

A Content Analysis of the Metaverse Articles

Nida Gökçe Narin
Muğla Sıtkı Koçman University
Department of Statistics
Muğla, Turkey
gnida@mu.edu.tr
0000-0002-4840-5408

Abstract— Metaverse, which was first defined as fictional about 20 years ago, refers to a virtual universe where people feel entirely mentally with engaged augmented virtual reality devices today. The first applications of metaverse were computer games consisting of virtual worlds. Gaming companies were racing to offer more unique experiences to their users. With social media giants and big technology companies announcing the metaverse as the future of the internet, it started to attract the attention of the wider masses. The concept of metaverse has been the subject of academic studies in many different fields, from literature to art, from music to education over the years. In this review article, a total of 40 journal articles containing the "metaverse" keyword in all fields in the Web of Science database were examined in terms of content and method. The outputs of this study provide a piece of brief information about the research area to both researchers and technology developers.

Keywords—metaverse, content analysis, second life, virtual worlds

I. INTRODUCTION

The metaverse, first described in author Neal Stephenson's novel "Snow Crash" published in 1992, has become a concept used to describe 3D (three-dimensional), VWs (virtual worlds) in which people interact with each other and their environment without the physical limitations of the real world. The first metaverse was CitySpace [1], which was active from 1993-1996. Subsequently, numerous metaverses such as Active Worlds [2] and There (www.there.com) emerged. The most popular of these was Second Life (SL, www.secondlife.com), developed by Linden Lab in 2003. With SL, the doors of the web-based VWs were opened to game enthusiasts. SL promised its users a second world where they can create their own avatars and determine all features of them, the limits of which depend only on one's imagination. In this world, a person could socialize, buy real estate, design, and even realize all kinds of fiction, up to university education. SL created its own economy, even had the Linden Dollar currency. Moreover, the Swedish government opened an embassy in SL, where many cities, universities, artists, and individuals created virtual assets.

In the game world, the examples of metaverses such as Roblox (www.roblox.com), Sandbox (www.sandbox.game), Fortnite (epicgames.com/fortnite) are increasing day by day. However, with the press release of Marc Zuckerberg in which he announced that he changed the company name to Meta, wider audiences began to explore what the metaverse is [3]. As of October 2021, according to google trend reports, there has been a severe increase of searches on Metaverse in the google search engine. Considering the importance of social media, especially for the Z generation, investments in the metaverse are shaping the technology of the future. While

talking about the future metaverses, it is also necessary to examine the academic studies on the metaverse in the last 20 years. For this purpose, academic journal articles containing the keyword metaverse in the Web of Science (WoS) were examined in terms of scope and method in this survey. Proceedings, books, and other works are ignored. In the search carried out in all fields, 48 journal articles containing metaverse keywords were found. When these articles were examined in terms of method and scope, it was determined that 40 of them were suitable for the study. The aim of this study is to provide a projection to the researchers by making a detailed analysis of the articles.

The following section introduces the research method and contains general information about the publication years of the articles, within the scope of the research, the journals in which they were published, and the research areas. Section 3 briefly introduces the selected papers in chronological order from the past to the present in terms of scope and method. Section 4, where discussion and findings are given, classifies the articles as content. Section 5 ends with a discussion of the implications, main limitations, and contributions for researchers who will work in this field.

II. METHOD

A. Google Trend

After Marc Zuckerberg's press release, the increased interest in the metaverse is seen in Google Trend data [4]. In Fig. 1, the graph of the weekly values of YouTube and Google searches in the last year is given. In October 2021, there was a significant increase in metaverse searches on both YouTube and Google. Furthermore, it is observed that there was a jump in YouTube searches in April as well.

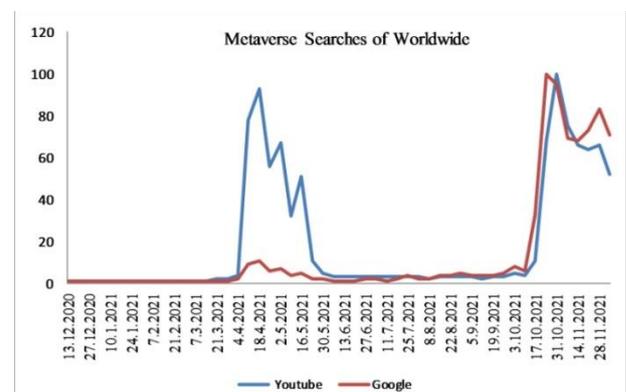


Fig. 1. The number of Metaverse searches performed on Youtube and Google in the last year with Google trend [4].

Narin N.G.

- The metaverse itself
- Humans/avatars in the metaverse
- Technology capabilities in the metaverse
- The behavior of avatars in the metaverse
- The outputs of the metaverse

They also explored how the concepts of communication, creation, interaction, and team process could expand the metaverse [9]. Bourlakis et al. [10] examined the effects of product and service marketing and specifically retailing in the online VW where individuals and organizations operate. They presented a comparative study of traditional store retailing, e-retailing, and metaverse retailing. They drew attention to many essential questions, such as: Which criteria do retail in the virtual world? Which regulatory agency will oversee product pricing? Whether virtual currencies used in metaverse retailing be converted to real currency? Tasa and Görgülü [11] explained what meta-art is and discussed whether the metaverse will be a new art medium in the future. They stated that the collective and connecting nature of the Internet could be used to connect avatars and create a space attached to other levels of reality. As a result, they argued that for art to be local in the metaverse with its form, content, and creative process, art must be context dependent [11]. Brennen and Dela Cerna [12] examined the effects of journalism in a virtual environment and how the relationship between real life and SL influences and shapes news content. In addition, the Alphaville Herald, Metaverse Messenger, and SL newspapers developed in VR were evaluated, and some implications were made for future journalism applications. Ayiter [13] analyzed 'alpha.tribe', an experimental avatar group establishing a virtual fashion business in SL. In the research, the author, a designer, and an art educator brought together five avatars of both human and non-human genders in a design initiative to create a design that follows the creation line of each virtual personality [13].

Han et al. [14] created a 3D user interface for the home automation system in VR. They explained the necessary protocols for the relationships between the metaverse client, metaverse server, and home server. They showed that home devices could be monitored and controlled over the internet from anywhere and anytime via this interface [14]. Owens et al. [15] examined how metaverse technology capabilities interact with the social and technical aspects of virtual teams, how metaverse capabilities differ from other collaboration technologies, and how these capabilities affect virtual projects. Lee et al. [16] studied the innovative and reflective effects of metaverse services used to express services such as life logging, mirror world, AR, and VWs. To measure the acceptability of Twitter, Google, iPhone, and SL products, IP traffic, and iPhone sales volume data of "twitter.com," "maps.google.com," "secondlife.com" addresses from the first quarter of 2008 to the last quarter of 2009 were collected. They modeled the data with the Bass model based on time series. They showed that each service gives different innovation and reflection coefficient values and that the reflection effects are higher than the innovation effects for all metaverse services [16]. Leone [17] examined the relations between the religious dimensions of the first life and the second life in terms of

sociology and psychology of religion. The study showed that, based on a six-month "virtual" ethno-semiotic participatory observation, digital places of worship revealed five main characteristics: isolation, prototypicality, didacticity, anarchy, and parasitism [17].

Arroyo et al. [18] explored the possibilities of using meta bots with mobility capabilities in complex VWs. They also built a learning model based on techniques used in evolutionary computing to optimize fuzzy controllers to be used by meta bots to move around in a virtual environment [18]. Cameron [19] examined the concept of philosophers' islands as a literary and philosophical metaphor. The author argues that "utopic" islands provide a fictional field of experimentation to form "real" state spaces. In the study, he examined the concepts of Utopia, Endotopia, and Xenotopia in detail from a similar perspective. Dionisio et al. [20] examined the issues required to move from a set of independent virtual worlds to an integrated network of virtual worlds, or the metaverse, that creates an alternative space for human sociocultural interaction. In particular, they drew attention to (1) realism, (2) ubiquity, (3) interoperability, and (4) scalability, which are considered central components of a valid metaverse [20].

