.742	Confirmation
Attention to cataloging	0.600	0.850	0.950	0.800	Confirmation
User support	0.500	0.725	0.850	0.692	Rejection
Optimal access and sharing of information	0.525	0.750	0.850	0.708	Confirmation
Creativity and innovation	0.475	0.725	0.950	0.717	Confirmation
A sense of psychological security	0.550	0.775	0.850	0.725	Confirmation
Education	0.600	0.850	0.925	0.792	Confirmation
entertainment	0.650	0.900	0.975	0.842	Confirmation
accessibility	0.650	0.900	0.975	0.842	Confirmation
personalization	0.100	0.250	0.500	0.283	Rejection
Motivation and participation	0.375	0.625	0.875	0.625	Rejection
sense of presence	0.450	0.700	0.950	0.700	Confirmation
User satisfaction	0.475	0.650	0.750	0.625	Rejection
Flexibility	0.325	0.575	0.775	0.558	Rejection
Creating legal regulations	0.450	0.700	0.800	0.650	Rejection
The role of governments and institutions on the content of digital libraries in Metaverse	0.450	0.700	0.950	0.700	Confirmation
Creating optimal rules for the implementation of Metaverse	0.450	0.700	0.950	0.700	Confirmation

Strict government regulations in the technology sector	0.550	0.800	0.900	0.750	Confirmation
Protection of intellectual property rights	0.600	0.850	0.925	0.792	Confirmation
Diversity and inclusion	0.500	0.750	1.000	0.750	Confirmation
Avatars and their legal challenges	0.650	0.900	1.000	0.850	Confirmation
Privacy protection	0.750	1.000	1.000	0.917	Confirmation
Confidentiality of information	0.650	0.900	0.975	0.842	Confirmation
Data security	0.475	0.725	0.925	0.708	Confirmation
Information protection and security	0.000	0.175	0.425	0.200	Rejection
Political promotion and education	0.450	0.700	0.900	0.683	Rejection
Using technologies by management to make decisions	0.150	0.400	0.650	0.400	Rejection
Strengthening the technical knowledge of managers	0.375	0.625	0.850	0.617	Rejection
Gathering information and statistics	0.575	0.800	0.900	0.758	Confirmation
Having management stability	0.600	0.850	0.950	0.800	Confirmation
Creating coordination between different departments of management	0.550	0.800	0.900	0.750	Confirmation
Creating an operational competition of intelligence among managers	0.475	0.725	0.925	0.708	Confirmation
Existence of regulatory norms in operational policies	0.025	0.100	0.350	0.158	Rejection
Financial maturity and budget	0.375	0.625	0.875	0.625	Rejection
Quality and credibility of resources	0.475	0.725	0.950	0.717	Confirmation
Education and resource development	0.475	0.700	0.850	0.675	Rejection
Data management and analysis	0.225	0.475	0.725	0.475	Rejection
Content management	0.550	0.800	0.875	0.742	Confirmation
Cooperation and communication with other institutions	0.550	0.800	0.975	0.775	Confirmation
Accountability and monitoring	0.425	0.675	0.900	0.667	Rejection
Having standard smart equipment	0.375	0.625	0.875	0625	rejection
Having the right framework in the field of technology	0.350	0.600	0.850	0.600	Rejection
Necessary standards for digital content production	0.750	1.000	1.000	0.917	Confirmation
Attention to processing and software infrastructure	0.450	0.700	0.950	0.700	Confirmation
Attention to the organization of computer networks	0.175	0.425	0.675	0.425	rejection
Attention to computing technologies	0.150	0.400	0.650	0.400	rejection
Monitoring and continuous technical support	0.300	0.550	0.800	0.550	rejection
Attention to the technical infrastructure in the digital library	0.600	0.850	0.950	0.800	Confirmation
The presence of devices such as Holons	0.600	0.850	0.950	0.800	Confirmation
Designing a graphic world outside of physical reality	0.525	0.775	0.875	0.725	Confirmation
interactive and finally authentication technologies	0.375	0.625	0.850	0.617	Rejection
Pay attention to the update	0.525	0.775	0.975	0.758	Confirmation
Access to virtual reality headsets	0.550	0.800	0.950	0.767	Confirmation
Having virtual reality smart glasses	0.575	0.825	0.950	0.783	Confirmation
Having national and international high-speed internet	0.550	0.800	0.975	0.775	Confirmation
Ability to search and discover	0.100	0.300	0.550	0.317	Rejection
Virtual reality (VR) and augmented reality (AR)	0.450	0.675	0.825	0.650	Rejection
User interaction level	0.475	0.700	0.875	0.683	Rejection
Expandability	0.125	0.325	0.575	0.342	Rejection
User interface design	0.575	0.825	0.925	0.775	Confirmation
Technical support	0.650	0.900	0.975	0.842	Confirmation

