The rising trend of metaverse in education: challenges, opportunities, and ethical considerations

Sanaa Kaddoura [Corresp., 1] , **Fatima Al Husseiny** [2]

1 Department of Computing and Applied Technology, Zayed University, Zayed City, Abu Dhabi, United Arab Emirates

2 Lebanese International University, Beirut, Lebanon

Corresponding Author: Sanaa Kaddoura
Email address: sanaa.kaddoura@zu.ac.ae

Metaverse is invading the educational sector and will change human-computer interaction techniques. Prominent technology executives are developing novel ways to turn the Metaverse into a learning environment considering the rapid growth of technology. Since the COVID-19 outbreak, people have grown accustomed to teleworking, telemedicine, and numerous other forms of distance interaction. Recently, the Metaverse has been the focus of many educators. With Facebook's statement that it was rebranding and promoting itself as Meta, this field saw a surge in interest in the areas of computer science and education. There is a literature gap in studying the Metaverse's role in education. This paper is a systematic review following the PRISMA framework that reviews the role of the Metaverse in education to shrink the literature gap. It presents various educational uses to aid future research in this field. Additionally, it demonstrates how enabling technologies like extended reality (X.R.) and the internet of everything (IoE) will significantly impact educational services in the Metaverses of the future of teaching and learning. The paper also outlines key challenges, ethical issues, and potential threats to using the Metaverse for education to offer a road map for future research that will investigate how the Metaverse will improve learning and teaching experiences.

1 The rising trend of Metaverse in education: challenges,
2 opportunities, and ethical considerations

4 Sanaa Kaddoura [1],

5 Fatima Al Husseiny [2],

7 [1] Zayed University, Abu Dhabi, United Arab Emirates
8 [2] Lebanese International University, Beirut, Lebanon

10 Corresponding Author: Sanaa Kaddoura, sanaa.kaddoura@zu.ac.ae

12 Abstract
13 Metaverse is invading the educational sector and will change human-computer interaction techniques.
14 Prominent technology executives are developing novel ways to turn the Metaverse into a learning
15 environment considering the rapid growth of technology. Since the COVID-19 outbreak, people have
16 grown accustomed to teleworking, telemedicine, and numerous other forms of distance interaction.
17 Recently, the Metaverse has been the focus of many educators. With Facebook's statement that it was
18 rebranding and promoting itself as Meta, this field saw a surge in interest in the areas of computer science
19 and education. There is a literature gap in studying the Metaverse's role in education. This paper is a
20 systematic review following the PRISMA framework that reviews the role of the Metaverse in education
21 to shrink the literature gap. It presents various educational uses to aid future research in this field.
22 Additionally, it demonstrates how enabling technologies like extended reality (X.R.) and the internet of
23 everything (IoE) will significantly impact educational services in the Metaverses of the future of teaching
24 and learning. The paper also outlines key challenges, ethical issues, and potential threats to using the
25 Metaverse for education to offer a road map for future research that will investigate how the Metaverse
26 will improve learning and teaching experiences.

28 **Keywords:** Metaverse, education, human-computer interaction, challenges, virtual reality, augmented
29 reality, mixed reality

31 Introduction

33   Maslow was a pioneer of modern and contemporary perspectives on domain-specific requirements,
34 although he paid less attention to reproductive urges, which were among the fundamental physiological
35 needs. Modern advancements, however, have recommended various changes to his pyramid (Rasskazova
36 et al., 2016). When we come to the digital age, Wi-fi has replaced one of the lowest sub-stratal demands
37 in the modern age, significantly impacting all five hierarchy divisions (Logan, & Everall,.2019).
38   Wi-fi can help "self-actualize " and reframe digital technology's improvements so they can tap into their
39 incredible potential. Even after most of one's basic wants are met, one could still feel new resentment and
40 impatience until the person acts in a way that is appropriate for him (Stosny, 2016). The digital
41 technology wave that swept all age groups made individuals dependent on internet usage including
42 gadgets such as cell phones, iPads, laptops, and iPods. This led to the inclusion of the internet as one of
43 the physiological requirements of the Hierarchy of Needs.
44   Through social networking sites like Facebook, WhatsApp, and Twitter. These demands in the digital
45 age can now be referred to as "Love, Like, Share, and Retweet Needs" (Bilski, 2018).
46   The original pyramid's inversion is one of the key differences between the new generation's
47 adaptations(Medeni et al., 2020) and interpretations. The world was completely different when

48 psychologist Abraham Maslow's "hierarchy of needs" concept was initially published in 1943. In 2019,
49 the world stepped on the verge of the Fourth Industrial Revolution, another significant paradigm change.
50 This revolution resulted in a new paradigm shift for emerging digital needs.
51 According to recent research based on a global poll of over 43,000 people from 24 countries, which
52 examined what it takes for an individual to succeed in today's tech-driven world, a new framework
53 emerged (World Economic Forum, 2019). The digital framework of ' 'today's needs consisted of four
54 inspired by ' 'Maslow's hierarchy of needs (1) basic needs (digital infrastructure), (2) psychological needs
55 (social networks), (3) Self-fulfillment (career and skills development), and (4) Societal needs
56 (connectedness and the digital economy) (World Economic Forum, 2019). Figure 1 illustrates this new
57 dimension where A.I., DL, and K.I. stand for artificial intelligence, deep learning, and knowledge
58 integration, respectively (Medeni et al., 2020).
59
60 **Figure 1. A New Technology-Supported Maslow's Pyramid of Needs**
61
62 According to the pyramid's design (Figure 1), the lower levels of Maslow's hierarchy give more attention
63 to more material needs, while the upper levels allow less room for more moral demands. The
64 interpretation is made possible by inverting the pyramid to allocate more room to needs at higher levels
65 and less space to needs at lower levels. This perspective offers a more precise understanding of the
66 relationships between various human needs and is more per the socioeconomic requirements inherent in
67 human nature. Making fresh interpretations and modifications to Maslow's models can also be beneficial.
68 One of these new, noteworthy interpretations is part of the Digital Society Index (DSI) investigations. As
69 a result, the hierarchy structure is maintained to offer a more unified strategy for tackling digital needs
70 and associated societal concerns (Digital Society Index, 2019). For this, the new version of ' 'Maslow's
71 pyramid highlights the tech ' 'generation's digital need while in the presence of virtual reality or
72 Metaverse. Since so much of our identity is shaped by the socio-digital world, it is impossible to
73 completely break away from it (Serpil & Karaca 2023).
74

Research Gap

76 Compared to earlier generations of the Metaverse, access to it is now possible anytime, anyplace due
77 to the rapid advancement of mobile technology and deep learning. This has also enhanced the accuracy of
78 visual and language recognition, leading to more immersive environments (Park & Kim, 2022a). In
79 addition, several literature reviews on the Metaverse in general (e.g., Narin, 2021), reviews of graphics,
80 interactions, and visualization studies related to the Metaverse (Zhao et al., 2022), and reflections on
81 virtual commerce from application design and consumer behavior in the Metaverse (Shen et al., 2021)
82 with scarce literature available related to Metaverse in education. This paper specifically addresses the
83 following research questions
84 Q1: In what ways can Metaverse be defined?
85 Q2: How is the Metaverse applied in education?
86 Q3: What are the advantages and disadvantages of using Metaverse in education?
87 Q4: What are the challenges and opportunities arising from Metaverse implementation in education?
88 Q5: How do ethical considerations appear when Metaverse is applied in education?
89

Background

91 It is evident that digital reality technologies have the potential to revolutionize the domains of education,
92 remote work, marketing, and economics, as well as the entertainment business. These technologies have
93 also begun to establish a new paradigm for information exchange. It may be claimed that a new paradigm
94 has developed that is centered on the idea of the Metaverse (Mystakidis, 2022). The terms "meta," which
95 means beyond or after, and "universe" are combined to make the phrase "Metaverse" (Cheng et al., 2022).
96 Metaverse platforms offer additional advancements across the board as virtual reality systems become
97 more user-friendly and networked. It may be much more practical to broaden their use cases and adapt

98 them to educational situations once virtual reality glasses and accessories obtain a more comfortable
99 design suitable for long-term use. Making hardware and software based on the Metaverse that may be
100 used in educational settings is very important. Thus, collaboration and mutual guidance on this issue are
101 crucial for educators, researchers, designers, and developers (Saritas, 2022).
102 Virtual reality (V.R.) and augmented reality (A.R.), two spatial, immersive technologies, are currently
103 driving the fourth wave of computing innovation (Kamenov, 2017). This wave is anticipated to create the
104 following ubiquitous computing paradigm, which has the power to revolutionize (online) business,
105 entertainment, remote work, and education. The Metaverse is this new paradigm. Meta (a Greek prefix
106 that means after or beyond) and universe make up the closed compound word that is the Metaverse. The
107 Metaverse is, in other words, a post-reality cosmos that combines physical reality and digital virtuality in
108 a continuous and enduring multiuser context. Metaverse has the potential to address the fundamental
109 drawbacks of web-based 2D e-learning tools in the context of online distance education
110 (Mystakidis,2022).
111 Neal Stephenson's science fiction book Snow Crash (Stephenson, 2003) described the idea of the
112 Metaverse that he coined in 1992. Stephenson is credited for introducing the concept of the Metaverse to
113 the world (Duan et al., 2021). Many efforts and studies have been done to develop Metaverse technology,
114 which is based on a fictional novel but does not actually exist as technology that can be used in real life
115 (Kye et al., 2021). However, Metaverse quickly gained fame after Mark Zuckerberg made the Metaverse
116 project official in October 2021 (Tilli, 2022).
117 The phrase "Extended Reality" or "Cross Reality" (X.R.) refers to a group of immersive technologies
118 that create electronic, digital settings where data are represented and shown. Virtual Reality (V.R.),
119 Augmented Reality (A.R.), and Mixed Reality (M.R.) are all parts of X.R. In all of the X.R. aspects,
120 people view and engage with a totally or partially artificial digital environment created by technology.
121 V.R. is a different, entirely fake environment that was produced digitally. Users experience immersion,
122 feel as though they are in a separate universe, and behave in a manner that is similar to how they would in
123 the real world (Slater& Sanchez, 2016).
124 This experience is enhanced by the modalities of vision, sound, touch, movement, and natural contact
125 with virtual things with the aid of specialist multimodal equipment, including immersion helmets, V.R.
126 headsets, and omnidirectional treadmills (Pellas, et al. 2021, & Pellas, et al., 2022). To improve physical
127 environments, A.R. takes a different method. It incorporates digital inputs and virtual aspects into the real
128 world (Ibáñez, B. & Delgado-Kloos, C. 2018). It geographically combines the real and virtual worlds
129 (Klopfer, 2008). The result is a layer of digital artifacts spatially projected and mediated by objects like
130 smartphones, tablets, glasses, contact lenses, or other transparent surfaces (Mystakidis, et al., 2021).
131 The definition of M.R. has changed throughout time, reflecting changing technology advancements and
132 the predominant verbal meanings and narratives. M.R. is a more complex notion. In that the physical
133 world interacts in real-time with the projected digital data, M.R. is occasionally described as an advanced
134 version of A.R. As a result, M.R. remains a blend of A.R. and V.R., the two core technologies (Speicher,
135 et al., 2019). In real-world settings, augmented reality (A.R.) is an example of a partially virtual
136 Metaverse. A Metaverse could be entirely virtual, like a virtual reality (V.R.) system. People can interact
137 socially in the Metaverse by having conversations, working on projects, playing games, and learning from
138 their mistakes or successes (Bourlakis et al., 2009; Park & Kim, 2022a). Real people or virtual characters
139 could be one's companions or friends in the Metaverse (Díaz et al., 2020; Kye et al., 2021). The
140 lifelogging feature allows for complete documentation of meta-verse life (Thawonmas & Fukumoto,
141 2011).
142 The Metaverse is far more than V.R. or A.R., which some people would mistakenly believe (Park &
143 Kim, 2022b). The Metaverses have a framework of three characteristics "shared," "persistent," and
144 "decentralized,"—which distinguish it significantly from traditional V.R. or A.R. (Min & Cai, 2022).
145 Additionally, artificial intelligence (A.I.) is a necessary technology for the Metaverse's universe to
146 function according to the programmer's rules. From this structure, it is clear that an A.R. or V.R. system
147 might be used to present virtual content in the Metaverse; alternatively, the Metaverse itself could include
148 A.R. or V.R. aspects in addition to other necessary elements. People can use different identities to connect