Crespo et al. [21] analyzed educational virtual environment applications and the dissemination of knowledge in the form of free courses in the metaverse. They performed a simulation that checked the properties of objects created in the metaverse with GNU tools. In particular, they showed the importance of implementing OpenSim in some engineering fields. They also used the ARIMA model to estimate server load due to access by students who might want to take online courses and showed that the model produced acceptable results [21]. Hassouneh and Brengman [22] examined 27 virtual stores in SL and proposed a virtual store typology based on atmospheric classifications. In addition, the study provides a framework for investigating the shopper behavior in the virtual store environment and the factors affecting the performance of metaverse retailers [22]. Villalba [23] studied SL as an example of cultural interaction through virtual worlds and explored the reasons for declining interest in SL. He first examined the technology factor but came to the conclusion that it was not very decisive. The author concluded that the inability to classify SL as just a game or social media reduces users' interest, and they turn to more real platforms where users can interact with their acquaintances. In the article, reasons such as the embodiment of the flaws and problems of real society in the utopic elements produced in SL, the lack of story, the difficulty in finding others, and the lack of eroticism were cited as causing the alienation of users. However, it was predicted that these problems would be resolved soon, and the way of user interaction in SL could be reorganized [23].

Romero et al. [24] highlighted the arts and examined how SL could pave the way for the creative process in many areas. The article showed that in SL, an artist could act as a curator, theorist, critic, collector, producer, and art publisher as he is in reality. Vaca Barahona et al. [25] examined students' communication, interaction, and collaboration in virtual learning environments where 3D simulations were integrated. The article discussed the

interaction between the participant and the 3D object and the interaction that develops among the participants as an interaction that encourages students to learn. Martín [26] examined whether personal interaction through virtual environments enhances collective creativity. The article discussed the metaverse environment effects, in which a different symbolic connection is formed among the participants, on creativity, with an Avatar Orchestra example. It has been determined that environments where participants do not have face-to-face contact and where there are no barriers such as age, ethnicity, and geographical diversity in the physical world are suitable environments that encourage collective creativity [26]. Pinchuk et al. [27] examined the problems of synthetic learning environments in the metaverse. The article analyzed new learning environments based on information and communication technologies. In addition, they discussed game-based learning based on the simulation of the actual physical world and the combined use of social networks with a "synthetic environment" [27]. Choi and Kim [28] presented a virtual museum experience by connecting a pointer placed in an actual space exhibition hall to an HMD (head-mounted display). Metaverse, which is a combination of AR and VWs, diversified the user experience about the features and stories of the works in the museum with the content of the exhibition.

Ayiter [29] discussed the transformation of a small 3D artwork created in the meta-universe inspired by Jorge Luis Borges' story Aleph. The author philosophically redefined Aleph as a time machine for avatars. Jaramillo-Mujica et al. [30], in their articles on education in Metaverse, presented the idea of designing and applying education in the 3D environment to Physics Engineering students. The study explains the development, conceptualization, and implementation stages of scenarios on the OpenSim platform, which is expressed with a virtual classroom in Moodle. Nevelsteen [31] described a "virtual world" that uses grounded theory to be applied directly to technology. The resulting definition was compared with related studies and used to classify advanced technologies such as persistent video game, MANet, virtual and mixed reality, and metaverse. As a result, the study includes a breakdown of the features that distinguish the various technologies from each other. It also presents an ontology showing the relationship between complementary terms and abbreviations [31]. Zhou et al. [32] discussed virtual world ownership and income generation in the virtual world. They examined the concept of ownership in the metaverse under two headings: content ownership and virtual platform ownership. The study collected data from real court case files, discussion boards, expert comments, interviews, news, and blogs. The findings suggest that the intrinsic interdependencies of content and platform ownership need to be addressed separately as they pose significant challenges for entrepreneurs.

Ayiter [33] discussed the following questions linking Marc Augé's concepts of 'place/non-place' and Gaston Bachelard's 'poetic space' to the avatar of real-time, continuous, online, three-dimensional virtual worlds as metaverses: *"Are metaverses 'places' or 'non-places'? Do we really live in the metaverse, or do we go through this*

world in the sense that Marc Augé describes them as transition loci assigned only to limited and specific locations? [33]". Díaz [34] discussed virtual worlds in higher education and innovations in the teaching-learning process in the metaverse. In the study, a virtual world was developed as a digital tool to provide teaching support to Cundinamarca University System Engineering Faculty students and teachers. The study, which aims to facilitate and make the access of students and teachers to information inside and outside the classroom flexible, explains the integration of developing technology with hybrid and mobile learning models. Diaz et al. [35] dealt with the design, development, and implementation of a virtual or metaverse world in an educational environment within the scope of Scrum methodology. In addition, access to synchronous and asynchronous information provides an alternative way of transmitting and acquiring knowledge through technological tools. Designed to resemble a real university for Systems Engineering Faculty students, the metaverse considers hybrid and mobile learning models that change with the inverted and collaborative classroom. Murray [36] positioned VR as a medium that evolves media traditions to support continuous interaction and immersion, rather than thinking of virtual reality as a magic technology. He introduced VR not as an inevitable and misleading metaverse but as a representational environment that always requires active belief creation.

George Reyes [37] analyzed the perceptions of upper-middle-level students at a private educational institution in Mexico regarding the development of teaching strategies using augmented reality based on the metaverse mobile application. One hundred ninety-two first-term students attending the Mathematics Fundamentals course participated in the research in the period of August-December 2018. The research was carried out using a digital questionnaire. The results showed that the application of augmented reality in mathematics teaching significantly increased student performance. Estudante and Dietrich [38] developed a mobile AR application to use escape games in education. In the study, a scenario was proposed that directs students to follow the footsteps of Belgian Physicist Ernest Solvay to improve students' motivation and communication skills. According to this scenario, participants discover a secret room in Brussels that contains Solvay's secrets through riddles. AR escape games can be easily applied to crowded classrooms without any teacher and without any systematic preparation. The advantages and limitations of such tools are discussed in the study. It has been shown that the proposed approach is effective in increasing motivation in the trials in which the students participated.

Jun [39] studied religious activities in the metaverse. With the development of augmented reality and virtual reality technologies, virtual reality churches began to be created to fulfill the missions and duties of churches in the virtual world. Although virtual reality churches have new mission boundaries in the digital age, the article addresses theological issues from the perspective of traditional church ministry and mission. Siyaev and Jo [40] introduced a metaverse environment for Boeing-737 aircraft maintenance training and education, including legacy manuals, 3D models, 3D simulators, and aircraft

maintenance information. It uses Neuro-Symbolic Speech Executor (NSSE), which is different from traditional speech recognition methods, as a speech comprehension module. NSSE uses Neuro-Symbolic AI, which combines neural networks and conventional symbolic reasoning to understand users' requests and respond based on context and aircraft-specific information. Synthetic data were used for training the model. The model's performance was realized with automatic speech recognition metrics on the data of real users. As a result, it has been shown that the model can generalize with an average accuracy of 94.7% and a word error rate (WER) of 7.5%. [40].

Siyaev and Jo [41] discussed Boeing 737 maintenance training by using digital twin and mixed reality technologies in the metaverse. A realistic training environment is suggested for trainee engineers in the study. This environment allows controlling planes by maintaining social distance through virtual assets and voice commands, especially during the pandemic. In the study, a convolutional neural network (CNN) was used for voice recognition. Command recognition and language recognition performance of the CNN model trained for English and Korean languages were found to be 95.7% and 99.6%, respectively, according to the F1-Score metric [41]. Park et al. [42] investigated the differences in learning motivation among different types of players. The study was conducted on 91 university students who were instructed to attend a classroom using gamification. In the study, it is stated that creating environments where all kinds of players can create their own game experiences, rules and strategies is an important factor in gamification design. As a result of the research, it was determined that gamification is effective on motivation, but there is no significant difference in motivation between player types [42].

Bolger's [43] work focused on the evolutionary integration described by Teilhard/Delio while guided by Bevens' five (early) contextualization models. The contextual integration method provides ways to see, embrace, communicate, complicate and create in the metaverse. The author explored the nature of the metaverse in the first half of the article. He discussed these insights in the second half, after collecting insights from the dialogue between contextual theology and culture in the first half [43]. Park et al. [44] focused on identifying the factors that can affect the user's social perception (likeness, familiarity, attractiveness, liking, and participation) of personalized virtual avatars designed by considering the user's facial features. In this study, the researchers showed that the avatars with familiar facial expressions of the participants looked more like the participants and gave a more familiar feeling than the others. The study of Heo et al. [45] proposed a new AR-based system for traditional sport climbing training. With this method, where an instructor shows the positions of the hands and feet one by one, the climbing movements and stances of a novice athlete are spontaneously demonstrated to the student with a character animation on an artificial climbing structure. In addition, in this system, the student can choose the route he wants to learn and can study many times without the help of the instructor. Research results showed that AR support for climbing is as effective as the traditional teaching method [45].

IV. DISCUSSION AND FINDINGS

This review article is designed to provide a projection for researchers who want to do academic studies in the metaverse field. Metaverse is used synonymously with VWs or SL in many studies. However, this study only includes journal articles filtered by the keyword "metaverse" in the WoS database. Some of the studies defined the basic concepts and features of VWs, and some discussed the metaverse's sociological and philosophical effects. In addition, applications based on 3D, AR, VR, and mixed reality have also been developed in different work areas over the last 20 years. The articles were examined in terms of method and content, and the findings were discussed in this section.

A. Focus on Methods

The articles were examined in terms of methodology except those published to introduce conceptual structures and technologies and explore sociological, philosophical, and cultural aspects. The methods used, especially in education and engineering, are given in Figure 6 in the form of a tree graph.

In these studies, together with 3D, AR, VR technologies, GNU[21], OpenSim [21,30], Moodle [30], Minitab 18 [37], Microsoft Excel Pro 365 ProPlus [37] and Neuro-Symbolic Speech Executor [40] tools have been used.

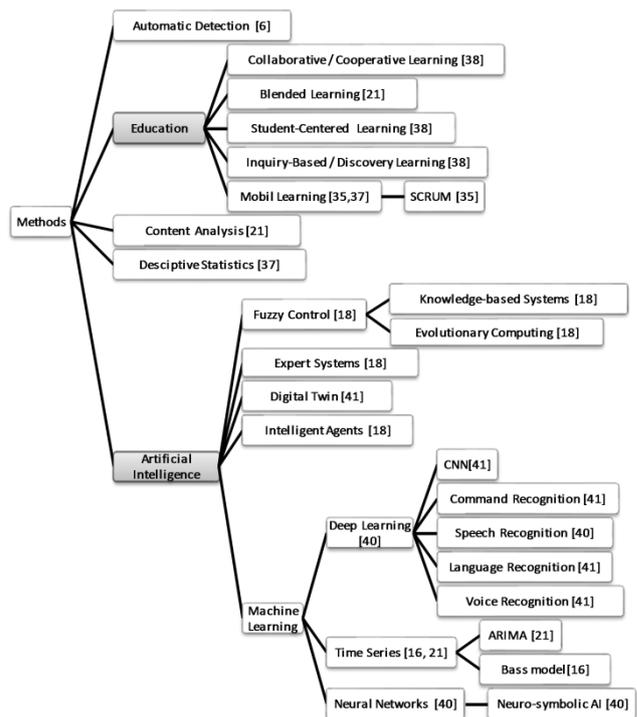


Fig. 6. Methods used in the studies

While different learning methods are used in metaverse research in education, it is seen that other artificial intelligence (AI) based methods are mostly used. While studies focused on design at first, in parallel with technological developments, it turned to developing new methods to provide users with realistic experiences in the virtual world. In this sense, more personal data and the preferences and tastes of users have begun to come to the fore. The prominence of AI methods, especially in studies

conducted in recent years, gives an important clue for the future of metaverse studies. Combining AR, VR technologies with AI is predicted to improve the quality of personalized applications in VWs.

TABLE I. CLASSIFICATION OF ARTICLES ON METAVERSE

Classification of Articles on Metaverse		
ID	Titles	Years
Education		
[26]	Use of ARIMA mathematical analysis to model the implementation of expert system courses by means of free software OpenSim and Sloodle platforms in virtual university campuses	2013
[30]	The communication in simulated learning environments	2016
[32]	Synthetic educational environment-a footpace to new education.	2017
[35]	An experience using metaverses for teaching mechanical physics to engineering students	2017
[39]	Virtual world as a complement to hybrid and mobile learning	2020
[40]	Virtual World as a Resource for Hybrid Education	2020
[42]	Perception of high school students about using Metaverse in augmented reality learning experiences in mathematics	2020
[43]	Using augmented reality to stimulate students and diffuse escape game activities to larger audiences	2020
[45]	Neuro-Symbolic Speech Understanding in Aircraft Maintenance Metaverse	2021
[46]	Aircraft Maintenance Metaverse Using Speech Interactions with Virtual Objects in Mixed Reality	2021
[47]	Differences in Learning Motivation among Bartle's Player Types and Measures for the Delivery of Sustainable Gameful Experiences	2021
[50]	Effect of Augmented Reality Affordance on Motor Performance: In the Sport Climbing.	2021
Definition and Properties		
[11]	Rapidly deployable multiprojector immersive displays	2005
[14]	Avatars, people, and virtual worlds: Foundations for research in metaverses	2009
[20]	An empirical investigation of virtual world projects and metaverse technology capabilities	2011
[21]	Innovation and imitation effects in Metaverse service adoption	2011
[23]	Adaptive fuzzy knowledge - based systems for control metabots' mobility on virtual environments	2011
[25]	3D virtual worlds and the metaverse: Current status and future possibilities	2013
[29]	New artistic behaviors in "Second Life"	2016
[36]	Virtual world, defined from a technological perspective and applied to video games, mixed reality, and the Metaverse	2018
[41]	Virtual/reality: how to tell the difference	2020
Art on Metaverse		
[16]	Meta-art: art of the 3-D user-created virtual worlds	2010
[18]	alpha. tribe	2010
[24]	Splendid isolation:'Philosopher's islands' and the reimagination of space	2012
[29]	New artistic behaviors in "Second Life"	2016

Classification of Articles on Metaverse		
ID	Titles	Years
Education		
[31]	Social and psychological impact of musical collective creative processes in virtual environments; The Avatar Orchestra Metaverse in Second Life	2018
[33]	A content service deployment plan for metaverse museum exhibitions—Centering on the combination of beacons and HMDs	2017
[34]	Building a (virtual) aleph: the visual transformation of a tiny cosmogony	2017
[38]	Spatial poetics, place, non-place and storyworlds: Intimate spaces for metaverse avatars.	2019
Game		
[12]	Making real money in virtual worlds: MMORPGs and emerging business opportunities, challenges and ethical implications in metaverses	2008
[13]	Second life and the new generation of virtual worlds	2008
[43]	Using augmented reality to stimulate students and diffuse escape game activities to larger audiences	2020
[47]	Differences in Learning Motivation among Bartle's Player Types and Measures for the Delivery of Sustainable Gameful Experiences	2021
Religion		
[22]	The semiotics of religious space in Second Life	2011
[44]	Virtual reality church as a new mission frontier in the metaverse: Exploring theological controversies and misional potential of virtual reality church	2020
[48]	Finding Wholes in the Metaverse: Posthuman Mystics as Agents of Evolutionary Contextualization	2021
Cultural Simulation		
[28]	Cultural simulation through virtual worlds. The case of Second Life: an approach to the representation, narrative and rhetorical potential in the new media cultures	2015
[49]	Individual's Social Perception of Virtual Avatars Embodied with Their Habitual Facial Expressions and Facial Appearance	2021
Retailing / Virtual Merchandising		
[15]	Retail spatial evolution: paving the way from traditional to metaverse retailing. Electronic Commerce Research	2009
[27]	Retailing in social virtual worlds: developing a typology of virtual store atmospherics.	2015
Misc		
[17]	Journalism in Second Life	2010
[19]	User-friendly home automation based on 3D virtual world	2010
[37]	Ownership in the virtual world and the implications for long-term user innovation success	2018

B. Focus on Content

The articles discussed within the scope of the research were divided into seven different classes according to their application areas and similarities with content analysis. These groups are listed in Table 1 according to the number of publications.

The articles that were not included in any other group were gathered under a single title. It has been observed that most publications in the literature are in the field of education in the metaverse. In order to design a learning process in which students are actively involved by modeling learning-teaching processes in virtual environments, applications for mathematics [42], engineering education [39], climbing training in sports

Narin N.G.

[50], and the maintenance and control of Boeing 737s have been developed. In addition, there is a study that introduces the virtual campus application [26] together with the studies in which the gamification [43,47] approach is used in education.

Articles that focus on the concept of a metaverse in general and introduce the features and technologies required for designing the metaverse are classified under the title of metaverse definition and characteristics. After education, the most studied private field has been art. In this group, which is discussed under the heading of art in the metaverse, there are studies on literature and philosophy [18,24,34,38] that explain 3D designs in the virtual world [16,29], examining an avatar orchestra [31], and presenting a virtual museum experience [33].

Although there are many metaverse applications in the game world today, only four articles have examined the subject of pure gaming. These are studies promoting online multi-user games [12] and the popular game Second Life [13] and blending education and game in a gamification approach in education [43,47]. The perception of the metaverse as a second life gave birth to the concept of religious activities and belief in the SL. There are three articles dealing with the idea of religion in the metaverse. In other studies, the metaverse through simulations [28,49], retailing in the virtual world [15,27], journalism in the second life [17], home automation in the virtual world [19], and ownership and revenue management in the metaverse [37] have been examined.

V. CONCLUSION AND RECOMMENDATIONS

The metaverse, designed as a simulation of the natural world, covers all areas related to humans and society and offers a suitable working platform for researchers in all fields, from health to sports, from education to art. This research deals with the scientific aspect of metaverse studies and examines academic studies. Most of the studies in the literature have explained the concept of the metaverse. Some have fictionally examined the education, art, religion, and socio-cultural interactions in the metaverse, and some have realized metaverse applications in certain areas. This study examined academic studies conducted parallel with technological developments such as 3D, AR, and VR in the last 20 years. It has been observed that the implemented applications are mainly at the prototype level. However, these studies, which make significant contributions to the literature in terms of design and editing, have a high potential to be realized when sufficient technical infrastructure is provided.

With the Covid 19 pandemic, people have to stay at home and perform many activities in digital environments, which has accelerated the digitalization process. Recent investments by media giants and some large companies in the metaverse have been seen as a vital sign that the internet will take on a new dimension. The new internet design is planned to be developed to support a permanent digital world where thousands and millions of people can act simultaneously and switch between different platforms. However, problems such as the management of energy resources and equipment products that will support the necessary infrastructure need to be overcome.

The AR/VR technologies, online multi-player games, digital virtual twins, and blockchain applications, which are components of the metaverse, have been actively used for a while. Furthermore, technological developments that allow the purchase and sale of non-Fungible Token (NFT)-based artworks, souvenirs, and lands, which have been very popular lately, show that the promised universe is one step closer. However, for this fictional universe to be fully realized, 5G technology needs to come into play, AR/VR hardware and content should become widespread, and the use of peer2peer technologies should increase.

When the metaverse is brought to life as it was designed, it will be possible to perform many daily activities such as working, traveling, shopping, going to school, having fun by creating a 3d avatar in a digital universe. Any change users make in the metaverse will be permanently visible to almost everyone, thus providing users with greater identity and continuity of experience. The socio-cultural and psychological effects of these changes will also be a subject to be studied. The metaverse becoming a reality will support and transform existing research topics and reveal new research areas. In addition, this digital universe will be a big data source with the data it will produce. Therefore, it will also provide a suitable working platform for big data, data science, and artificial intelligence researchers. With the development of the technological infrastructure and the interest of researchers in this field, it is expected that the number of scientific studies in the area will increase, and richer content will emerge soon. All these developments herald an exciting future.

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