The results of the second phase of fuzzy Delphi

In this stage, the questionnaire of the first stage of Delphi along with the indicators that were extracted from the opinions of the experts were designed in a new questionnaire and provided to the experts. Also, in this round, the definitive average of the first round was also placed so that the experts could the average of each index in the previous step should also be known. The results of the second stage of fuzzy Delphi are given in Table 8. In this round, the fuzzy average scores are calculated in a similar way using relations 1-4 to 3-4, and definite scores are calculated by relation 4-4.

Table 8. *The results of the second round are fuzzy*

Components	Fuzzy average of the second stage			The definitive average of the first round	The definitive average of the second round	Difference	Status
Access to fees for the implementation of Metaverse plans	0.925	0.825	0.575	0.725	0.850	0.075	Confirmation
The cost of high-speed internet	0.900	0.825	0.600	0.708	0.838	0.063	Confirmation
Financial innovations	0.925	0.850	0.600	0.725	0.858	0.067	Confirmation
Monetization in Metaverse by library	0.925	0.850	0.600	0.700	0.858	0.067	Confirmation
Social interaction	0.875	0.650	0.425	0.717	0.763	0.113	Rejection
Attention to intellectual property	0.875	0.800	0.550	0.742	0.808	0.067	Confirmation
Attention to cataloging	0.950	0.850	0.600	0.800	0.875	0.075	Confirmation
Optimal access and sharing of information	0.925	0.825	0.575	0.708	0.850	0.075	Confirmation
Creativity and innovation	0.650	0.425	0.275	0.717	0.550	0.100	Rejection
A sense of psychological security	0.925	0.850	0.600	0.725	0.858	0.067	Confirmation
Education	0.925	0.850	0.600	0.792	0.858	0.067	Confirmation
entertainment	0.975	0.900	0.650	0.842	0.908	0.067	Confirmation
Access to fees for the implementation of Metaverse plans	0.975	0.900	0.650	0.842	0.908	1.750	Confirmation
The cost of high-speed internet	0.725	0.475	0.300	0.700	0.613	0.113	Rejection
Financial innovations	0.875	0.650	0.400	0.700	0.758	0.117	Rejection
Monetization in Metaverse by library	0.950	0.750	0.500	0.700	0.842	1.575	Confirmation
Social interaction	0.500	0.275	0.150	0.750	0.404	0.713	Rejection
Attention to intellectual property	0.925	0.850	0.600	0.792	0.858	0.067	Confirmation
Attention to cataloging	0.450	0.225	0.125	0.750	0.358	0.092	Rejection
Optimal access and sharing of information	1.000	0.900	0.650	0.850	0.925	1.775	Confirmation
Creativity and innovation	0.975	0.900	0.650	0.917	0.908	0.067	Confirmation
A sense of psychological security	0.975	0.900	0.650	0.842	0.908	1.750	Confirmation
Education	0.650	0.425	0.175	0.708	0.533	0.11	Rejection
entertainment	0.475	0.250	0.150	0.758	0.383	0.092	Rejection
accessibility	0.500	0.275	0.150	0.800	0.404	0.096	Rejection
sense of presence	0.900	0.800	0.550	0.750	0.825	0.075	Confirmation
The role of governments and institutions on the content of digital libraries in Metaverse	0.925	0.725	0.475	0.708	0.817	0.108	Confirmation
Creating optimal rules for the implementation of Metaverse	0.350	0.100	0.000	0.717	0.250	0.100	Rejection
Strict government regulations in the technology sector	0.875	0.800	0.550	0.742	0.808	0.067	Confirmation
Protection of intellectual property rights	0.975	0.800	0.550	0.775	0.875	0.100	Confirmation
Diversity and inclusion	0.975	0.900	0.650	0.917	0.908	0.067	Confirmation
Avatars and their legal challenges	0.925	0.675	0.425	0.700	0.800	0.125	Rejection
Privacy protection	0.775	0.525	0.275	0.800	0.650	0.125	Rejection
Confidentiality of information	0.950	0.850	0.600	0.800	0.875	0.075	Confirmation
Data security	0.875	0.775	0.525	0.725	0.800	0.075	Confirmation
Gathering information and statistics	0.975	0.775	0.525	0.758	0.867	0.108	Confirmation
Having management stability	0.950	0.800	0.550	0.767	0.858	0.092	Confirmation
Creating coordination between different departments of management	0.950	0.825	0.575	0.783	0.867	0.083	Confirmation
Creating an operational competition of intelligence among managers	0.500	0.275	0.150	0.775	0.404	0.096	Rejection

Quality and credibility of resources	0.925	0.825	0.575	0.775	0.850	0.075	Confirmation
Content management	0.975	0.900	0.650	0.842	0.908	0.067	Confirmation
Cooperation and communication with other institutions	0.925	0.825	0.575	0.725	0.850	0.075	Confirmation
Necessary standards for digital content production	0.900	0.825	0.600	0.708	0.838	0.063	Confirmation
Attention to processing and software infrastructure	0.925	0.850	0.600	0.725	0.858	0.067	Confirmation
Attention to the technical infrastructure in the digital library	0.925	0.850	0.600	0.700	0.858	0.067	Confirmation
The presence of devices such as Holons	0.875	0.650	0.425	0.717	0.763	0.113	Rejection
Designing a graphic world outside of physical reality	0.875	0.800	0.550	0.742	0.808	0.067	Confirmation
Pay attention to the update	0.950	0.850	0.600	0.800	0.875	0.075	Confirmation
Access to virtual reality headsets	0.925	0.825	0.575	0.708	0.850	0.075	Confirmation
Having virtual reality smart glasses	0.650	0.425	0.275	0.717	0.550	0.100	Rejection
Having national and international high-speed internet	0.925	0.850	0.600	0.725	0.858	0.067	Confirmation
User interface design	0.925	0.850	0.600	0.792	0.858	0.067	Confirmation
Technical support	0.975	0.900	0.650	0.842	0.908	0.067	Confirmation

In Table 8, the fuzzy and definitive mean of the second phase of fuzzy Delphi is given. Also, in this step, the difference between the definite mean of the second and the first phase is also given. According to Cheng Lin and his colleagues, if the difference between the two stages of polling is less than a very small threshold (0.1), the polling process is stopped, that is, we have reached a consensus (Cheng and Lin, 2002). Table 8 shows that the average difference is less than 0.1 in most of the indicators extracted from the literature review, so we have reached a consensus that the results can be seen in Table 9.

Table 9. *Consensus results of experts in the field of digital library indicators in the Metaverse environment*

Dimension	Component	Fuzzy average			Definite average	Status
Economic	Access to fees for the implementation of Metaverse plans	0.575	0.825	0.575	0.775	Confirmation
	The cost of high-speed internet	0.600	0.825	0.600	0.775	Confirmation
	Financial innovations	0.600	0.850	0.600	0.792	Confirmation
	Monetization in Metaverse by library	0.600	0.850	0.600	0.792	Confirmation
Human	Attention to intellectual property	0.550	0.800	0.875	0.742	Confirmation
	Attention to cataloging	0.600	0.850	0.950	0.800	Confirmation
	Optimal access and sharing of information	0.575	0.825	0.925	0.775	Confirmation
	A sense of psychological security	0.600	0.850	0.925	0.792	Confirmation
	Education	0.600	0.850	0.925	0.792	Confirmation
	entertainment	0.650	0.900	0.975	0.842	Confirmation
Political	Creating optimal rules for the implementation of Metaverse	0.500	0.750	0.950	0.733	Confirmation
	Protection of intellectual property rights	0/600	0.850	0.925	0.792	Confirmation
	Avatars and their legal challenges	0.650	0.900	1.000	0.850	Confirmation
	Privacy protection	0.650	0.900	0.975	0.842	Confirmation
	Confidentiality of information	0.650	0.900	0.975	0.842	Confirmation
Managerial	Creating coordination between different departments of management	0.900	0.800	0.550	0.750	Confirmation
	Creating an operational competition of intelligence among managers	0.925	0.725	0.475	0.708	Confirmation
	Content management	0.875	0.800	0.550	0.742	Confirmation
	Cooperation and communication with other institutions	0.975	0.800	0.550	0.775	Confirmation
Technology	Necessary standards for digital content production	0.975	0.900	0.650	0.842	Confirmation
	The presence of devices such as Holons	0.950	0.850	0/600	0.800	Confirmation
	Designing a graphic world outside of physical reality	0.875	0.775	0.525	0.725	Confirmation
	Pay attention to the update	0.975	0.775	0.525	0.758	Confirmation

	Access to virtual reality headsets	0.950	0.800	0.550	0.767	Confirmation
	Having virtual reality smart glasses	0.950	0.825	0.575	0.783	Confirmation
	User interface design	0.925	0.825	0.575	0.775	Confirmation
	Technical support	0.975	0.900	0.650	0.842	Confirmation

As can be seen in Table 9, the average difference of all indicators in the first and second stage of fuzzy Delphi is less than 0.1, which shows that we have reached a consensus in this section as well. Also, most of the research indicators that have been confirmed in the first and second round of Delphi have an average higher than a very low range (Mousavi et al., 2015), which is usually considered to be 0.3. So, 5 dimensions and 28 indicators have been confirmed and selected as digital library indicators in the Metaverse environment.

Discussion

Digital libraries are a collection of electronic resources and technical facilities related to them to produce information, search and use it. Digital libraries ideally have an attitude to the entire library resources and do not consider the form and format of that information; And several users can use a specific resource at the same time. The biggest advantage of digital books compared to paper books is their volume and portability, and they require little space. It is also possible to retrieve and save information and to use it easily anywhere in the world. The purpose of digital libraries in general is to collect, store, organize and disseminate information and knowledge in digital formats.

Digital libraries are expanding due to ease of use. Digital information has a unique nature that should be decided upon considering all the existing conditions of your organization and library. And by making resources available to people and maintaining and protecting the global collection of knowledge and creativity for the future generation, creating access facilities to a wide extent to a wide range of cultural and historical documents and cooperation in education and lifelong learning, among other ideal goals. The plan is to create digital libraries. In fact, the presence of metaverse in digital libraries has profound and far-reaching effects that include changes in the way information resources are accessed, interacted with, and used. The metaverse is an environment that allows users today to easily enter virtual environments similar to physical libraries, study halls, or even science-fiction worlds. In fact, instead of browsing digital pages linearly, users interact with resources in new ways, such as watching related videos or even entering educational simulations. In fact, Metaverse allows users from any geographic location to access library resources without limitations. Physical or geographic access. In other words, users interact with others in virtual spaces, especially for group projects or scientific discussions, these interactions take place in various forms including virtual meetings, educational workshops, or specialized discussions. Therefore, the current research was conducted with the aim of identifying digital library indicators in the Metaverse environment. Therefore, first, 75 indicators were identified through background reviews and interviews with experts in the field of metaverse, digital libraries, information science and epistemology, and information technology engineering. These indicators were screened by distributing a questionnaire among experts and using the Delphi method, and 28 indicators were selected for the final analysis. This research was categorized by considering 5 dimensions including economic, human, political, managerial, and technological dimensions. Based on the obtained scores, 9 components including avatars and its legal challenges, privacy protection, confidentiality of information,

entertainment, accessibility, technical support, necessary standards for digital content production, existence of HoloLens devices and attention to cataloging were the most important.

The economic category is considered one of the important categories of the Metaverse and digital libraries. Because it plays an important role in setting up digital libraries in the Metaverse environment. Based on the results of the current research, four indicators were identified. Which is: access to the cost to implement Metaverse plans, the cost of high-speed Internet, financial innovations and income generation in Metaverse by the library. Therefore, launching and implementing Metaverse projects requires significant initial investment. These costs include the development of software, hardware, and technical support, which is of great importance for digital libraries that are planning to enter the Metaverse environment, funding for these types of investments. In particular, the costs related to the purchase and maintenance of new technologies and the hiring of specialized labor influence the decision on the implementation of Metaverse projects. And high-speed Internet access is one of the basic requirements for the effective use of Metaverse. Without high-speed Internet, users may face problems such as delays and reduced quality of experience. For the presence of digital libraries in the Metaverse, this means costs for upgrading the communication infrastructure, which affects the overall budget of the project. Therefore, it is important to pay attention to the economic costs related to the Internet as one of the components. Financial innovations in digital libraries in the cloud environment include new economic models and financial solutions that help reduce costs and improve productivity. These innovations may include new payment methods, decentralized financial models, or crowdfunding systems. Using these innovations, digital libraries reduce the costs related to the implementation and maintenance of Metaverse projects and attract financial resources. And finally, income generation is one of the key aspects in the evaluation of Metors projects. Digital libraries generate income by providing services and resources to individuals in the Metaverse, through various income generation models such as advertising, and content sales. Evaluation and analysis and the amount of income generation helps to justify economic projects and make decisions about investment in this area. Overall, the economics of digital libraries in a cloud environment is related to a combination of initial costs, the need for communication infrastructure, financial innovations, and monetization strategies. Understanding and managing these factors will help the success of Metaverse projects and their economic sustainability.

Another category that was investigated in this research is human indicators. In this research, the human dimension is one of the categories that should be looked at in a special way. In fact, with the arrival of new technologies and turning them into a mass of equipment and devices, the role of human power as a vital and strategic factor in the survival of any organization is clearly evident.

The results of this research showed that 7 human indicators were approved by the experts, such as: entertainment, accessibility, attention to intellectual property, attention to cataloging, access and sharing of information, feeling of psychological security and education. Therefore, digital libraries in the Metaverse environment, the aspect of entertainment and attractive interactions for users is of special importance. For digital libraries, creating interactive and fun experiences will attract and retain users and help them better interact with library content. This human dimension has an impact on improving the user experience and

the satisfaction of users Accessibility is one of the critical indicators that ensure that all users, including people with special needs, can access the resources and services of digital libraries.

The design and implementation of digital libraries in the Metaverse environment should be such that users with different limitations can use it easily. Paying attention to this index helps to reduce digital inequalities and improve access justice. By entering the world of digital libraries and metaverse, issues related to intellectual property and authors' rights are especially raised. Digital libraries should pay attention to the observance of intellectual property rights and formulate policies for the management and protection of digital works and content. Paying attention to these legal and ethical aspects creates trust among authors and content producers.

Cataloging and organizing information is essential for optimal use of digital resources. Paying attention to this index helps to effectively manage data and information and facilitates access to resources. Accurate and updated cataloging helps users to easily and quickly access the information they need. Providing easy and effective access and sharing of information is one of the main goals of digital libraries. This index means creating platforms for exchanging knowledge and information efficiently and without obstacles. Improving access and information sharing can be effective in improving productivity and collaboration among users. Creating an environment where users feel psychologically safe is of great importance, especially in the world of digital libraries that may be associated with threats and concerns. Digital libraries must ensure that users feel secure in using their resources and services and are protected from cyber threats and privacy violations. Training and empowering users to optimally use digital technologies and resources is another important human indicator. Continuous training of users and library personnel in various areas such as using digital tools, information management, and maintaining information security helps improve productivity and reduce technology-related problems.

In general, the human indicators identified in this research show the importance of different dimensions of human interactions with new technologies and metaverse. Paying attention to these indicators helps to create a positive, fair and safe experience for users and adds to the success and sustainability of digital library projects in the Metaverse environment.

The political indicators of the digital library in the metaverse environment in the current research are: creating favorable laws for the implementation of the metaverse, maintaining intellectual property rights, avatars and its legal challenges, maintaining privacy and confidentiality of information. It is very important to create appropriate rules and regulations for the management and implementation of Metaverse projects. Desirable laws should comprehensively and accurately regulate the implementation of metaverse technologies in digital libraries and ensure that all activities and interactions in this environment are done properly and in accordance with legal standards. These laws include the determination of responsibilities, legal frameworks, and enforcement policies that should be considered especially in the context of digital resource management, user interactions, and economic activities in the metaverse. The intellectual property rights of digital libraries are a critical issue in the metaverse environment.

Due to the fact that digital libraries in the metaverse deal with a large amount of digital content and data, the protection of intellectual property rights, including authorship and publication rights, is very important. Laws and policies related to intellectual property rights should specifically address the protection of digital works, the prevention of copyrights, the

management of licenses, and the use of rights related to the consideration of content. The use of avatars in digital libraries in a secure environment, where the users are in this environment, is associated with legal challenges. These challenges may include issues of identity, legal liability arising from the behavior of avatars, and maintaining the personal and commercial rights associated with these users. Laws of rights and responsibilities for avatars and solutions to the challenges related to their rights require the formulation of specific policies and laws to the legal and ethical problems associated with the use of avatars for proper management. Keeping the privacy and security of digital library information in the metaverse is a critical issue, especially considering that in this environment, users' personal and professional information is being widely exchanged and stored. Appropriate laws and policies should effectively protect user privacy, prevent unauthorized access to information, and ensure data confidentiality. These rules should include security and privacy protocols, measures to protect user data, and strategies for managing and responding to security and privacy breaches. Finally, the political indicators examined in the current research refer to different legal and policy dimensions in the metaverse environment. Paying attention to these indicators is essential for the success and sustainability of digital libraries in this environment, because they ensure that digital activities are carried out in compliance with legal and ethical principles and that the rights of users and content producers are properly protected.

In digital libraries, one of the important issues and actually affecting the progress of the goals and perspectives set in the library is its managerial role. Therefore, the management indicators of the digital library in the metaverse environment in the current research include: creating coordination between different departments of management, creating operational competition of intelligence among managers, content management, cooperation and communication with other institutions, which have been approved by experts. Effective coordination between different departments of digital library management in the Metaverse environment is of particular importance. Due to the complexities of technology and the need for continuous interactions, the metaverse environment requires careful coordination between different departments such as information technology, content management, technical support, and human resources. Establishing coordination helps to reduce the problems caused by lack of agreements and conflicts between departments and leads to more productivity and providing more optimal services to users. Clear policies and protocols for interdepartmental coordination and communication effectively contribute to more efficient management and better realization of organizational goals. Healthy and intelligent competition among administrators helps improve performance and innovation in digital library management.

This competition should be done in principle and based on certain criteria in order to prevent the creation of a negative competitive environment and, instead, to increase the motivation to improve the quality of services and productivity. The use of new technologies and intelligent management strategies help managers to respond more effectively to the challenges of the metaverse environment and optimize processes. Effective content management is critical in digital libraries, especially in the metaverse environment. This includes organizing, maintaining, and accessing digital resources. Content management should be set up so that digital content is up-to-date, accessible and tailored to users' needs. This requires advanced management tools and clear policies for categorization, indexing,

and content quality assurance. Also, special attention should be paid to updating and managing content changes in the Metaverse environment. Effective collaboration and communication with various institutions, including other libraries, academic organizations, and public and private institutions, helps to improve the services and resources of digital libraries. These collaborations include exchanging information, sharing resources, and collaborating on research and educational projects. Strong communication and interorganizational collaborations have helped to increase access to more resources and improve the quality of services, and are effective in better realizing the goals and visions of digital libraries in the metaverse environment. In general, the management indicators identified in this research emphasize the importance of creating an efficient management structure, healthy competition, effective content management, and interorganizational cooperation in digital libraries. Paying attention to these indicators will help to realize the goals and advance the prospects of digital libraries in the complex and developing environment of the metaverse, and is the basis for their success and sustainability in this new environment.

The new world of digital technology affects people's lives in different ways. In fact, the technological indicators of the digital library in the environment in the current research are based on the terms: standards necessary for digital production, the existence of devices such as Helons, user interface design, technical support, attention to updating, design The graphic world outside of reality, access to virtual reality headsets, having virtual reality smart glasses, which are approved by experts. For the success of digital libraries in the turbulent environment, compliance with the standards for digital production is one of the important things that are known. These standards include formats, quality, and compliance with technical requirements and the use of digital libraries in a secure environment. These standards help to ensure the quality and compatibility of digital libraries and provide a better experience.

Also, these standards will help the exchange and use of content among different platforms. Advanced devices such as HoloLens, which provide augmented reality (AR) and virtual reality (VR), play an important role in the communication and provision of digital library services in the metaverse. These devices help the users of digital libraries to interact with different environments more attractively and actively. The existence and use of these technologies in digital libraries is effective in increasing the quality and variety of user experience and provides new possibilities for interacting with digital content. The design of the user interface (UI) of digital libraries in the Metaverse environment should be such that it optimizes the user experience and makes access to resources and services simple and convenient. UI design should take into account the needs of users and the specific characteristics of the metaverse environment and include visual elements, user interactions, and organizing information in a user-friendly way. The user interface will reduce problems and increase user satisfaction. Strong and effective technical support is critical for digital libraries in a metaverse environment. This includes support services for solving technical problems, user guidance, and technical systems' management. Technical support assures users that their problems are resolved quickly and efficiently, helping to reduce disruptions and increase user satisfaction. Regular updating and updating of content and technologies used in digital libraries is of great importance.

Up-to-date content and technologies help to improve the quality of services and prevent resources from becoming obsolete. This includes updating software, upgrading technical systems, and adding new and relevant content. The design of the graphic environment of digital libraries in Metaverse should be done creatively and attractively to provide an immersive and attractive experience for users. The design of the graphic world should take advantage of Metaverse's capabilities to create visual and interactive experiences and give users the feeling of being in a new and innovative digital space. Access to virtual reality (VR) headsets is necessary for digital libraries to interact with the metaverse environment. These headsets allow users to fully and realistically interact with the content of digital libraries and gain an immersive experience of the Metaverse environment.

As a result, providing users with access to these devices helps increase their engagement and satisfaction. Virtual reality smart glasses allow users to simultaneously interact with digital libraries and the information contained therein. These glasses should have features such as high resolution, ease of use, and interactive features to provide a better user experience. The use of these technologies are effective in improving the quality of user interactions in the Metaverse environment. Finally, the technological indicators identified in this research emphasize the importance of using advanced technologies and appropriate standards in the design and management of digital libraries in the metaverse environment.

Conclusion

The presence of digital libraries in the cloud environment significantly changes the way of providing services, interacting with users, and managing resources. These quality changes are aimed at improving performance, enhancing services, and overall improving the performance of digital libraries in this new world. In fact, in the Metaverse environment, digital libraries are permanently available and allow users to access the resources they need at any time and from any place without time and place limitations. It is also suggested that researchers analyze the needs of users of digital libraries in environmental metaverses, review and analyze technical standards and digital libraries in environmental metaverses, and evaluate social and cultural impacts on digital libraries.

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