149   with others in a multiuser V.R. system such as Second Life (Min & Cai, 2022). Still, if the system cannot
150   offer a persistent reality where users can live real life experiences including working, owning, learning,
151   interacting, producing, and having fun, it is not considered a Metaverse (Min & Cai, 2022).
152

Methodology

154   According to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses steps
155   (PRISMA) (Moher, et al., 2009) which are shown (Figure 2) and discussed below, this systematic
156   literature review was conducted.
157

158   **Figure 2. PRISMA Model for article selection**
159

160   The PRISMA model followed to develop this review started with four steps that constructed the
161   framework, (1) inclusion (keyword search), (2) eligibility, (3) screening, and (4) identification (Oláh, et
162   al. 2020).
163

164   *(1) Inclusion*
165   After a thorough search of several preview publications related to Metaverse in education, the gap in the
166   literature was evident due to the freshness of the topic. There were a minimal number of recent papers on
167   the issue. As a result, the research started with identifying empirical and narrowing down the search
168   history of documents and previous work. Several database searches and search engines were used, mainly
169   Google Scholar, ScienceDirect (Elsevier), Taylor & Francis Online, Wiley Online Library, IEEEXplore,
170   and Springer.
171   Several keywords were used to narrow down the search (Figure.3). The keywords used were Metaverse
172   and education, Metaverse in higher education, Metaverse role in education, Metaverse tools in education,
173   and Metaverse challenges and educational opportunities. Also, the search terms' digital education, 'virtual
174   reality,' and 'Metaverse' were mainly used to search the database. It is noteworthy that general keywords
175   and phrases were excluded, for example, "assessment, online, and Remote learning." This initial search
176   included 870 articles.
177

178   **Figure 3. Keywords search word cloud for article search**
179

180   *(2) Eligibility*
181   The research studies evaluated for inclusion in the review met several requirements listed in Table 1.
182   After filtering the articles and documents from the initial search, 200 duplicate articles were removed.
183

184   **Table 1. Inclusion and exclusion criteria**
185

186   *(3) Screening*
187   The screening stage was divided into two sub-stages filtering and another layer of exclusion. In the
188   filtering stage, 530 articles were screened and narrowed down, preparing for the final exclusion stage,
189   which eliminated 247 with reasonable justifications. In this sense, a rational explanation falls under the
190   exclusion criteria mentioned in Table 1.
191

192   *(4) Selection*
193   Finally, the 53 papers selected for this review were collected and prepared for synthesis and are listed in
194   Table 2 with their description. The final step of the selection process prepares for the discussion part.
195

Data Analysis and Discussion

197   This section provides answers to the five questions that were raised in the Research Gap section above.
198   A summary of the literature is presented in Table 2.

199

200

201 **Table 2. Some of the selected articles and studies with descriptions**

202

203 ## Discussion

204 ## Metaverse in Higher Education

205 The coronavirus pandemic disrupted education globally. Both learners and teachers have had to adjust to
206 a new, distant learning method from the beginning of 2020. Throughout the global lockdowns, technology
207 has been essential for ensuring that education has not stopped (E.U. Business School,2022).
208 The world has been severely challenged and disrupted by the COVID-19 epidemic. This pandemic has
209 affected all facets of society, particularly the educational system, changing pupils' settings, attitudes, and
210 abilities (Toquero, 2020).The end of in-person instruction in schools and colleges required legislation on a
211 global scale, forcing the transition to online delivery methods (Itani et al., 2021).
212 Now, educators and I.T. professionals are thinking the same thing: if the internet helps individuals learn
213 in its current form, what kinds of things would the Metaverse allow everyone to do? (Contreras et al.,
214 2022).
215 The Metaverse allows the curriculum to customize to the student's needs (Mistretta, 2022).With new
216 technology and schools of thought always emerging, the world is constantly evolving. Curricula can
217 easily fall behind, but the Metaverse has the power to turn the entire world into a virtual global school.
218 Following the previous benefit, "gamifying" learning is one of the Metaverse's most promising potential
219 uses in education (E.U. Business School, 2022). With its emphasis on teamwork and finishing tasks, the
220 virtual world might make education seem like a video game, with classes organized like quests, inspiring
221 students to complete their work and perform better (E.U. Business School, 2022).
222 Through immersive learning opportunities, the technology and tools of the Metaverse have significantly
223 improved pedagogical and technical support for education, positively impacting student motivation (Tilli
224 et al., 2022). In Figure 4, technology and tools are broken into seven categories: wearable, immersive,
225 instructional, modeling and simulation, mobile, sensors, and artificial intelligence (A.I.). The immersive
226 direct experience that students receive in the Metaverse encourages teamwork and skill development in
227 addition to engaging students in many ways in the classroom (Tarouco et al., 2013, Erturk & Reynolds,
228 2020). They combine virtual technologies such as Virtual Reality (V.R.), Multi-User Virtual Environment
229 (MUVE), Mixed Reality (M.R.), and Augmented Reality required to achieve immersion (A.R.).
230 Technologies that act as gateways and allow us to immerse ourselves in Metaverse environments suggest
231 the necessity of multimodal immersion (Mystakidis et al., 2021).
232 Siyaev and Jo's study (2021b) demonstrates that M.R. is a tool that combines the physical and virtual
233 worlds and is capable of increasing learning through deep learning voice interaction modules. It also
234 mentions the usage of M.R. in the Metaverse. Real-time V.R. and A.R. technology enable the creation of
235 fictitious interactive 3D characters (Sourin, 2017). When the Metaverse is used in education, it is
236 combined with educational platforms, allowing the immersive settings to be a significant part of
237 instructional topics and making it simpler to connect knowledge (Wagner et al., 2013).
238 The Metaverse in education combines the institutional learning management system (LMS), HotPotatoes,
239 MOOC, Moodle, Teleduc, Eduquito, and Sloodle. For instance, with Web 2.0 and AVAS, Massive Open
240 Online Courses (MOOCs) give students access to a social network. Many students may access subject
241 information for free thanks to the Metaverse and MOOC, and online courses enable them to increase their
242 knowledge (Wagner et al., 2013). Engineering, mathematics, and natural science courses employ virtual
243 learning laboratories. The Virtual Learning Laboratory (VLL) gives students access to a collaborative,
244 interactive, and dynamic studying environment, enhancing their motivation for learning and their
245 education quality (Tarouco et al., 2013). For instance, the Moodle-created virtual environment enables the
246 university's online learning platform to share user data, link user profiles between the two platforms, and
247 make presentations (Lucas et al., 2013).

248   Mobile technologies are considered the most prevalent in the Metaverse because they enable a
249   connection between the medium and the student, through using mobile devices and geographic mobility.
250   Learning processes can be improved when students use their Avatars in Metaverse on mobile devices.
251   One of the technology categories that enables teachers to monitor student dynamics by evaluating student
252   behavior is sensors and wearables, such as Microsoft HoloLens2 smart glasses and eye blinking (Barry et
253   al., 2015).
254   Students can engage with content and issue commands in the virtual world when they use HoloLens 2
255   smart glasses (Siyaev & Jo, 2021b). The Blinking system, which primarily uses specialized software to
256   record students' blinking times, is another widely used tool in the Metaverse. The blinking system records
257   more blinks when a student is emotionally unstable, allowing teachers to assess the student's behavior
258   more (Barry et al., 2015). In artificial intelligence, using neuro-symbolic A.I., convolutional neural
259   networks, machine learning, and semantic database technology aids students in processing learning-
260   related material more effectively (Duan et al., 2021).
261   The core idea of the Metaverse is the analysis of complex data for understanding, regulating, and
262   planning, and the development of artificial intelligence can be used as a foundation for processing this
263   data (Duan et al., 2021). Neuro-symbolic AI can use automatic voice recognition metrics to provide
264   feedback on user data by combining neural networks with traditional symbolic reasoning (Siyaev & Jo,
265   2021a). In training and instruction for aviation maintenance, neuro-symbolic A.I. is frequently employed.
266   For instance, in courses on aviation maintenance, neuro-symbolic A.I. can take the place of subject-matter
267   specialists by offering technical advice and all the resources to support efficient training and instruction in
268   aircraft maintenance (Siyaev & Jo, 2021a).
269   Convolutional neural networks (CNN) frequently process auditory information and the command and
270   language recognition learning and classification components, increasing learning efficiency (Siyaev & Jo,
271   2021a). The Metaverse's and Artificial Intelligence potentials also open new roles for intelligent non-
272   player characters (NPCs), including tutors, peers, and tutees (Hwang & Chien, 2022). Future research has
273   the potential to make use of Artificial Intelligence. technology to examine how students behave and
274   interact, as well as how well they function in the Metaverse, to create new positions. A variety of
275   technological fields have been utilized in Metaverse to build a healthy learning ecosystem. However,
276   several cutting-edge technologies are still not being used. For instance, a learning system with built-in
277   anti-cheating might be developed using blockchain to increase user security. Whereas cryptocurrency is
278   often employed in the Metaverse as a whole, this is not the case in the educational Metaverse. Using
279   various sensors and devices, Internet of Things (IoT) technology could also be used to develop a more
280   immersive learning environment that combines the real and virtual worlds.
281   The Metaverse offers a fully immersive educational experience to students. When studying planets, for
282   instance, the Metaverse could show the entire galaxy with the ability to zoom in and out so that a learner
283   can observe the texture and features of the cosmos. When studying old architecture, a learner can travel
284   back in time and observe the architecture's intricate elements firsthand (Ning et al., 2021). The Metaverse
285   can be conceptualized as a place where virtual reality is used to supplement the physical world with the
286   four types of Metaverse (see Figure 5): Augmented reality, Lifelogging, Mirror world, and Virtual reality
287   (Kye et al. 2021). The real world is either interconnected with virtual reality, or transformed into a
288   different environment inside the virtual reality. From an evolutionary perspective, the Metaverse reflects a
289   world that has spread and developed in reaction to the COVID-19 pandemic and is a combination of the
290   accelerated innovations with 5G and virtual convergence technology. (Ko et al., 2021).
291
292   **Figure 4. The four elements of Metaverse and their educational implications**
293
294   The four different forms of the Metaverse first evolved independently. However, through interacting and
295   dismantling barriers, they have later developed into a new type of convergence/composite service. For
296   instance, the lifelogging service Ghost Pacer mixes augmented reality and lifelogging (Lee, 2021). Virtual
297   reality is the most varied and actively utilized Metaverse among the four forms of education. The current

298 non-face-to-face period has been distinguished in particular by the widespread use of virtual reality,
299 which can be accessed from anywhere regardless of distance or geography.
300 The "5 Cs" are the following qualities of the virtual reality Metaverse that set it apart from already
301 available platform services: First, as a canon, designers and participants jointly create and expand the
302 space-time of the Metaverse. Second, anyone in the Metaverse can create content. Third, as a form of
303 digital currency, production and consumption are made possible through the production of various ranges.
304 Fourth, the Metaverse ensures the continuity of daily life. Fifth, the Metaverse connects the real and the
305 virtual, connecting the Metaverse world (avatars) (Kye et al. 2021).
306
307 **Table 3. Educational implications of the four elements of the Metaverse**
308
309 The "digital native generation" leave social and economic imprints through their many online personas
310 and avatars. The traits and educational consequences of each of the four categories of Metaverse from an
311 academic perspective are presented in Table 3.
312

Advantages and Disadvantages of Metaverse in Education

314 3D virtual worlds, primarily utilized for gaming and pleasure before Metaverse, were also used in
315 teaching after a while, as happens with every new technology (Bulu, 2012). Combining education and
316 entertainment makes learning environments more appealing, encouraging students to participate more
317 actively. As a result, the Metaverse is now being used as a 3D virtual environment in educational
318 activities. But it is progressively becoming clear that the idea of the Metaverse is not without its issues
319 and limitations (Minocha, S., & Reeves, A.J.2010.) Maintaining an active learning environment
320 emphasizes improving students' learning abilities, particularly critical thinking and participation in the
321 process. Although the idea of critical thinking is crucial in online learning settings, it is not adequately
322 investigated. New frameworks are required to enhance learning abilities and online performance
323 (Kaddoura and Al Husseiny, 2021).
324
325 **Figure 5. Advantages of using Metaverse in education**
326
327 Because there is a literature gap regarding Metaverse in education, the benefits of using it in educational
328 settings are listed in Figure 5and explained below.
329
330 Gamification
331 Generation Z individuals are the primary users of the Metaverse. Generation Z refers to people who were
332 born after 1995 and who differ from earlier generations in many ways. As this generation grew up during
333 the development of PC and mobile gaming technologies, scientists focused on their preference for game-
334 like experiences (Park et al., 2021). The term "gameful experience" refers to a method that applies game
335 mechanics like points, badges, levels, and leaderboards to non-game contexts including business,
336 education, and healthcare in order to increase user engagement and motivation (Deterding et al., 2011).
337 Through these game features, gamification in education promotes learner motivation, involvement in
338 learning, and attitude improvement (Kim et al., 2018).
339
340 Diversity and Inclusion
341 The use of Metaverse in education enables students from different backgrounds to learn in the same
342 environment (Park, 2021). Because of several socioeconomic circumstances, the culture of diversity,
343 equity, and inclusion has become more prominent in a lot of businesses. Access to a technology or service
344 has made it possible to establish a baseline of social equity that supports the promotion of diversity,
345 equity, and inclusion.(Zallio, & Clarkson, 2022) The Metaverse presents an excellent opportunity to
346 overcome many of the difficulties people encounter in the real world, including physical disabilities,
347 restricted access to certain locations, social exclusion brought on by a lack of exposure to the diversity of

348 people, and opportunities to provide new sensory experiences for those with sensory or cognitive
349 impairments (Zallio, & Clarkson, 2022).
350
351 Skill Based Learning
352   Learning in the Metaverse offers the chance to practice various skills and repeat them as often as desired
353 for skill-based learning approach (Locurcio, 2022., & Koo 2021). In addition, the current augmented
354 reality mobile media approach can foster the growth of cognitive abilities and produce innovative
355 experiences in the acquisition of material. The main objective is to boost students' academic performance,
356 and this will highlight how mobile augmented reality learning resources may be very useful when blended
357 into classroom instruction (Marini, et al. 2022).
358   As there are many obstacles, advances in self-education necessitate technological and educational
359 validation. Without extensive prior training, education, and preparation of teachers and pupils, it is vital to
360 ascertain whether such a move will increase the quality of instruction (Pedro et al., 2019). For this activity
361 to improve education quality, teachers must create communication channels that are appropriate for
362 digital needs and comprehend the role that technology plays in modern learning. To compete in upcoming
363 international economic competitions, students must also advance their technological proficiency
364 (Olszewski, B., & Crompton, 2020). To compete in the global market, students need to develop their
365 technological abilities. Just a few of the skills pupils need to develop include critical thinking aptitudes,
366 inventive problem-solving abilities, communication aptitudes, cooperative aptitudes, and tech-savvy
367 citizen aptitudes (Marini, et al. 2022).
368
369 Virtual Campus
370   The World Bank Group, through its Open Learning Campus, stresses the fact on more merits of
371 Metaverse in Education, such as connecting learners through a realistic virtual campus, improving real-
372 world expertise in hybrid and virtual situations, investigating various worlds via storytelling and
373 visualization, increasing human talents in social or challenging circumstances, developing accessible
374 solutions for learners with disabilities and increasing learning performance (World Bank Group, 2022).
375 The majority of current efforts to create a campus Metaverse concentrate on virtual environments or
376 virtual reality (VR) (Duan et al., 2021). An AR Metaverse allows situated interaction in a specific
377 physical space, bridging the gap between the physical campus infrastructure and digital content. To
378 expose located services to campus users, an AR campus Metaverse offers a rare chance to combine digital
379 content with physical infrastructure (Braud et al,. 2022).
380
381 Delightful Learning Environment
382   A Metaverse's social involvement is the first thing to be considered while deploying it (Getchell et al.,
383 2010). The four fundamental components of an educational scenario are teachers, students, learning
384 resources, and learning environments (Yuan et al. 2019). In an educational Metaverse, virtual learning
385 environments are not fixed and could be replicated and modified by some or all of the consumers who
386 inhabit them, facilitating interaction between students and learning resources and environments (Cai et al.,
387 2022). In fact, the Metaverse facilitates the interaction between the actual world and the virtual world for
388 learning by doing and living through offering realistic and rich educational experiences for learners
389 (Locurcio 2022., Park, J. 2021, Lee, H.& Hwang, Y. 2022). The Metaverse can significantly help realize
390 concrete learning which isone of the most desired roles in instructional environments. This appeals to
391 students' visual, aural, and tactilesenses which will create a delightful learning environment (Locurcio,
392 2022., Koo. 2021, Lee, & Hwang, 2022).
393
394 Visualized Learning
395   Due to the quick advancements in computer vision and graphics technology, the Metaverse scenes have
396 a strong visual impact. Teachers and students should be able to view realistic virtual scenes, and their
397 teaching actions should interact very organically, in an effective learning Metaverse educational setting.
398 Therefore, the educational Metaverse cannot disregard the advancement of natural interaction

399 technologies in the teaching and learning environment in addition to the complete development of visual
400 experience technologies (Cai et al., 2022).

402 **Figure 6. Disadvantages of using Metaverse in education**

404   On the other hand, there are drawbacks to the Metaverse use in educational settings, as illustrated in
405 Figure 6 and explained in the section below.

407 Expensive Infrastructure
408   In addition to costing more than traditional learning tools like computers and books, XR technologies
409 frequently call for a fast internet connection. Furthermore, creating content costs more since it requires
410 specific tools and abilities to produce the interactive virtual environments needed for efficient learning
411 (Pimentel et al, 2022).

413 Absence of Legislative Restrictions
414   - The Metaverse environment is now regarded as unusual because it is a relatively new notion. There are
415 no legislative restrictions in this field at the national or international levels. Therefore, making legal
416 arrangements for this circumstance is essential and may interest the national and international educational
417 communities. Since the Metaverse is a decentralized Internet environment, its computer security appears
418 lacking (Discover Hub Pages, 2022. & Akami, B. 2022).

420 Cultural Biases
421   The widespread use of ICT raises concerns about the possibility of widening social and economic
422 disparities since it may alienate "the unskilled and IT illiterate sectors of the local poorer community"
423 (Hollands, 2008). In virtual reality, a number of inequities in reality will be infinitely enlarged. The
424 Metaverse enables the reshaping of social equality laws (Zhang, 2022).

426 Usability and Accessibility Issues
427 For many people, the XR technologies available today are difficult to utilize. For instance, a person with
428 restricted hand movement can find it difficult to utilize controls. Wearing glasses, for example, can make
429 using an HMD challenging. Additionally, not all persons from different origins and identities can access
430 certain technology equally. For instance, certain head coverings and hairstyles, such as religious head
431 coverings and natural Black hairstyles, cannot be worn over headphones (Pimentel et al, 2022).XR is
432 particularly suited to teaching skills, competences, beliefs, and attitudes that multiple-choice learning tests
433 might not be able to capture since it can give a more personalised and unstructured learning experience.
434 And while XR allows for the collection of a variety of user data types (such as movement and eye
435 tracking), this data type has not yet been transformed into useful learning assessments (Pimentel et al,
436 2022).

438 Time Constraints
439   The effects of MDs used in VR and MR might deteriorate with time and can cause discomfort or nausea
440 in users in as little as 10-15 minutes, hence it is better to utilize them sparingly rather than as the primary
441 educational modality for an entire course. For longer-term interventions, different technologies like
442 computer programs, augmented reality on mobile devices, or low-tech fixes may be more appropriate
443 (Pimentel et al, 2022).

445 Expertise Deficiency
446   The learner's perception of how well technology fits into their background, standards, and previous
447 activities is known as perceived compatibility. In other words, compatibility refers to how the students see
448 the advantages of utilizing technology (Greenhalgh et al., 2004). This premise is consistent with the

449 notion of compatibility as people's willingness to accept novel technological advancements when those
450 advancements are compatible with their established norms and predictions (Rogers et al, 2014).
451

Challenges and Ethical Considerations

453   The ethical implications of the Metaverse are being discussed more than ever now, as new technologies
454 have always been required. For the Metaverse to be a secure virtual space that transcends the current
455 communication and equity barriers, many ethical issues need to be addressed.
456

Device Challenges

458   Processing, storage, and data transfer are the three factors that makeup computing power: the capacity to
459 process data. In the era of the digital economy, computing power is a crucial resource, and its
460 infrastructure is a vital support for technological advancement (Ning et al., 2021)Metaverse entails a more
461 significant user base, better network resources, and more processing power (Ning et al., 2021)The
462 emergence of new business models and the cloud computing-based Metaverse platform has raised the
463 need for computer resources and opened up new opportunities for their growth. High demands are placed
464 on client device performance and server resilience by the cloud storage, cloud computing, cloud
465 rendering, and other technologies employed by Metaverse. Metaverse must constantly increase processing
466 complexity, speed, and power consumption (Ning, H. et al., 2021).
467   The price of V.R. headsets and other technological innovations that will enable individuals to immerse
468 themselves in the many virtual worlds of the Metaverse is considered a difficulty that may present barriers
469 to widespread acceptance. Examples include Horizon Home, Future of Work, and Presence Platform.
470 Johnson (Johnson,2022) gives up-to-date data on how much consumers would shell out for cutting-edge
471 V.R. equipment to let them feel what they are experiencing in the Metaverse. Additionally, specific
472 segments of society will likely be "locked out" of the Metaverse based on factors like education,
473 socioeconomic status, age, and disability.
474   The functioning of Metaverse will produce a significant amount of data, including sensor-generated
475 metadata, a shared virtual area for user social interactions, and the transmission of high-resolution video
476 feeds, needing significant network capacity. The Metaverse, however, might not be supported by the
477 current 5G technology. Although theoretically, 10–20 Gbps is the most incredible speed that 5G can
478 provide, the bandwidth needs of the Metaverse may exceed what 5G can provide. Peer-to-peer (P2P)
479 communication methods could be a solution to this problem. User devices must therefore mix the content
480 obtained from various parties and present the virtual environment consequently (Ruizhi. et al. 2022).
481   The user experience is critically dependent on latency. Since users may access the Metaverse from
482 different locations, it can be challenging to guarantee low latency in geographically dispersed areas.
483 While this is going on, sensors in the Metaverse, like those on haptic and X.R. headsets, need latency as
484 low as tens of milliseconds to maintain an immersive user experience (Zhang, et al., 2022). The delay
485 between a user's motion and how others perceive their reflection in the Metaverse is a crucial measure to
486 optimize, much to the motion-to-photon latency in virtual reality. The network edge's remote rendering
487 (Koller, et al. 2004) of virtual content is a potential strategy for lowering the latency above.
488

Social and Ethical Considerations

490   People developed a new identity in the Metaverse, which has also produced a unique environment in
491 which to live and interact. There are more nuanced social dynamics there. The Metaverse must govern
492 and restrict user behavior and create explicit ethical and moral guidelines to maintain a positive ecological
493 environment.
494 The moral and ethical problems that Metaverse needs to address are:
495   • Issues with integrity include printing and spreading false information and fraud;
496   • Intellectual property rights violations
497   The importance of ethics at this moment has increased significantly (Ning et al., 2021)The original code
498 of ethics has been impacted, and the new code of ethics is being developed at a slow pace that cannot

499 keep up with the growth of the Metaverse. As a result, the Metaverse's oversight should be improved, and
500 pertinent rules and regulations should be created and promptly updated (Ning, et al., 2021).
501   As a result, the Metaverse will continue to reinforce the digital divides and favoritism that already exist
502 regarding access to current social media platforms (Rosenberg.2022).. However, the prevalence of spam
503 content on social media is drastically rising, making spam identification essential. As more individuals
504 utilize social media, such as Facebook, Twitter, YouTube, and email, the amount of spam content also
505 increases. Particularly during the pandemic, people are spending an excessive amount of time on social
506 media. Through social media, users receive a lot of text messages, and they often fail to notice the spam
507 content contained in these messages (Kaddoura et al. 2022).
508   Technology use is currently subject to accessibility stratification and discrimination, with tech-savvy
509 individuals leading the way in its uptake. This will prevent all residents from having full access,
510 incredibly the less tech-savvy, those who grew up before laptops, and those who are handicapped by
511 universal design. Despite Meta's assertion that using new technology will help young people develop their
512 critical thinking skills, this has always been the case regarding its application. The main concern is
513 whether the digital divide in virtual/augmented cities could develop into a Metaverse split. However, this
514 might benefit social groupings with unfavorable attitudes and feelings toward the Metaverse. This is
515 supported by the significant societal issues that the extensive usage of social media platforms has brought
516 about for many communities (Rosenberg.2022).
517   This raises the question of whether humans will broadly embrace the Metaverse. This is a challenging
518 subject to answer because people do not always embrace new experiences that are technologically
519 possible. The Metaverse probably won't appeal to all social classes, at least not in the same way or at the
520 same time. The unequal distribution of socioeconomic risks and advantages in society and individual
521 choices and beliefs is the cause. According to Lee et al.,2021 the sustainability of the Metaverse will
522 depend on the social acceptance of the Metaverse as well as several impacting design aspects, such as
523 fairness, cyberbullying, gadget acceptability, avatar acceptability, and privacy risks. In particular, it is
524 vital to apply a new socio-humanitarian logic in the construction of the Metaverse, as claimed by Gurov
525 and Konkova (Gurov, O. & Konkova, T.2022).
526   Similarly, AmI's, Ambient Intelligence, a vision was determined by humanistic design issues, see (Bibri,
527 S., & Zaheer, A. 2022).for a detailed discussion of the seminal role of participative and humanistic design
528 for the sustainability of AmI). AmI has emerged in the past 10 years as a multidisciplinary field within
529 ubiquitous computing (José et al., 2010). The development of AmI required a comprehensive perspective
530 that considered people and other non-technical issues. As a result, AmI's vision is constantly being rebuilt
531 around fresh concepts, ideas, and points to address, and R&D has changed its emphasis to creating
532 workable win-win solutions. Furthermore, the Metaverse will likely give rise to new issues that could
533 limit everyone's ability to access and use its goods, services, and technology or lead people to reject it if
534 new skills and knowledge are needed, which will lead to varying degrees of acceptance (Johnson,
535 2022)Increased technological literacy and skill levels were only 34% of the benefits of the Metaverse
536 globally in 2021, according to recent statistics (Johnson, 2022).
537   This percentage also shows that there are still a significant number of people who will not profit from the
538 Metaverse, including some who will be unable to use it effectively because it is a more complex platform
539 than current social media. This is in line with findings from earlier research on the vision of AmI, which
540 was conducted. Adults in the United States reported having the following attitudes about the Metaverse as
541 of January 2022: curious (33%), uninterested (27%), suspicious (23%), concerned (19%), indifferent
542 (19%), excited (18%), hopeful (16%), bewildered (12%), and none of these (7%) (Johnson, 2022). As a
543 result, unpleasant emotions frequently outweigh happy ones. This could be explained by the increased
544 awareness of social media platforms within this sector of society during the previous 20 years.
545   Therefore, it appears that this community group is not expressing any desire for the extraordinary in
546 service encounters in the virtual world, which might not help promote what is envisioned claimed to be
547 desired, pleasant, and amusing to specific groups of society in the short term. One of these groups is the
548 young people, who appear to be interested in and enthusiastic about the Metaverse, with unpredictable
549 medium-term results. To encourage more people to connect the potential outcomes to their actual needs,

550 dreams, and ambitions, the Meta-verse should at the very least expose what the so-called post-reality
551 cosmos has to offer even though the Metaverse provides the following advantages globally (Johnson,
552 2022). Avatars can participate in heterogeneous real-time activities that theoretically involve an infinite
553 number of concurrent users across numerous virtual environments (Lee, et al. 2021, Bibri, & Zaheer,
554 2022).
555

Network security and Privacy Concerns

557 The true identity and the Metaverse are tightly related to one another (Ning, et al., 2021). Like the
558 previous network environment, the Metaverse must fully care for data privacy protection issues as it
559 builds a new generation of networks (Ning, et al., 2021). As worries about security in immersive
560 educational platforms increase, attacks on head-mounted display (HMD) devices could give attackers the
561 ability to confuse users by superimposing or altering the pictures in their field of view
562 (Jagatheesaperumal, et al., 2022).
563 As a matter of fact, the privacy and security concerns in the Metaverse demand our attention. Although
564 our measurement investigation confirmed that commercial social V.R. platforms use secure
565 communication protocols (such as TLS and DTLS) to protect sent data, the Metaverse may still raise
566 various security issues, including user identifying data (Mathis F. et al., 2021). Due to the need for
567 headset access, users frequently must identify themselves using biometric data, making them vulnerable
568 to security assaults (Mathis F. et al., 2021).
569 The Metaverse's digital twins also require our defense. In this sense, many intricate machine learning
570 models will support digital twins, impacting real-world things. Attacking these theories will have
571 unpredicted consequences for the physical universe. Additionally, user-worn headsets would continuously
572 gather personal data (such as biometric data and user activity) to enhance the QoE, raising privacy
573 concerns. Blockchain storage for digital twins from the Metaverse and biometric data is one conceivable
574 direction (Ryskeldiev et al., 2018). However, users of the Metaverse should be most concerned about
575 privacy risks, mainly since the privacy-enhancing mechanisms presented so far are insufficient to address
576 this unique problem. Technology can only protect privacy to a certain extent; even this capability has
577 built-in constraints. .
578 The Metaverse faces a severe difficulty and conundrum about confidentiality (e.g., Dick 2020, Leenes
579 2007; Lee et al. 2021; Falchuk et al. 2018). Acceptable procedures for gaining access to and sharing
580 personally identifiable information about individuals are still up for discussion. Given the enormous
581 amount of data that will be gathered, analyzed, classified, commoditized, and commodified, datafication
582 and privacy are at the foundation of the Metaverse. For businesses, the value of data lies not in its
583 physical presence but in the connections, it can make with databases and analytical tools (Zuboff, 2019).
584 In the shape of new networked, digital technologies that have permeated the fabric of daily life, smart
585 cities are undergoing an unheard-of escalation of datafication and algorithmization. This raises severe
586 issues with the invasion of privacy. In the context of intelligent city ethics, Calvo (2020) discusses the
587 moral implications of the datafication and algorithmization of urban society.
588 In terms of legislation and information practice standards as a matter of justice, all harms will present
589 considerable hurdles to the Metaverse's privacy protection measures. Fairness is a crucial concern
590 regarding the rules and principles used in the Metaverse to profile and socially classify persons in the
591 virtual world behaviorally. The Metaverse should prioritize algorithmic fairness in all of its designs. As a
592 result, procedural justices should continue to serve in governing capacities since they "demand a high
593 degree of openness to the users and outcome control mechanisms" (Lee et al., 2021). Whatever the case,
594 algorithmic governance involves unfairness and inequity that replicate data justice issues (Dencik et al.,
595 2016; Taylor, 2017) across various demographics (Benjamin, 2019; Noble, 2018) with potentially
596 harmful outcomes.
597 Due to digital illiteracy, psychological manipulation, cognitive dissonance, and privacy paradox, the
598 problems, and hazards of privacy invasion do not seem to be a barrier to the youth age group using social
599 media as a daily activity (i.e., users willingly share their information). It follows that the acceptance of the

600 Metaverse by the same group is most likely to be the case. But the adult group is more concerned with
601 privacy (e.g., Johnson, 2022). Coming up with verifiable privacy measures is one of the main issues that
602 the Metaverse needs to address to be accepted by society (Lee et al., 2021).
603

Physical and Mental Health

605   The problematic use of the Metaverse and user addiction are challenging issues to address and
606 overcome. The COVID-19 pandemic and its long-term effects on urban living and working conditions
607 only exacerbate this. A significant body of recent research has shown that the continuous use of such
608 forms could produce further problems in terms of the abusive use or addiction to the internet, taking into
609 account the shift caused by this crisis from face-to-face meetings or social gatherings to virtual forms
610 (Garćia et al. 2020). Recent data and facts indicate mental health problems and addiction to virtual reality,
611 which account for 47% of the dangers of the Metaverse based on Internet users globally in 2021 (Johnson,
612 2022). Complete reliance on the Metaverse as a result of immersive experiences will lead to physical and
613 mental health issues, which will further impair and cause users to do nothing in their daily lives.
614 Indeed, the excessive use of Metaverse products and services has led to an addiction to immersive
615 technologies, which has sparked debates in the scientific, technological, and medical communities. It is
616 anticipated that this topic will be the subject of more investigation, discussion, and criticism and be
617 approached from many angles (Ning, et al. 2021). This suggests that it will be challenging to establish
618 and practice evidence-based initiatives and recommendations for policy makers. An individual can hang
619 out with friends, work, play, learn, shop, create, and more in the Metaverse, claims Meta. It's not always
620 about using the internet more. Making online time more purposeful is the goal. This contradicts itself
621 since, at least for the younger members of society, how cyberspace will be constructed in terms of the
622 variety of activities that may be undertaken there will most certainly drive constant usage of immersive
623 technologies. To put it in another way, what the Metaverse entails shows the opposite. It will enable
624 multiple avatars of real people to interact with one another and with aesthetically pleasing objects in
625 various visually appealing virtual worlds, luring young people to spend more time online pointlessly.
626 Many immersive elements, such as peak experiences, optimal attention span restoration, and happy
627 emotions, are directly linked to the psychological states that may happen when people engage with the
628 natural world in V.R. or augmented reality (Bibri, & Zaheer, 2022).
629   Designers can imitate the effects of real-world environments on emotional states through common life
630 scenarios in V.R. and A.R. The rehabilitative effects of simulated everyday situations in immersive
631 environments are probably to rise. Users may also encounter super-realism, which enables them to engage
632 in several activities in environments that closely mirror those found in reality. The Metaverse portrays
633 bleak visions of the future even though it can develop into something engaging for some sectors of
634 society(Colley et al., 2017, Tong et al., 2017).This is evident in how it conceptualizes the digital world,
635 configures users and their social relationships, and ignores social and ethical principles (such as integrity,
636 truthfulness, and loyalty) (e.g., freedom, respect, responsibility). Unfortunately, many values essential for
637 social health regarding community participation and a sense of belonging are not practiced in today's
638 digital world. V.R. might cause significant user behavior changes, affecting society (Colley et al., 2017,
639 Tong et al., 2017).
640   Despite this, the science fiction stories are developing the premise that the Metaverse will be present in
641 the various scenarios of people's everyday lives, creating a dramatic shift in that life. In this regard,
642 Johnson (2022) provides examples of activities that people will be able to engage in in the Metaverse that
643 they would not be able to in the real world, such as:
644 - Alter consciousness with the aid of V.R.
645 -Create an alter ego of the opposite sex or different age
646 - Spend a lot of money on group clothing or accessories
647 - Play adult games that feature extreme violence and sex
648 - Carry out unethical experiments on virtual humans
649 - Watch virtual executions

650   These things shed some light on the types of extreme behaviors that the Metaverse may encourage or
651   lead some individual users to engage in, which may have detrimental effects on societal norms. These
652   include the capacity for positive assertiveness, being true to oneself in all circumstances, participating
653   with others in one's community, treating others with respect, and communicating with others directly and
654   honestly without purposefully hurting their feelings. Cyber-dystopias depict a society in which human
655   traits like courage, honesty, kindness, self-awareness, and wholeheartedness are absent from humans,
656   leading to dehumanizing experiences. Overall, the Metaverse is a collection of highly realistic virtual
657   environments that will allow users to experiment with things that are impractical in real life (Lewis et al.,
658   2021),
659   The time has come for re-establishment when previously assumed rights and values encounter a new
660   paradigm. It can be extremely harmful when technology develops, and variety is emphasized more and
661   more in the world. Due to this ambivalence, the ethical framework must be flexible enough to keep up.
662   Adolescents who are the primary Metaverse users are introduced to ethical education on moral
663   metacognitive ability, moral sensitivity, moral judgment, and moral responsibility as the core values of
664   education, including human dignity, protection of human rights, non-infringement, and commitment
665   (Kim, , & Park, 2022).
666

Netiquettes Considerations

668   ASL (age, sex, locality), social position (occupation, wealth, standing, etc.), or physical interaction are
669   not inherently linked to a virtual community. As a result, its members typically gather in person rather
670   than having to travel great distances. Therefore, online communities are not an exception. Etiquette is a
671   protocol for how to interact with other members and communicate information. Netiquette violators are
672   flagged to other users and may endure a robust label ascription process (Gabriel, 2020). Particularly,
673   digital etiquette is typically referred to as netiquette, where correct communication is essential for asking
674   and answering questions respectfully and proactively by introducing oneself properly, posing precise
675   questions, and concluding formally. Ethical online citizenship is necessary for the Metaverse-based
676   education programs used in high schools, colleges, and businesses (Jagatheesaperumal et al., 2022).
677   Indeed, netiquette is needed in online learning environments where information and communication
678   technology (ICT) has altered socialization and communication practices. Regarding social interaction, the
679   Metaverse may encourage individuals to experiment with their identity, role-playing, and self-expression.
680   The Metaverse Roadmap states that this might result in new viewpoints on social norms related to gender,
681   ethnicity, species, socioeconomic status, manners, and collective ideals and goals.
682

Intellectual Copyrights

684   With the proliferation of multiple online educational platforms, it is challenging to manage the
685   intellectual property rights of educational content to prevent infringement on the copyrights of learning
686   resources (Jagatheesaperumal et al., 2022). Using both private and public blockchains, the digital
687   copyright management system (Jacob,et al., 2019) ensures the sharing of multimedia instructional
688   content. It guarantees the privacy of educational content, making it a suitable option for Metaverse
689   platforms. As the Metaverse is formed, develops, and scales, the I.P. issues from the previous economy
690   will likewise be put under stress. Only a few of the potential problems include ownership, protection,
691   piracy, and concerns with patents and I.P. definitions. The new economy will necessitate new ways of
692   thinking in a world where physical boundaries dissolve and territorial rights assume new significance. I.P.
693   produced by AI and Avatar may be the subject of legal challenges, for instance, contesting its legality.
694   Owners of content must be aware of their licensing restrictions and usage rights. Due to the use of famous
695   impersonators in video games, there has already been litigation; considering that specific avatars will also
696   have financial worth in the Metaverse, these conflicts could increase enormously (Nitin, 2022). Therefore,
697   there is a chance that I.P.'s rights will be violated in the Metaverse, concerning works coming from the
698   outside and results coming from within. New original works are being produced within the Metaverse, as
699   witnessed before. Any reproduction or dissemination of this online content by a third party without

700 permission could be considered copyright infringement, as these works are likely to be covered by
701 copyright. The same may occur if a third-party share works created outside the Metaverse—that is, from
702 the real world, such as a painting or photograph—in the Metaverse without the owner of the copyright's
703 consent (or without benefiting from a copyright exception) (European Innovation Council and SMEs
704 Executive Agency, 2022).
705 When we discuss copyrights in the Metaverse context, holders may face several difficulties. First, it might
706 be challenging to police copyright violations on the Metaverse. This problem might be solved by
707 including specialized copyright filters in the Metaverse program. However, it is uncertain whether the
708 Metaverse's creators will be able or willing to include such filters. Second, it will be required to ensure
709 that any licenses that content producers have obtained for copyrightable works before the development of
710 the Metaverse permit usage of the work on this new technology. Users of copyrighted content may
711 require comprehensive rights, which could be provided under a copyright license, given the intricacy of
712 the Metaverse.
713   Additionally, several plaintiffs asserted that Epic Games, Inc., the company behind the online game
714 "Fortnite," had unlawfully copied their dance techniques and included them in the game (Levan, 2022).
715 Besides, there will be copyright difficulties because the Metaverse assets (content) are user-generated.
716 Transferring users' assets from one Metaverse platform to another is a practical issue that needs to be
717 resolved. This is essential because there will be several Metaverse platforms. Such portability and
718 interoperability call for industry standardizations and judicial enforcement (Ruizhi et al., 2022).
719 Adding to the copyright challenges, intellectual property issues are also quite important. For instance,
720 when a given work in the Metaverse is the outcome of a decentralized collaborative process carried out by
721 anonymous users behind avatars, it could be more challenging to ascertain who the producers are.
722 Additionally, such ambiguity might alter how courts view fair usage. In the meanwhile, trademark
723 attorneys are concentrating on issues like who should be held accountable when the identity of the
724 infringement is ambiguous, how trademark dilution can occur in the Metaverse, and whether digital assets
725 should constitute "goods" for purposes of the trademark rules (Clifford Chance Briefings, 2022).
726 Numerous studies have been written on whether artificial intelligence objects should be given separate
727 legal personhood, comparing avatars to artificial intelligence systems in the Metaverse. Integrating
728 artificial intelligence tools with Metaverse makes it extremely complicated. It may be practical to give the
729 avatars in the Metaverse the rights and obligations that a human being would have in real world. Doing
730 this task requires assistance from "machine learning" algorithms which will allow the avatars to complete
731 routine tasks without human assistance (Cheong, 2022).
732

Conclusion

734   With the help of virtual worlds, new instructional approaches can be developed. This provides the
735 teachers and students with a different way to teach and learn while incorporating both learning models,
736 hybrid and mobile. A new generation of students is now enrolling in universities due to the quick rise in
737 interactive technology use throughout the early years of school. The use of visual imagery and active
738 participation in the learning process has increased recently It also makes it easier for teachers to employ
739 pedagogies like inverted classes and collaborative learning, encouraging flexibility and positive class
740 dynamics. Another thing to keep in mind is the way programming is done. How Metaverses are made,
741 they are scalable, allowing for the incorporation of different ICT resources as well as more interactive
742 elements and the expansion of the created region, which allows for a broader range of applications to be
743 made to suit academic research and leisure needs. Metaverse
744   A factor for a novice instructor to consider while interacting with a virtual world is that this may be
745 rapidly altered; all it takes is growing the understanding of ICT tools and their management. As for the
746 student, he adjusts more quickly because he is a digital native and has access to various technological
747 tools that make it easier for him to deal with this resource. In this way, the instructor can make use of this
748 digital resource. As mentioned, with sufficient platform expertise, students and teachers can implement a
749 single study plan, a curricular adaptation, and a methodological adaptation for everyone.

750   As a result, the design of virtual training spaces must adhere to rigorous and high-quality design
751   standards, just like the design of training spaces in the real world. . Doing so, both learners and instructors
752   will maximize their learning in a challenging free environment.
753   This paper also presented the advantages and disadvantage of Metaverse. Briefly advantages are directly
754   related to adding new styles and methodologies of learning that can contribute to better learning
755   environment. On the other hand, the disadvantages are mainly related to infrastructure, ethical concerns
756   and mental health. There are some challenges to incorporating Metaverse in education such as privacy
757   and security issues, device challenges and social and ethical considerations. However, despite of these
758   challenges, the opportunities offered by Metaverse in education are promising. Every new technology will
759   have some drawbacks that can be later researched and fixed.
760

Future Research

762   The Metaverse environment will significantly contribute to guided and unguided learning processes,
763   educational simulations, social learning environments, and remote learning thanks to its engaging,
764   interesting, and amusing characteristics. It is also evident that new chances can be offered to students with
765   impairments and/or those who have difficulties accessing learning resources in terms of providing equal
766   opportunities in education in a Metaverse setting where physical borders have been abolished. However,
767   incorporating any new technology into the classroom could lead to issues with instructional technology.
768   There are issues with, in particular, how to create efficient instructional designs for the Metaverse
769   environment, how learning will occur, and how to conduct an efficient assessment and evaluation.
770   Therefore, it is necessary to develop a new **Metaverse** pedagogy.
771   Since Metaverse is a brand-new technological entity, all parties participating in education must accept its
772   technical framework, including students, teachers, administrators, and school boards. Cultural variations,
773   psychological standards, and social conventions will impact how sound Metaverse technology is received.
774   As a result, significant consideration must be given to using Metaverse in learning processes.
775   The components and architecture of the Metaverse have not yet been fully developed and implemented
776   because the concept is new. However, the technology that will involve the sense organs in the process
777   needs to be more helpful and less expensive for learners to live and let this experience fully and
778   satisfactorily in learning contexts. This hardware will take some time to mature and become widely used.
779   National and international cooperation should be created for Metaverse to function appropriately in
780   learning contexts and make good use of the resources allotted for it. To develop the appropriate
781   technology, software, content, and human resources, academic and non-academic parties must collaborate
782   and carefully organize the process.
783

References

785

786   **Balta¸S, A.** 2022. Metaverse ¨un What the Metaverse Will Bring to Our Lives? Available at
787   https://www.acarbaltas.com/metaverseun-hayatimiza-getirecekleri-v/
788   **Barry, D. M., Ogawa, N., Dharmawansa, A., Kanematsu, H., Fukumura, Y., Shirai, T., Yajima, K.,**
789   **& Kobayashi, T.** 2015. Evaluation of students' learning manner using eye blinking system in Metaverse.
790   *Procedia Computer Science*,60, 1195–1204.
791
792   **Benjamin, R**. 2019. Race after technology. *Polity Books*
793
794   **Bibri, S., & Zaheer, A.** 2022. The Metaverse as a Virtual Form of Data-Driven Smart Urbanism: On
795   Post-Pandemic Governance through the Prism of the Logic of Surveillance Capitalism. *Smart Cities*. **5(2),**
796   715–727.
797
798   **Bilski, J.** 2018. Maslow's Hierarchy of Needs Revised for Modern Civilization. Available at
799   https://www.mcsweeneys.net/articles/maslows-hierarchy-of-needs-revised-for-modern-civilization

800

801 **Bourlakis, M., Papagiannidis, S., & Li, F. 2009**. Retail spatial evolution: Paving the way from
802 traditional to
803 Metaverse retailing. Electronic Commerce Research, 9(1), 135–148.
804

805 **Braud, T., Fernández, C. B., & Hui, P.** 2022. Scaling-up AR: University Campus as a Physical-Digital
806 Metaverse. In 2022 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops
807 (VRW). *IEEE.*
808

809 **Bulu, S.T.** 2012. Place presence, social presence, co-presence, and satisfaction in virtual worlds. *Comput.*
810 *Educ*. **58(1),** 154–161.
811

812 **Cai, S., Jiao, X., & Song, B.** 2022. Open another door to education—Applications, challenges and
813 perspectives of the educational Metaverse. *Metaverse*, **3(1),** 12.
814

815 **Calvo, P.** 2020. The ethics of Smart City (EoSC): Moral implications of hyper-connectivity,
816 algorithmization, and the datafication of urban digital society. *Ethics and Information Technology*,**22(2),**
817 141–149.
818

819 **Cheng, R., Wu, N., Chen, S., & Han, B**. 2022. Will Metaverse be NextG Internet? Vision, Hype, and
820 Reality. arXiv preprint arXiv:2201.12894. https://doi.org/10.48550/arXiv.2201.12894
821

822 **Cheong, B. C.** 2022. Avatars in the Metaverse: potential legal issues and remedies. *International*
823 *Cybersecurity Law Review*, 1-28.
824

825 **Clifford Chance Briefings,** 2022. The Metaverse: What Are The Legal Implications? Available at
826 https://www.cliffordchance.com/briefings/2022/02/the-metaverse--what-are-the-legal-implications-.html
827

828 **Colley, A., J., Lin, AY., De-graen, D., Fischman, B., Jonna Ha˙kkila˙, F., Kuehl, K., Nisi, V., Nunes,**
829 **N.J., Wenig, N., Wenig, D., Hecht, B., Scho˙ning, J.** 2017. The geography of pokémon go: Beneficial
830 and problematic effects on places and movement. In Proceedings of the 2017 CHI *Conference on Human*
831 *Factors in Computing Systems, New York.*
832

833 Contreras, G. S., González, A. H., Fernández, M. I. S., Martínez, C. B., Cepa, J., & Escobar, Z. (2022).
834 The Importance of the Application of the Metaverse in Education. Modern Applied Science, 16(3), 1-34.
835

836 **Dencik, L., Hintz, A., & Cable, J.** 2016. Towards data justice? The ambiguity of anti-surveillance
837 resistance in political activism. *Big Data and Society*, **3(2),** 1–12.
838

839 **Deterding, S.; Dixon, D.; Khaled, R.; Nacke, L.** 20211. From game design elements to
840 gamefulness: Defining """"gamification"""". In Proceedings of the 15th *International Academic*
841 *MindTrek Conference:* Envisioning Future Media Environments, New York, NY, USA.
842

843 **Dick, E.** 2020 How to Address Privacy Questions Raised by the Expansion of Augmented Reality in
844 Public Spaces; Technical report. Washington, DC*: Information Technology and Innovation Foundation.*
845

846 **Dick, E.**2021. Public Policy for the Metaverse: Key Takeaways from the 2021 *AR/VR Policy*
847 *Conference.*
848

849 **Digital Society Index**. 2019. Digital Needs. Available at https://www.dentsu.com/reports/dsi_2019
850

851 **Dionisio, J. D. N., Burns, W. G., and Gilbert, R.** 2013. 3D virtual worlds and the Metaverse: current
852 status and future possibilities. *ACM Comput. Surv*. **45**: 1–38. DOI: 10.1145/2480741.2480751

854 **Discover Hub Pages.** 2022. The 7 Biggest Threats To Metaverse. Available at
855 https://discover.hubpages.com/technology/

857 **Duan, H., Li, J., Fan, S., Lin, Z., Wu, X., & Cai, W.** 2021. Metaverse for social good: A university
858 campus prototype. In Proceedings of the 29th *ACM International Conference on Multimedia*.

860 **Díaz, J., Saldan˜a, C., & Avila, C.** 2020. Virtual world as a resource for hybrid education. Int. J. *Emerg.*
861 *Technol. Learn.* (iJET) **15(15):** 94–109.

863 **E.U. Business School**. 2022. How Can the Metaverse be Used in Education? Available at
864 https://www.euruni.edu/blog/how-can-the-metaverse-be-used-in-education/

866 **Erturk, E., & Reynolds, G. B.** 2020. The expanding role of immersive media in education. In
867 International Conference on E-Learning.

869 **European Innovation Council and SMEs Executive Agency**. 2022. Intellectual Property in the
870 Metavers.

872 **Falchuk, B. S., & Loeb, and Ralph Neff. 2**018. The social Metaverse: Battle for privacy. IEEE
873 *Technology and Society Magazine* **37(2):** 52–6.

875 **Gabriel S.** 2020. Identity Reshaping and Manipulation In Cyberspace. Anthropological Researches And
876 Studies. 1-8.

878 **Garćıa, L.C., Cruz Sánchez Gómez, M., & Garćıa-Valcárcel Muñoz Repiso, A.** 2020. Scales for
879 measuring internet addiction in covid- 19 times: Is the time variable still a key factor in measuring this
880 addiction? *In Eighth International Conference on Technological Ecosystems for Enhancing*
881 *Multiculturality,* New York.

883 **Getchell K, Oliver I, Miller A, et al**. 2010. Metaverses as a platform for game-based learning.
884 24th IEEE International Conference on Advanced *Information Networking and Applications*
885 *(AINA)*. New York: IEEE.

887 **Greenhalgh, T., Robert, G., Macfarlane, F., Bate, P., & Kyriakidou, O.** 2004. Diffusion of
888 innovations in service organizations: systematic review and recommendations. *The milbank quarterly*
889 **82(4):** 581-629.

891 **Gurov, O.; Konkova, T.** 2022. Metaverse for Human or Human for Metaverse?
892 Availableathttps://artsoc.jes.su/s207751800019011-1-1/

894 **Hollands, R.G.** 2008.Will the real smart city please stand up? Intelligent, progressive or entrepreneurial?
895 *City*. **12**:303–320

897 **Hwang, G. J., & Chien, S. Y.** 2022. Definition, roles, and potential research issues of the Metaverse in
898 education: An artificial intelligence perspective. *Computers and Education: Artificial Intelligence* **3**:1-6.

900 **Ibáñez, M.-B.; Delgado-Kloos, C.** 2018.Augmented reality for STEM learning: A systematic review.
901 *Comput. Educ.***123**:109–123.

902

903 **Itani, M., Itani, M., Kaddoura, S., & Al Husseiny, F.** 2022. The impact of the Covid-19 pandemic on
904 online examination: challenges and opportunities. *Global Journal of Engineering Education* **24**(2).
905

906 **Jacob H., Rooksby., and Christopher S.** 2019.Copyrights in higher education: motivating a research
907 agenda. *The Journal of Technology Transfer* **44** (1):250–263.
908

909 **Jagatheesaperumal, S. K., Ahmad, K., Al-Fuqaha, A., & Qadir, J.** 2022. Advancing Education
910 Through Extended Reality and Internet of Everything Enabled Metaverses: Applications, Challenges, and
911 Open Issues. *arXiv preprint*. Available at arXiv:2207.01512
912

913 **Johnson, J.** 2022. Metaverse - Statistics & facts. *Statista, Physical and Mental Health.*
914

915 **José, R., Rodrigues, H., & Otero, N.** 2010. Ambient Intelligence: Beyond the Inspiring Vision. J.
916 *Univers. Comput.* Sci. **16** (12):1480-1499
917

918 **Kaddoura, S. and Al Husseiny, F.,** 2021. An approach to reinforce active learning in higher education
919 for I.T. students. *Global J. of Engng. Educ.* **23** (1): 43-48.
920

921 **Kaddoura, S. and Al Husseiny, F.,** 2021. Online learning on information security based on critical
922 thinking andragogy.*World Trans. on Engng. And Technol. Educ.* **19(**2): 157-162.
923

924 **Kaddoura, S., Chandrasekaran, G., Popescu, D. E., & Duraisamy, J. H.** 2022. A systematic literature
925 review on spam content detection and classification. *PeerJ Computer Science* **8**.
926

927 **Kamenov, K.** 2017. Immersive Experience. *The 4th Wave in Tech: Learning the Ropes.* Available at
928 https://www.accenture.com/gb-en/blogs/blogs-immersive-experience-wave-learning-ropes
929

930 **Kim, C., & Park, J.** 2022. An Exploratory Study on the Production of Metaverse Ethics Education
931 Contents for Adolescents. *Easy Chair.*
932

933 **Kim, S.; Song, K.; Lockee, B.; Burton,** J.2018. Gamification in Learning and Education; *Springer*: New
934 York, NY, USA.
935

936 **Koller D., Turitzin, M.Levoy, M.Tarini, G.Croccia, P. Cignoni, and R. Scopigno.** 2004.Protected
937 Interactive 3D Graphics Via Remote Rendering. ACM Transactions on Graphics **23**(3): 695–703.
938

939 Ko, S. Y., Jung, H. G., Kim, J. I., & Shin, Y. T. (2021). Concept and development directions of
940 Metaverse. Korea Information Processing Society Review, 28(1), 7-16.
941

942 **Klopfer, E.** 2008. Augmented Learning: Research and Design of Mobile Educational Games*; MIT Press.*
943 Cambridge, USA
944

945 **Koo H.** 2021. Training in lung cancer surgery through the Metaverse, including extended reality, in the
946 smart operating room of Seoul National University Bundang Hospital, *Korea. J. Educ. Eval. Health Prof*
947 *18*: 33.
948

949 **Kye, B., Han, N., Kim, E., Park, Y., & Jo, S.** 2021. Educational applications of Metaverse: Possibilities
950 and limitations. *J. Educat. Eval. Health Prof.* **18**:32.
951

952 **Lee, H., and Hwang, Y.** 2022. Technology-enhanced education through VR-making and metaverse-
953 linking to foster teacher readiness and sustainable learning. *Sustainability* **14**(8).
954
955 **Lee, L.H., Braud, T., Zhou, P., Wang, L., Xu, D., Lin, Z., Kumar, A., Bermejo, C., Hui, P.** 2021. All
956 one needs to know about Metaverse: A complete survey on technological singularity, virtual ecosystem,
957 and research agenda. Available at arXiv, 2110.05352
958
959 **Leenes R.,** 2007. Privacy in the Metaverse. In IFIP International Summer School on the Future of
960 Identity in the Information Society, Springer **95**:112.
961
962 **Lee, S**. 2021.Log in Metaverse: a revolution of human × space × time. Available
963 From: https://spri.kr/posts/view/23165?code = issue reports.
964
965 **Levan N.** 2022., If the Metaverse is Built, Will Copyright Challenges Come? *UIC, Review of Intellectual*
966 *Property Law* 1:39.
967
968 **Lewis, R. & Taylor-Poleskey, M.** 2021. Hidden town in 3d: Teaching and reinterpreting slavery
969 virtually at a living history museum. *J Comput Cult Herit* **14**(2).
970
971 **Locurcio, L.L.** 2022. Dental education in the metaverse. *Br. Dent. J.* **232**(4):191.
972
973 **Logan, J., & Everall, K.** 2019. First things first: Exploring Maslow's hierarchy as a service prioritization
974 framework. *Journal of Library User* **2**(2)
975
976 **Lucas, E. P., Benito, J. C., & Gonzalo, O. G.** 2013. Learning and professional practicing in a 3d virtual
977 world. In 2nd International Workshop on Evidence-based Technology Enhanced Learning. *Springer*.
978
979 **Marini, A., Nafisah, S., Sekaringtyas, T., Safitri, D., Lestari, I., Suntari, Y., ... & Iskandar, R.** 2022.
980 Mobile Augmented Reality Learning Media with Metaverse to Improve Student Learning Outcomes in
981 Science Class. *International Journal of Interactive Mobile Technologies* 16(7).
982
983 **Mathis F., Williamson J. H., K. Vaniea, and M. Khamis.** 2021. Fast and Secure Authentication virtual
984 Reality Using Coordinated 3D Manipulation and Pointing. *ACM Transactions on Computer-Human*
985 *Interaction* **28**(1):1–44.
986
987 **Medeni, T. D., Aydın, A., Medeni, T., & Soylu, D**. 2020. Development of a Needs Hierarchy For
988 Organizations to Complement Needs Hierarchy For Individuals In Today's Digital Age. In The
989 International Scientific Conference of Librarians Western Balkan Information and Media Literacy
990 Conference.
991
992 **Mystakidis, S.** 2022. Metaverse. *Encyclopedia*, **2**(1): 486-497.
993 https://doi.org/10.3390/encyclopedia2010031
994
995 **Min, T., & Cai, W.** 2022. Portrait of decentralized application users: An overview based on large-scale
996 Ethereum data. CCF. Trans. Pervasive. *Comput. Interaction* 1-18.
997
998 **Minocha, S., Reeves, A.J.** 2010. Design of learning spaces in 3D virtual worlds: an empirical
999 investigation of second life. *Learn. Media Technol*. **35**(2):111–137.
1000
1001 **Mistretta, S.** (2022). The Metaverse—An Alternative Education Space. AI, Computer Science and
1002 Robotics Technology.

1003

1004 **Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & PRISMA Group**. 2009. Preferred reporting
1005 items for systematic reviews and meta-analyses: the PRISMA statement. *Annals of internal medicine*
1006 **151**(4):264-269.

1007

1008 **Mystakidis, S., Fragkaki, M., & Filippousis, G.** 2021. Ready teacher one: Virtual and augmented
1009 reality online professional development for K-12 school teachers. Computers **10**(10):1-16.

1010

1011 **Mystakidis, S.; Christopoulos, A.; Pellas, N.** 2021. A systematic mapping review of augmented reality
1012 applications to support STEM learning in higher education. *Educ. Inf. Technol* 1–45.

1013

1014 **Narin, N. G.** 2021. A content analysis of the metaverse articles. Journal of Metaverse **1**(1):17–24.

1015

1016 **Ning, H., Wang, H., Lin, Y., Wang, W., Dhelim, S., Farha, F., & Daneshmand, M.** 2021. A Survey
1017 on Metaverse: The State-of-the-art, Technologies, Applications, and Challenges. *Cornell University.*
1018 Available at https://arxiv.org/abs/2111.09673

1019

1020 **Nitin K.** 2022. Forbes. Six Unaddressed Legal Concerns For The Metaverse. Available at
1021 https://www.forbes.com/sites/forbestechcouncil/2022/02/17/six-unaddressed-legal-concerns-for-the-
1022 metaverse/

1023

1024 **Noble, S. U**. 2018. Algorithms of Oppression: How Search Engines Reinforce Racism. *New York*
1025 *University Press.*

1026

1027 **Olszewski, B. and Crompton, H**. 2020. Educational technology conditions to support the development
1028 of digital age skills. *Computer and Education 1*50: 1–2.

1029

1030 **Oláh, J., Krisán, E., Kiss, A., Lakner, Z., & Popp, J.** 2020. PRISMA statement for reporting literature
1031 searches in systematic reviews of the bioethanol sector. *Energies* **13**(9):2323.

1032

1033 **Park, J.** 2021. Exploring the possibility of using Metaverse in Korean language education. *Journal Of*
1034 *The International Network For Korean Language And Culture.*

1035

1036 **Park, S. M., & Kim, Y. G.** 2022a. A Metaverse: Taxonomy, components, applications, and open
1037 challenges. *IEEE Access* **10**:4209–4251.

1038

1039 **Park, S., & Kim, S.** 2022b. Identifying world types to deliver gameful experiences for sustainable
1040 learning in the Metaverse. Sustainability **14**(3):1-14.

1041

1042 **Park, S.; Min, K.; Kim, S.** 2021. Differences in learning motivation among ' 'Bartle's player types and
1043 measures for the delivery of sustainable gameful experiences. *Sustainability* 1-14.

1044

1045 **Pedro, A., Piedade, J., and Filipe, J.** 2019. Integrating digital technology in the school curriculum.
1046 *International Journal of Emerging Technologies in Learning*. **14**(21): 4–15.

1047

1048 **Pellas, N., Dengel, A., Christopoulos, A.** 2020. A Scoping Review of Immersive Virtual Reality in
1049 STEM Education.*IEEE Trans. Learn.Technol.* **13**:748–761.

1050

1051 **Pellas, N., Mystakidis, S., Kazanidis, I.** 2021. Immersive Virtual Reality in K-12 and Higher Education:
1052 A systematic review of the last decade's scientific literature. *Virtual Real.* **25**: 835–861.

1053

Pimentel, D., Fauville, G., Frazier, K., McGivney, E., Rosas, S., & Woolsey, E. 2022. An introduction to learning in the Metaverse. *Meridian Treehouse.*

Rasskazova, E., Ivanova, T., & Sheldon, K. 2016. Comparing the effects of low-level and high-level worker need satisfaction: A synthesis of the self-determination and Maslow's need theories. *Motivation and Emotion* 40(4):541-555.

Rogers, E. M., Singhal, A., & Quinlan, M. M. 2014. Diffusion of innovations. In An integrated approach to communication theory and research. *Routledge*.

Rosenberg, L. 2022. Regulation of the Metaverse: A Roadmap. In Proceedings of the 6th International Conference on Virtual and Augmented Reality Simulations (ICVARS 2022), Australia.

Ruizhi C., Nan W., Songqing C., and Bo H. 2022. Will Metaverse be NextG Internet? Vision, Hype, and Reality. Available at https://arxiv.org/abs/2201.12894

Ryskeldiev B., Ochiai Y, M. Cohen, and J. Herder. 2018. Distributed Metaverse: Creating Decentralized Blockchain-based Model for peer-to-peer Sharing of Virtual Spaces for Mixed Reality Applications. *InProceedings of Augmented Human International Conference (A.H.).*

Sarıtaş, M. T., & Topraklıkoğlu, K. 2022. Systematic literature review on the use of Metaverse in education. International Journal of Technology in Education **5**(4):586-607.

Serpil, H., & Karaca, D. (2023). The Metaverse or Meta-Awareness?. Journal of Metaverse, 3(1), 1-8.
Shen, B., Tan, W., Guo, J., Zhao, L., & Qin, P. 2021. How to promote user purchases in the Metaverse? *Applied Sciences* **11**(23):11087.

Siyaev, A., & Jo, G. S. 2021a. Neuro-symbolic speech understanding in aircraft maintenance metaverse. *IEEE Access* **9**:154484–154499.

Siyaev, A., & Jo, G. S. 2021b. Towards aircraft maintenance Metaverse using speech interactions with virtual objects in mixed reality. *Sensors* **21**:6,1-21.

Slater, M.; Sanchez-Vives, M.V. 2016. Enhancing Our Lives with Immersive Virtual Reality. *Front. Robot AI* **3**(74):1-47.

Sourin, A. 2017. Case study: Shared virtual and augmented environments for creative applications. Research and development in the academy, creative industries, and applications. *Springer* 49–64.

Speicher, M.; Hall, B.D.; Nebeling, M. 2019. What is Mixed Reality? In Proceedings of the 2019 *CHI Conference on Human Factors in Computing Systems*, Glasgow, UK.

Stephenson, N. 2003. Snow crash: A novel. *Spectra*.

Stosny, **S.** 2016. Soar Above: How to Use the Most Profound Part of Your Brain Under Any Kind of Stress. *Health Communications*, Inc.

Suh, W., Ahn, S. 2022. Utilizing the Metaverse for learner-centered constructivist education in the post-pandemic era: an analysis of elementary school students. *J. Intell* **10**(1).

Tarouco, L., Gorziza, B., Corrêa, Y., Amaral, É. M., & Müller, T. 2013. Virtual laboratory for teaching Calculus: An immersive experience. At the 2013 *IEEE Global Engineering Education Conference.*

Taylor, L. 2017. What is data justice? The case for connecting digital rights and freedoms globally. *Big Data and Society* **4**(2):1–14.

Toquero, C. M. (2020). Challenges and opportunities for higher education amid the COVID-19 pandemic: The Philippine context. Pedagogical Research, 5(4).

Thawonmas, R., & Fukumoto, A. 2011. Frame extraction based on displacement amount for automatic comic generation from metaverse museum visit log. In Intelligent interactive multimedia systems and services. *Springer* **11**:153–162.

Tlili, A., Huang, R., Shehata, B., Liu, D., Zhao, J., Metwally, A. H. S., ... & Burgos, D. 2022. Is Metaverse in education a blessing or a curse: a combined content and bibliometric analysis? *Smart Learning Environments* **9**(1):1-31.

Tong, X., Gupta, A., Lo, H., Choo, A., Gromala, D., & Shaw, CD. 2017. Chasing lovely monsters in the wild, exploring players' motivation and play patterns of pokémon go: Go, gone, or go away? In Companion of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing, New York.

Wagner, R., Piovesan, S. D., Passerino, L. M., & de Lima, J. 2013. Using 3D virtual learning environments in a new education perspective in 2013 12th International Conference on Information Technology Based Higher Education and Training. *IEEE*. 1–6.

World Bank Group. 2022. Education Meets the Metaverse: Reimagining the Future of Learning. Available at https://olc.worldbank.org/about-olc/education-meets-the-metaverse-reimagining-the-future-of-learning

World Economic Forum. 2019. We all have a 'hierarchy of needs.' But is technology meeting them? Available at https://www.weforum.org/agenda/2019/07/is-technology-meeting-our-fundamental-human-needs/

Yuan L, Zhang Y, Luo G.2019. Changes in elements of the education scene in the era of 5G and strategies to cope with them. *Journal of Distance Education* **3**:27–37.

Zallio, M., & Clarkson, P. J. 2022. Designing the Metaverse: A study on Inclusion, Diversity, Equity, Accessibility and Safety for digital immersive environments. *Telematics and Informatics*. 101909.

Zhang W., Han B., and Hui P. 2022.SEAR: Scaling Experiences in Multi-user Augmented Reality. In Proceedings of IEEE Conference on Virtual Reality and 3D User Interfaces (V.R.).

Zhang, Q. 2022. Rule of the Metaverse. *Metaverse* **3**(1):21.

Zhao, Y., Jiang, J., Chen, Y., Liu, R., Yang, Y., Xue, X., & Chen, S. 2022. Metaverse: Perspectives from graphics, interactions, and visualization. *Visual Informatics* **6**(1):56–67

Zuboff, S. 2016. The Secrets of Surveillance Capitalism. Available at https://www.getabstract.com/en/summary/the-secrets-of-surveillance-capitalism/26667

Figure 1

A New Technology-Supported Maslow's Pyramid of Needs
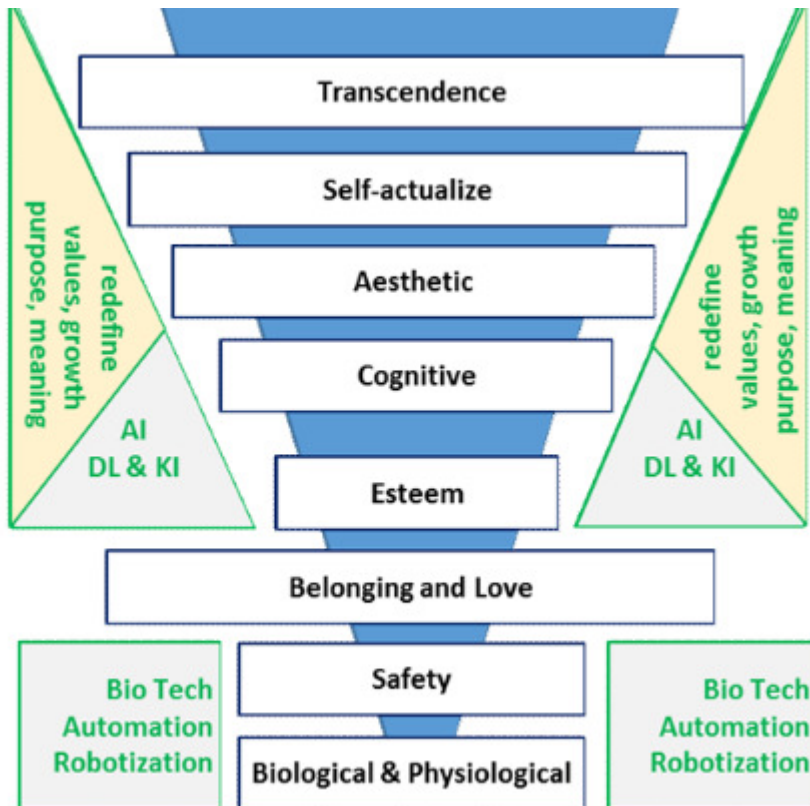
Figure 2

PRISMA Model for article selection
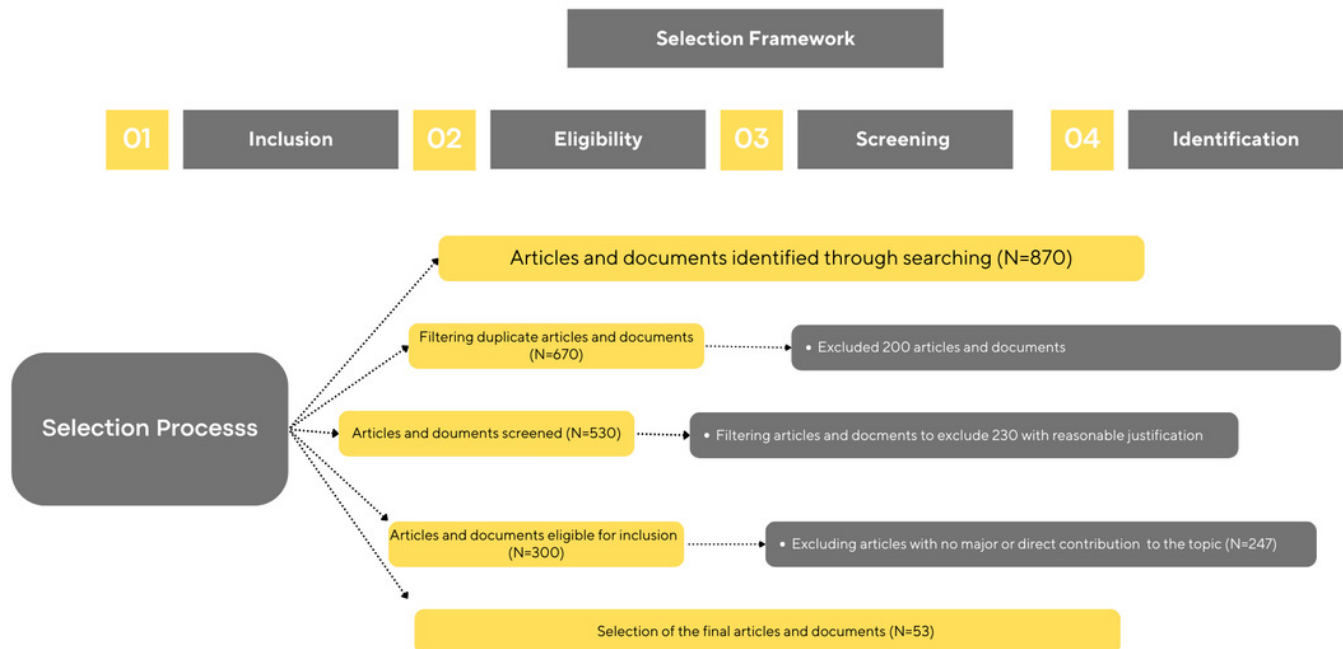
Figure 3

Keywords search word cloud for article search
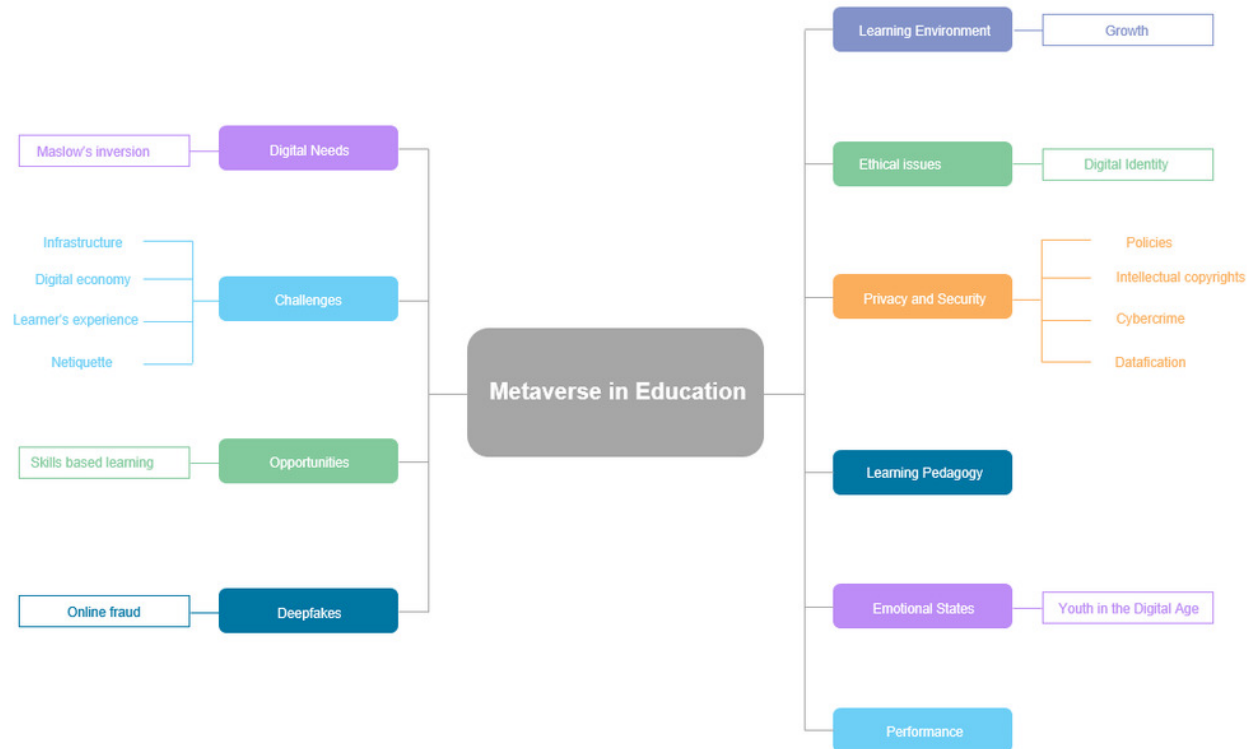
Figure 4

The four elements of Metaverse and their educational implications
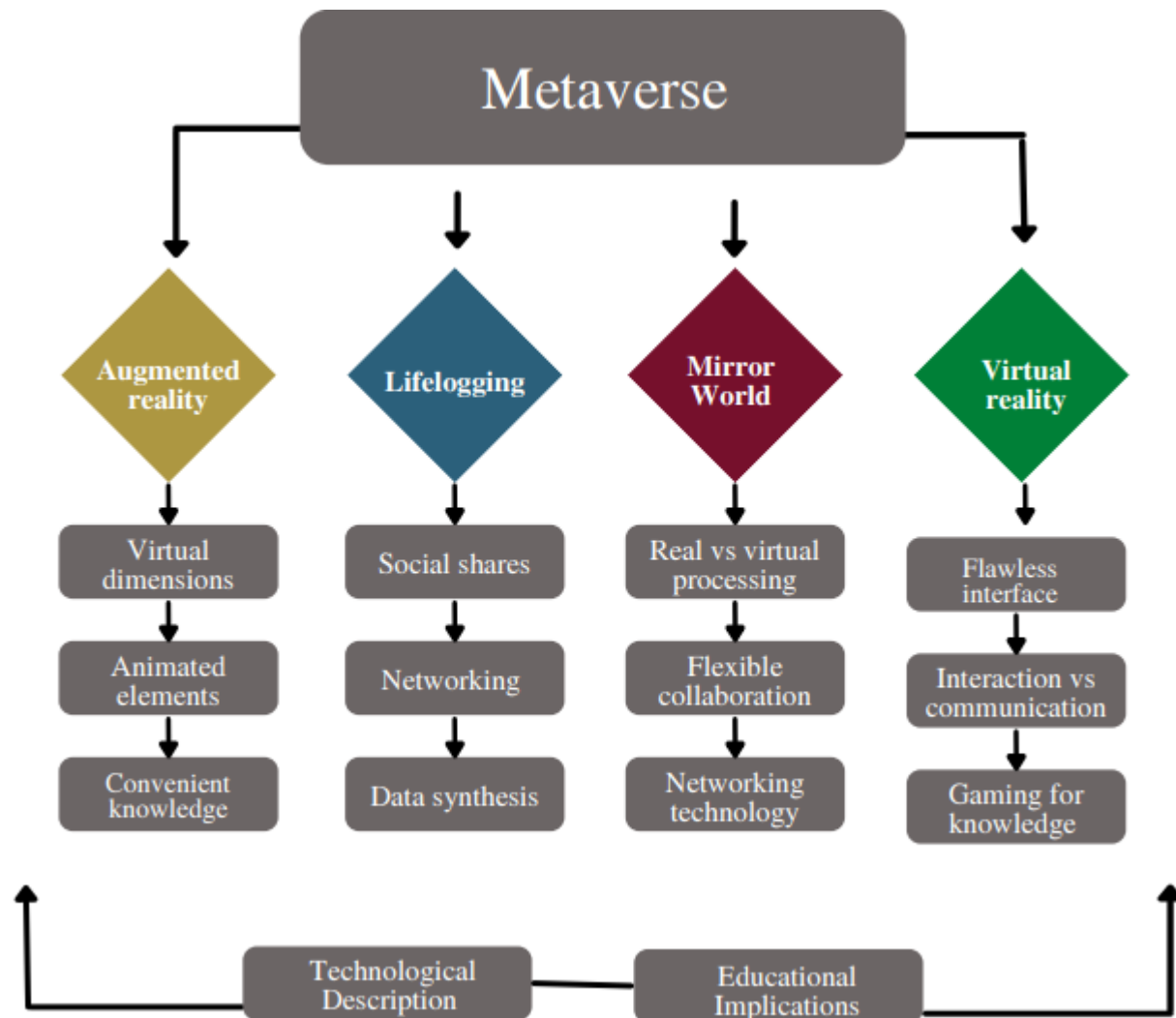
Figure 5

Advantages of using Metaverse in education
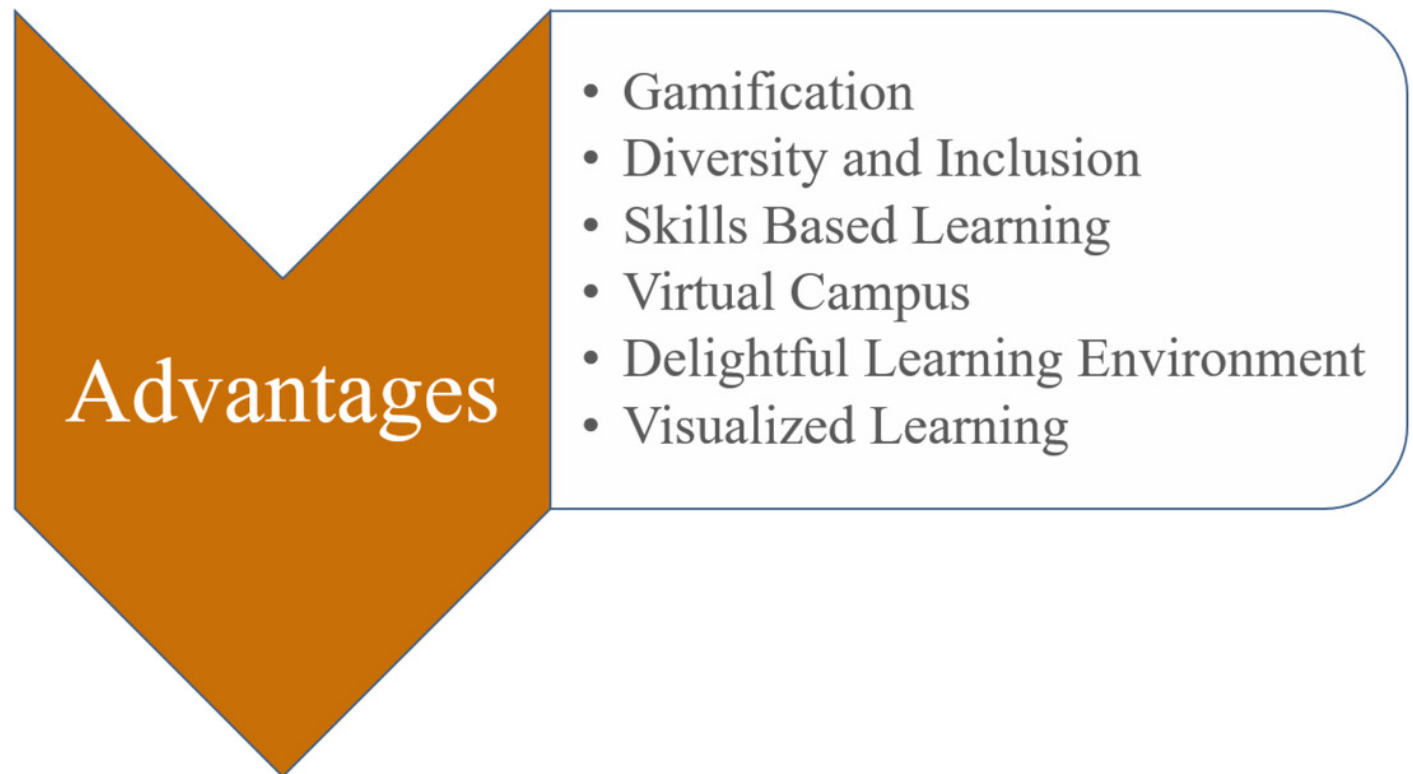
Figure 6

Disadvantages of using Metaverse in education

Inclusion and exclusion criteria Inclusion and exclusion criteria

Inclusion Criteria	Exclusion Criteria
• The article has been published in journals, books, and proceedings • The report is focused on the Metaverse in education, the use of the Metaverse in education, tools, applications, challenges, opportunities	• