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What Is Metaverse?—A Definition Based on Qualitative Meta-Synthesis

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Abstract: The term Metaverse has received much attention in various industries, in society, and, increasingly, in scientific communities. This creates demand for a comprehensive and broadly accepted definition of the subject, which is well grounded in research. At the same time, the Metaverse is rather a vision under evolution than an examinable phenomenon. Therefore, this study applied an adapted version of the meta-synthesis method to analyze the existing literature and distill a proposal for a Metaverse definition. The adapted method takes the nature of the subject into account by weighing younger publications with many citations over older, less influential documents. Initially, 47 publications were fed into the process, of which 24 were left after the primary analysis. As a result of the analysis, the following definition is proposed: "The Metaverse is an interconnected web of ubiquitous virtual worlds partly overlapping with and enhancing the physical world. These virtual worlds enable users represented by avatars to connect and interact with each other, to experience and consume user-generated content in an immersive, scalable, synchronous and persistent environment. An economic system provides incentives for contributing to the Metaverse." The meta-synthesis method ensures a systematic and reproducible approach while at the same time preserving the original voice and notion of the analyzed literature in order to create new knowledge based on the existing literature; thus the proposed Metaverse definition might serve as a helpful foundation for future research.

Keywords: metaverse; virtual world; definition; meta-synthesis; literature survey

1. Introduction

Since Neal Stephenson coined the term Metaverse in his novel Snow Crash [1], the idea of the next iteration of the internet [2] has received increasing attention. Google Trends showed significantly increasing interest in the term since the end of 2021, when Facebook rebranded to Meta [3], as can be seen in Figure 1. Likewise, the number of scientific publications related to the Metaverse soared. Analyzing the publications listed in the Web of Science database that include the term "Metaverse" in any field reveals this steep increase. In 2020, six, and in 2021, 32 publications were listed, whereas from January to August 2022, 158 documents were found.

Despite the huge interest and of its first appearance in fiction some 30 years ago, the Metaverse is still considered to be in its infancy. As Matthew Ball, a prominent Metaverse thinker stated: " . . . it is too early to know exactly what a "day in the life" might look and feel like, when the Metaverse arrives." Along these lines, he emphasized the need to focus on the technologies and features comprising the Metaverse [4]. The Metaverse is often described as the next iteration of the internet after the fixed-line internet of the 1990s, the social net of the 2000s, and the mobile internet [2]. It is not a replacement of the aforementioned but the extension of them to a ubiquitous, persistent, and immersive digital layer adding to our physical world.
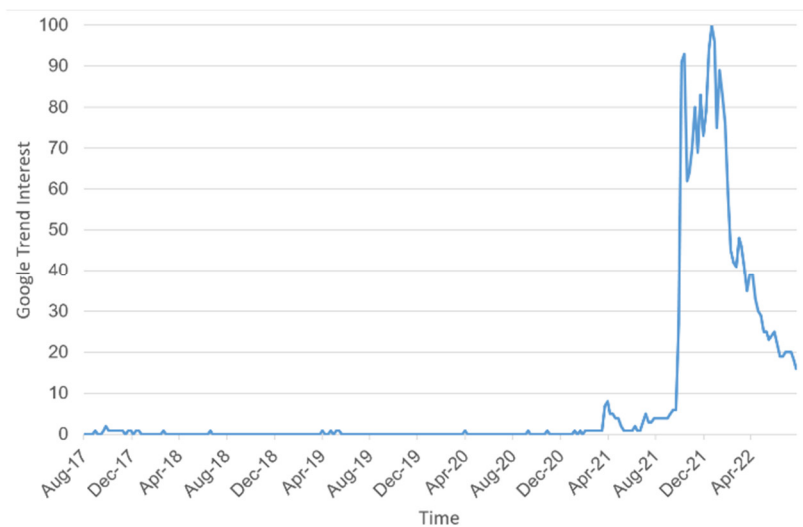
Figure 1. Search volume for "Metaverse" over time (own diagram based on data from Google Trends retrieved 18 August 2022).

Retail is already entering the Metaverse. Hoping to create new levels of shopping experiences, various fashion brands opened stores in virtual worlds [5]. The entertainment industry is experimenting with concerts in the Metaverse [6], and industrial companies are building virtual production lines to simulate physical plants. These digital twins are industry's take on the Metaverse [7].

Despite the aforementioned description of the Metaverse, a commonly accepted scientific definition is currently not available. It is difficult to define future phenomena, and to many practitioners, it might seem meaningless to put effort into a clear and concise definition. However, as the body of knowledge related to the Metaverse is growing quickly and the discussions in scientific communities deepen, a broadly accepted definition is crucial to foster communication between scientists working on a shared topic [8].

This article proposes a definition for the term Metaverse, which could serve as a basis for scientific endeavors exploring this new realm. Recently, various definitions have been presented in scientific and non-scientific publications. This study aims at including both in one common approach. Most probably, this definition will be outdated after a while. Nevertheless, for the time being, it will have a positive effect.

In order to tie the named definition to the state of science, a survey of scientific publications from the Web of Science and Google Scholar has been conducted. The results from this survey were then fed into a consolidation process applying an adapted qualitative meta-synthesis method [9].

This paper presents the applied meta-synthesis method in Section 2. The intermediate results from the first process steps are explicated in detail in Section 3 before the results are explained and tied to the underlying literature in Section 4. Finally, the discussion is included in Section 5.

2. Adapted Qualitative Meta-Synthesis Method

The meta-synthesis method aims to combine the qualitative results from several studies in a manner that is systematic and reproducible. It uncovers new knowledge instead of just reviewing the existing literature [9].

The meta-synthesis method comprises the following process steps [9]:

1. Conducting the primary search: Identify sources, e.g., articles or papers, to be included in the study.
2. Primary Analysis: Determine the documents fitting the research scope.
3. Coding "Within case analysis": Identify the themes or topics exemplifying the main ideas.

4. Synthesis "Cross case analysis": Identify the commonalities in themes and topics across the various documents.

5. Presenting results: The presentation of the results should have a rather narrative style, not just present quantitative data.

In this study, the method outlined above has been adapted by introducing an additional step after step 3. The vision of the Metaverse and its understanding have evolved since the term first appeared in the literature in the 1990s. Because the subject of this research is a vision for the future rather than being defined by natural law, it is reasonable to take the time of the publication of the individual literature sources into account. Furthermore, the analyzed sources do not seem to all have the same influence on the scientific discussion on the Metaverse. Thus, it is reasonable to adapt the qualitative meta-synthesis method and introduce a weighting factor. Further details on the calculation of this weight will be presented in Section 3.

3. Intermediate Results

This chapter is organized along the process steps explained in Section 2, except for the last step, "Presenting results", which can be found in Section 4. The results of each process step are presented and explained.

3.1. Primary Search—Data Collection

For the identification of the sources to be included in the study, Noah [9] recommends including additional sources of articles and papers as soon as data saturation on one database is reached. This should not be limited to academic journals.

The publications included in this study were found on the Web of Science (retrieved on 18 August 2022) and Google Scholar (retrieved on 12 July 2022). In both databases, "metaverse definition" was used as a search term without any additional filters. This provided a large number of results in Google Scholar. The first 40 results of this search were included for the next step of the analysis, as saturation seemed to be reached with this number of results. This was further confirmed by the observation that the overall weight calculated in Section 3.3 decreases significantly for higher search results. While the first five results in Google Scholar [10–14] have a combined weight of 55.2, the same value for search results No. 36 to 40 [15–19] is only eight. The search on the Web of Science provided a total of nine results, four of which were also comprised in the Google Scholar results.

In addition, two non-academic publications authored by influential Metaverse thinkers—Matthew Ball and John Coogan—were included. This is in line with the aim of the meta-synthesis method to provide comprehensive results [9]. An overview of the 47 publications covered in this survey is presented in Table 1.

Table 1. List of publications initially included in the qualitative meta-synthesis. For Google Scholar the sequence reflects the respective search result rank.

Reference	Authors	Title	Year of Publication	Source	Reason for Exclusion
[10]	Nevelsteen, Kim J. L.	Virtual world, defined from a technological perspective and applied to video games, mixed reality, and the Metaverse	2018	Google Scholar, Web of Science	
[11]	Mystakidis, Stylianos	Metaverse	2022	Google Scholar	

Table 1. *Cont.*

Reference	Authors	Title	Year of Publication	Source	Reason for Exclusion
[12]	Narin, Nida Gökçe	A Content Analysis of the Metaverse Articles	2021	Google Scholar	No own definition included
[13]	Kim, Jooyoung	Advertising in the Metaverse: Research Agenda	2021	Google Scholar	No own definition included
[14]	Hwang, Gwo-Jen; Chien, Shu-Yun	Definition, roles, and potential research issues of the metaverse in education: An artificial intelligence perspective	2022	Google Scholar	
[20]	Duan, Haihan; Li, Jiaye; Fan, Sizheng; Lin, Zhonghao; Wu, Xiao; Cai, Wie	Metaverse for social good: A university campus prototype	2021	Google Scholar	No own definition included
[21]	Park, Sang-Min; Kim, Young-Gab	A Metaverse: Taxonomy, Components, Applications, and Open Challenges	2022	Google Scholar, Web of Science	No own definition included
[22]	Dionisio, John David N.; III, William G. Burns; Gilbert, Richard	3D Virtual worlds and the metaverse	2013	Google Scholar	
[23]	Davis, Alanah; Murphy, John; Owens, Dawn; Khazanchi, Deepak; Zigurs, Ilze	Avatars, People, and Virtual Worlds: Foundations for Research in Metaverses	2009	Google Scholar	
[24]	Cheng, Ruizhi; Wu, Nan; Chen, Songqing; Han, Bo	Will Metaverse be NextG Internet? Vision, Hype, and Reality	2022	Google Scholar	
[25]	Hollensen, Svend; Kotler, Philip; Opresnik, Marc Oliver	Metaverse—the new marketing universe	2022	Google Scholar	
[26]	Kye, Bokyung; Han, Nara; Kim, Eunji; Park, Yeonjeong; Jo, Soyoung	Educational applications of metaverse: possibilities and limitations	2021	Google Scholar	No own definition included
[27]	Song, Stephen W.; Chung, Dong-Hun	Explication and rational conceptualization of metaverse	2021	Google Scholar	No own definition included
[28]	Kozinets, Robert V.	Immersive netnography: a novel method for service experience research in virtual reality, augmented reality and metaverse contexts	2022	Google Scholar, Web of Science	
[29]	Lim, Wei Yang Bryan; Xiong, Zehui; Niyato, Dusit; Cao, Xianbin; Miao, Chunyan; Sun, Sumei; Yang, Qiang	Realizing the Metaverse with Edge Intelligence: A Match Made in Heaven	2022	Google Scholar	

Table 1. *Cont.*

Reference	Authors	Title	Year of Publication	Source	Reason for Exclusion
[30]	Shen, Bingqing; Tan, Weiming; Guo, Jingzhi; Zhao, Linshuang; Qin, Peng	How to Promote User Purchase in Metaverse? A Systematic Literature Review on Consumer Behavior Research and Virtual Commerce Application Design	2021	Google Scholar	
[31]	Akour, Iman A.; Al-Maroof, Rana Saeed; Alfaisal, Raghad; Salloum, Said A	A conceptual framework for determining metaverse adoption in higher institutions of gulf area: An empirical study using hybrid SEM-ANN approach	2022	Google Scholar	
[32]	van der Merwe, David Frederick	The metaverse as virtual heterotopia	2021	Google Scholar	No own definition included
[33]	Mozumder, Md Ariful Islam; Sheeraz, Muhammad Mohsan; Athar, Ali; Aich, Satyabrata; Kim, Hee-Cheol	Overview: Technology Roadmap of the Future Trend of Metaverse based on IoT, Blockchain, AI Technique, and Medical Domain Metaverse Activity	2022	Google Scholar	
[34]	Kraus, Sascha; Kanbach, Dominik K.; Krysta, Peter M.; Steinhoff, Maurice M.; Tomini, Nino	Facebook and the creation of the metaverse: radical business model innovation or incremental transformation	2022	Google Scholar	No own definition included
[35]	Ning, Huansheng; Wang, Hang; Lin, Yujia; Wang, Wenxi; Dhelim, Sahraoui; Farha, Fadi et al.	A Survey on Metaverse: the State-of-the-art, Technologies, Applications, and Challenges	2021	Google Scholar	
[36]	Damar, Muhammet	Metaverse Shape of Your Life for Future: A bibliometric snapshot	2021	Google Scholar	
[37]	Jeon, Joo-Eon	The Effects of User Experience-Based Design Innovativeness on User-Metaverse Platform Channel Relationships in South Korea	2021	Google Scholar	No own definition included
[38]	Vidal-Tomás, David	The new crypto niche: NFTs, play-to-earn, and metaverse tokens	2022	Google Scholar	
[39]	Lee, Un-Kon; Kim, Hyekyung	UTAUT in Metaverse: An "Ifland" Case	2022	Google Scholar, Web of Science	No own definition included
[40]	Collins, Chris	Looking to the future: Higher education in the Metaverse	2008	Google Scholar	No own definition included
[41]	Han, Yue; Niyato, Dusit; Leung, Cyril; Miao, Chunyan; Kim, Dong	A Dynamic Resource Allocation Framework for Synchronizing Metaverse with IoT Service and Data	2021	Google Scholar	No own definition included

Table 1. *Cont.*

Reference	Authors	Title	Year of Publication	Source	Reason for Exclusion
[42]	Pamucar, Dragan; Deveci, Muhammet; Gokasar, Ilgin; Tavana, Madjid; Köppen, Mario	A metaverse assessment model for sustainable transportation using ordinal priority approach and Aczel-Alsina norms	2022	Google Scholar	No own definition included
[43]	Lee, Lik-Hang; Braud, Tristan; Zhou, Pengyuan; Wang, Lin; Xu, Dianlei; Lin, Zijun et al.	All One Needs to Know about Metaverse: A Complete Survey on Technological Singularity, Virtual Ecosystem, and Research Agenda	2021	Google Scholar	
[44]	Lombardi, Julian; Lombardi, Marilyn	Opening the Metaverse. In: Online Worlds: Convergence of the Real and the Virtual	2010	Google Scholar	Book Chapter not accessible
[45]	Wiederhold, Brenda K.	Ready (or Not) Player One: Initial Musings on the Metaverse	2022	Google Scholar	No own definition included
[46]	Shin, Donghee	The actualization of meta affordances: Conceptualizing affordance actualization in the metaverse games	2022	Google Scholar	Book Chapter not accessible
[47]	Fang, Zhixin; Cai, Libai; Wang, Gang	MetaHuman Creator The starting point of the metaverse	2021	Google Scholar	
[48]	Baía Reis, António; Ashmore, Mark	From video streaming to virtual reality worlds: an academic, reflective, and creative study on live theatre and performance in the metaverse	2022	Google Scholar	Paper not accessible
[49]	Wang, Yuntao; Su, Zhou; Zhang, Ning; Liu, Dongxiao; Xing, Rui; Luan, Tom H.; Shen, Xuemin	A Survey on Metaverse: Fundamentals, Security, and Privacy	2022	Google Scholar	
[19]	Chen, Donghua; Zhang, Runtong	Exploring Research Trends of Emerging Technologies in Health Metaverse	2022	Google Scholar	
[18]	Tlili, Ahmed; Huang, Ronghuai; Shehata, Boulus; Liu, Dejian; Zhao, Jialu; Metwally, Ahmed Hosny Saleh et al.	Is Metaverse in education a blessing or a curse: a combined content and bibliometric analysis	2022	Google Scholar	
[17]	Seidel, Stefan; Berente, Nicholas; Nickerson, Jeffrey; Yepes, Gregory	Designing the Metaverse	2022	Google Scholar	
[16]	Sriram, Gopala Krishna	A Comprehensive Survey on Metaverse	2022	Google Scholar	No own definition included
[15]	Gokmi, Kim; Jeon, Ju Hyun	A Study on the Copyright Survey for Design Protection in Metaverse Period	2021	Google Scholar	No own definition included

Table 1. *Cont.*

Reference	Authors	Title	Year of Publication	Source	Reason for Exclusion
[50]	Ayiter, Elif	Spatial poetics, place, non-place and storyworlds: Intimate spaces for metaverse avatars	2019	Web of Science	
[51]	Deveci, Muhammet; Pamucar, Dragan; Gokasar, Ilgin; Koppen, Mario; Gupta, Brij B.	Personal Mobility in Metaverse With Autonomous Vehicles Using Q-Rung Orthopair Fuzzy Sets Based OPA-RAFSI Model	2022	Web of Science	No own definition included
[52]	Rauschnabel, Philipp A.; Babin, Barry J.; tom Dieck, M. Claudia; Krey, Nina; Jung, Timothy	What is augmented reality marketing? Its definition, complexity, and future	2022	Web of Science	No own definition included
[53]	Rauschnabel, Philipp A.; Felix, Reto; Hinsch, Chris; Shahab, Hamza; Alt, Florian	What is XR? Towards a Framework for Augmented and Virtual Reality	2022	Web of Science	No own definition included
[54]	Moon, Jaewoong; Kim, Subin; Song, Jaeseung; Kim, Kyungshin	Study on Machine Learning Techniques for Malware Classification and Detection	2021	Web of Science	No own definition included
[4]	Ball, Matthew	The Metaverse: And How it Will Revolutionize Everything	2022	Additionally selected source	
[55]	Coogan, John	You Don't Know the Metaverse . . .	2021	Additionally selected source	

For all of the publications included in further analysis, the number of citations, as seen in Google Scholar, was recorded. For the book authored by Matthew Ball and published in July 2022, citations were already recorded in Google Scholar. This information was retrieved on 26 August 2022. For John Coogans YouTube video, no actual citation information is available. In order to represent the influence of this publication, the number of subscribers to John Coogans YouTube channel (198,000 as of 26 August 2022) and the number of views of the respective video (378,012 as of 26 August 2022) were considered. Taking these figures into account, a virtual number of citations of 10 was estimated and added to the dataset.

3.2. Primary Analysis

The texts were carefully read to determine whether significant definitions for the term Metaverse were included in the publications. This was considered the case if the document included a self-contained definition of the term Metaverse that was not just a full citation of another source. The publications without an included Metaverse definition were excluded from the further analysis process. For example, in the case of a metastudy, just presenting definitions from other publications no own definition was recorded in this process step. This led to the exclusion of such metastudies. However, in such cases, many publications presented in the respective metastudies are included in this survey as original sources. In total, 23 documents were excluded from further analysis, leaving 24 documents in the process. The details can be seen in Table 1.

3.3. Weighing

The characteristic of the research topic required adapting the meta-synthesis method with an additional step. This has already been discussed in Section 2.

In order to take the time since publication and the impact of a document on the scientific discussion into account, a weight was calculated for each document. For the weight (*W*), Formula (1) was applied. While *n* is the total number of citations, in the denominator, the time between the year of the study at hand (2022) and the year of the respective publication (*y*) is calculated. One is added to avoid division by zero for publications dating from 2022

$$W = \frac{n}{2022 - y + 1} \tag{1}$$

The result of the weighing is presented in Table 2.

Table 2. Results after weighing the documents included for further analysis.

Reference	Authors	Title	Year of Publication	No of Citations	Weight
[43]	Lee, Lik-Hang; Braud, Tristan; Zhou, Pengyuan; Wang, Lin; Xu, Dianlei; Lin, Zijun et al.	All One Needs to Know about Metaverse: A Complete Survey on Technological Singularity, Virtual Ecosystem, and Research Agenda	2021	104	52
[11]	Mystakidis, Stylianos	Metaverse	2022	34	34
[23]	Davis, Alanah; Murphy, John; Owens, Dawn; Khazanchi, Deepak; Zigurs, Ilze	Avatars, People, and Virtual Worlds: Foundations for Research in Metaverses	2009	371	26.5
[22]	Dionisio, John David N.; III, William G. Burns; Gilbert, Richard	3D Virtual worlds and the metaverse	2013	235	23.5
[35]	Ning, Huansheng; Wang, Hang; Lin, Yujia; Wang, Wenxi; Dhelim, Sahraoui; Farha, Fadi et al.	A Survey on Metaverse: the State-of-the-art, Technologies, Applications, and Challenges	2021	43	21.5
[29]	Lim, Wei Yang Bryan; Xiong, Zehui; Niyato, Dusit; Cao, Xianbin; Miao, Chunyan; Sun, Sumei; Yang, Qiang	Realizing the Metaverse with Edge Intelligence: A Match Made in Heaven	2022	18	18
[25]	Hollensen, Svend; Kotler, Philip; Opresnik, Marc Oliver	Metaverse–the new marketing universe	2022	17	17
[28]	Kozinets, Robert V.	Immersive netnography: a novel method for service experience research in virtual reality, augmented reality and metaverse contexts	2022	13	13
[14]	Hwang, Gwo-Jen; Chien, Shu-Yun	Definition, roles, and potential research issues of the metaverse in education: An artificial intelligence perspective	2022	12	12
[36]	Damar, Muhammet	Metaverse Shape of Your Life for Future: A bibliometric snapshot	2021	24	12

Table 2. *Cont.*

Reference	Authors	Title	Year of Publication	No of Citations	Weight
[49]	Wang, Yuntao; Su, Zhou; Zhang, Ning; Liu, Dongxiao; Xing, Rui; Luan, Tom H.; Shen, Xuemin	A Survey on Metaverse: Fundamentals, Security, and Privacy	2022	11	11
[10]	Nevelsteen, Kim J. L.	Virtual world, defined from a technological perspective and applied to video games, mixed reality, and the Metaverse	2018	46	9.2
[30]	Shen, Bingqing; Tan, Weiming; Guo, Jingzhi; Zhao, Linshuang; Qin, Peng	How to Promote User Purchase in Metaverse? A Systematic Literature Review on Consumer Behavior Research and Virtual Commerce Application Design	2021	18	9
[38]	Vidal-Tomás, David	The new crypto niche: NFTs, play-to-earn, and metaverse tokens	2022	8	8
[4]	Ball, Matthew	The Metaverse: And How it Will Revolutionize Everything	2022	8	8
[31]	Akour, Iman A.; Al-Maroof, Rana Saeed; Alfaisal, Raghad; Salloum, Said A	A conceptual framework for determining metaverse adoption in higher institutions of gulf area: An empirical study using hybrid SEM-ANN approach	2022	6	6
[33]	Mozumder, Md Ariful Islam; Sheeraz, Muhammad Mohsan; Athar, Ali; Aich, Satyabrata; Kim, Hee-Cheol	Overview: Technology Roadmap of the Future Trend of Metaverse based on IoT, Blockchain, AI Technique, and Medical Domain Metaverse Activity	2022	6	6
[24]	Cheng, Ruizhi; Wu, Nan; Chen, Songqing; Han, Bo	Will Metaverse be NextG Internet? Vision, Hype, and Reality	2022	5	5
[55]	Coogan, John	You Don´t Know the Metaverse . . .	2021	10	5
[47]	Fang, Zhixin; Cai, Libai; Wang, Gang	MetaHuman Creator The starting point of the metaverse	2021	8	4
[19]	Chen, Donghua; Zhang, Runtong	Exploring Research Trends of Emerging Technologies in Health Metaverse	2022	4	4
[17]	Seidel, Stefan; Berente, Nicholas; Nickerson, Jeffrey; Yepes, Gregory	Designing the Metaverse	2022	4	4
[50]	Ayiter, Elif	Spatial poetics, place, non-place and storyworlds: Intimate spaces for metaverse avatars	2019	6	1.5
[18]	Tlili, Ahmed; Huang, Ronghuai; Shehata, Boulus; Liu, Dejian; Zhao, Jialu; Metwally, Ahmed Hosny Saleh et al.	Is Metaverse in education a blessing or a curse: a combined content and bibliometric analysis	2022	0	0

3.4. Coding

The Metaverse definitions were excerpted from the relevant publications. Only these excerpts were compared in an iterative process. This led to a list of key topics, which can be found in the left column "Key Topic" of Table 3.

Table 3. Results after clustering key topics and sorting for the cluster weight.

Key Topic	Cumulated Weight	Cluster Weight
3D virtual world	140.5	
Virtual World—real-world metaphor/simulated environment/computer-generated world/virtual world/mirroring the physical world	155.2	426.2
Facilitated/enabled by XR, AR, VR—fully or partly virtual	130.5	
Immersive Internet	52	
Immersive, Realism	228.5	300
Embodied internet (with the notion of being inside it)	19.5	
Interaction, communication, collaboration activity	214.7	
Next-Gen social **connection**	12	265.2
New internet application	38.5	
Scalability, multiuser, unlimited no of users	141	258.7
Unified/shared/shardless	117.7	
Persistent	159.2	
Perpetual	86	253.2
Continuity of data	8	
Integrating/blending/blurring the virtual world and real world	157.5	
Virtually **enhanced physical** reality and space	6	181.5
Entire digital and virtual world	6	
Recording lifelogging	12	
Interoperability	97	180.5
Interconnected web	83.5	
Several virtual worlds form the metaverse	172.2	172.2
Avatars/agents	127.7	127.7
Concurrent/live/**synchronous**/real-time	105.2	105.2
Economic system		
Self-sustaining	67.5	78.5
Economic governance		
Consistent value system	11	
Ubiquity (accessibility everywhere and device independently)	74	74
User-generated content	55.5	
Various Events/Activities	4	59.5
Open-ended setting/digital culture	23.5	
Mirror image of real world	21.5	
Artificial space in **parallel to physical world**—independent	8	49.7
Hyper spatiotemporal	20.2	

3.5. Synthesis

The qualitative meta-synthesis method aims to leverage existing knowledge to "syn-thethise and create new knowledge" [9]. Thus, the weight of each key topic was used as an important indicator for dominant wording and the impact of specific key topics. However,

at the same time, intuition was applied for the clustering of similar topics. Further details of the procedure are laid out in this chapter.

In the synthesis step of the analysis, the key topics, which resulted from the coding step, were first clustered to find common elements. In order to identify the dominant wording for these elements, the weight was taken into account. This meant that each key topic earned the weight of all documents in which it appeared. These figures were summed up for each key topic and labeled "Cumulated Weight".

Table 3 presents the results of the synthesis step. Key topics surrounded by a solid line represent a cluster. This means that they represent very similar ideas, features, or understanding of the Metaverse. In the column "Cumulated Weight", for each key topic, the sum of all weights is included. These weights originate from the source documents in which the respective key topic appeared. Finally, the right column, "Cluster Weight", contains the sum of the key topic weights for each cluster. Table 3 has been sorted to decrease the "Cluster Weight".

4. Results

The meta-synthesis method aims to keep the voice of the original text alive rather than just calculating abstract data [9]. Following this approach, this chapter first presents two comprehensive and up-to-date definitions from the sources included in this study in order to provide a complete picture of the current status of the scientific discourse. Then the results related to the found key topic clusters, as depicted in Table 3, are explained along with characteristic example citations from impactful sources. Finally, a comprehensive definition is distilled, taking the development over time into account.

4.1. Existing Definitions from Literature

The following definitions are cited from the documents that were included in this study. They exemplify the current status of the scientific discourse.

The article published by Lee et al. in 2021 [43], despite being quite young, reached the highest weight. It does not provide a dedicated Metaverse definition, but the following fragments contribute to a closed picture of the authors' view. In the abstract of their article, they state, "At the core of the metaverse stands the vision of an immersive Internet as a gigantic, unified, persistent, and shared realm." Later they add: "In this paper, we consider the metaverse as a virtual environment blending physical and digital, facilitated by the convergence between the Internet and Web technologies, and Extended Reality (XR)." Finally, they add the following aspects: "The metaverse should own perpetual, shared, concurrent, and 3D virtual spaces that are concatenated into a perceived virtual universe."

Ball's book, published in July 2022, and his previously released so-called Metaverse Primer have been well received and covered by many mainstream media, such as the Financial Times [56] or the Washington Post [57]. Ball contributes the following definition: "The Metaverse is a massively scaled and interoperable network of real-time rendered 3D virtual worlds which can be experienced synchronously and persistently by an effectively unlimited number of users with an individual sense of presence, and with continuity of data, such as identity, history, entitlements, objects, communications, and payments." [4]

4.2. Analysis Results for Key Topic Clusters

In 2009 Davis et al. [23] wrote: "Metaverses are immersive three-dimensional virtual worlds . . . " using the plural of the term Metaverse. However, later in the same article, they write, "A specific instantiation of a metaverse is a virtual world, including what others refer to as virtual spaces or virtual world environments." [23] In their 2021 article, Lee et al. [43] state that the Metaverse is " . . . characterised by perpetual, shared, concurrent, and 3D virtual spaces concatenating into a perceived virtual universe." This clearly emphasizes the notion that there is only one Metaverse comprising many virtual worlds.

Many authors, such as Ball [4], Mystakidis [11], and Coogan [55], underline that these virtual worlds need to be interconnected, making interoperability an important feature of

the Metaverse. Dionisio et al. [22] defined interoperability as " . . . the ability of distinct systems or platforms to exchange information or interact with each other seamlessly and, when possible, transparently. Interoperability also implies some type of consensus or convention which then become standards when formalized." Moreover, in the same article, they come to the conclusion that "interoperability remains a key feature of virtual worlds in its own right, because it is interoperability that puts the capital M in the Metaverse: just as the singular capitalized Internet is borne of layered standards which allow disparate heterogeneous networks and subnetworks to communicate with each other transparently."

Regarding the nature of the Metaverse, Wang et al. [49] wrote in their 2022 article: "Commonly, the metaverse is regarded as a fully immersive, hyper spatiotemporal, and self-sustaining virtual shared space blending the ternary physical, human, and digital worlds." This clarifies that the Metaverse includes a variety of concepts ranging from purely virtual worlds leveraging a real-world metaphor, as Davis et al. [22] framed it, to others overlapping with or mirroring the physical world. For example, Ning et al. [35] emphasize these aspects as they write: "It provides an immersive experience based on augmented reality technology, generates a mirror image of the real world based on digital twin technology, . . . ".

Several documents included in this study comprise the aspect of ubiquity [22,29,35]. Dionisio et al. [22] draw from the understanding that the Metaverse " . . . operates in parallel with the physical domain". This leads to the idea of a virtual or digital layer overlaying the physical world. To realize this, two aspects of ubiquity are required: "ubiquitous availability and access, and ubiquitous persona and presence." [22] While ubiquitous availability relates to the specific requirements towards UI hardware, computing power, and connectivity, does the idea of ubiquitous persona and presence lead to the notion of persistent avatars representing users and their identity. This will be discussed in the following paragraphs.

The idea that users are represented by avatars in the Metaverse can already be found in Stephenson's novel Snow Crash [1]. Many documents in this study explicitly mention this aspect, when explaining the Metaverse [10,14,23–25,29,30,35,38,50].

The aspect of persistence is important, too, and it is not limited to avatars but many other elements of virtual worlds, such as assets, content, or currencies [4,22]. While Ball, in his 2022 book [4], explains: "Some virtual worlds are fully persistent, which means everything that happens inside them is permanent." Dionisio et al. [22] define: "It is persistent. The virtual environment continues to operate even when a particular user is not connected." Furthermore, in his 2021 video, Coogan [55] states, referring to the Metaverse, that persistence means " . . . that it never resets, pauses or ends."

Users are assumed to engage in the Metaverse in order to connect and interact with other users. Hwang et al. [14], for example, write: "In the Metaverse space, people can engage in social activities such as discussing an issue, collaborating on a project, playing games, and learning from experiencing or solving some problems." Shen et al.'s [30] definition of a virtual world includes the following statement: " . . . allowing users represented as avatars to interact with other users and in-world content." extending the scope to in-world content.

As Coogan [55] says in his video referring to user-generated content: "This is basically a requirement, since no single company could ever hope to produce enough variation in their games to satisfy everyone. Roblox and Minecraft have been so successful, because community members create engaging and unique experiences for each other." Furthermore, Ning et al. [35] state that a Metaverse should allow " . . . each user to produce content and edit the world."

Important factors motivating users to contribute to a virtual world are monetary incentives, which require an economic system. This aspect has completed the understanding of the Metaverse only lately. All of the analyzed documents mentioning this aspect were published in 2021 or later. For example, Wang et al. [49], in their 2022 article, defined: "The Metaverse [. . .] is a computer-generated world with a consistent value system and an

independent economic system linked to the physical world." And Coogan [55] makes a prediction saying: "The Metaverse will have a fully functioning economy".

Another important aspect for both users and content creators is that virtual worlds and the Metaverse, as a whole, are immersive. This has been mentioned in more than half of the source documents included for analysis in this study. Mystakidis [11] explains: "Immersion determines the degree that the user feels that s/he is cognitively teleported to an alternative, synthetic world.". He distinguishes socio-psychological immersion, similar to the feeling of being drawn into a movie or a thrilling book, and multimodal immersion, created by technical means to feed sensory channels with optical, acoustic, touch, and other signals.

Contributing least to this immersion are the two other requirements for the Metaverse and the constituting virtual worlds: They must be scalable and real-time synchronous. Ning et al. [35] define scalability as "The ability of the virtual social world to manage computational power in such a way that a large number of users can interact socially in the Metaverse without experiencing disconnections and interruptions in their immersive experience." This includes aspects of handling very large numbers of users concurrently, coping with a large number of very detailed and complex objects and avatar interactions [22]. Moreover, Shen et al. [30] state that virtual worlds are "environments, allowing users [. . .] to interact with other users and in-world content in (nearly) realtime."

4.3. Analysis Result and Definition

The meta-synthesis process provided clustered key topics with clustered weights, providing an indication of the important topics to be considered in a new definition. Reviewing the existing self-contained definitions from the sources included in this study, as well as again reviewing the original sources related to specific key topics, as presented in Section 4.2, led to a well-founded intuition to find the dominant terms for each topic. These dominant terms are printed in bold font in Table 3. In line with Noah's [9] approach to "create new knowledge from existing knowledge", these results were used to propose the following definition for the term Metaverse for future use in scientific discussion:

The Metaverse is an interconnected web of ubiquitous virtual worlds partly overlapping with and enhancing the physical world. These virtual worlds enable users who are represented by avatars to connect and interact with each other, and to experience and consume user-generated content in an immersive, scalable, synchronous, and persistent environment. An economic system provides incentives for contributing to the Metaverse.

5. Discussion

This study aimed to contribute a definition of the term Metaverse that is soundly anchored in the existing body of knowledge. In order to reach this, an established research method has been applied: the meta-synthesis method. Its strength lies in a systematic and reproducible approach, which at the same time incorporates the original literature. This ensures maintaining the voice of the original literature and its notion, thus leading to the aforementioned anchoring. Based on this analysis, the process requires intuition and creativity to create new knowledge: the Metaverse definition is presented in Section 4.3.

As the subject of study is still years from its full implementation, it is constantly evolving, and the ideas and opinions amongst researchers and practitioners have been subject to change, as can be seen from the results of this study. For example, the notion of only one Metaverse comprising many virtual worlds has not been clearly phrased in earlier documents. The importance of a complete economic system has been pointed out only in recent publications. In order to cope with the characteristics of such a new topic, the method has been adapted as the documents have been weighted.

Comparing the resulting definition presented in Section 4.3 to the existing definitions by Lee [43] and Ball [4] cited in Section 4.1 shows, on the one hand, that the newly proposed definition is in no contradiction to the existing, impactful literature. At the same time, it becomes obvious that both definitions lack important aspects, which are present in other

sources, such as the notion of users being represented by avatars in the Metaverse or the importance of an economic system.

As the Metaverse is not mature, the question might be asked whether it is reasonable to try to define the phenomenon. On the other hand, researchers around the world are exploring this interesting space. As can be seen from the analyzed documents, all of them spend a lot of effort into explaining or even defining the term Metaverse for the scope of their research. The results of this study can help to reduce this effort by proposing a unified yet comprehensive definition.

From today´s perspective, the descriptions and definitions of the Metaverse might seem blurry and provisional, and the application of the examples provided in Section 1 are very small first steps. However, the Metaverse can serve well as an indication of where the internet will develop. These indications point towards a direction where users have the notion of being surrounded by or immersed in a virtual layer that is ubiquitous and persistent. The Metaverse provides huge opportunities and important challenges, e.g., regarding privacy or user security, such as social media or mobile internet did some 20 years ago.

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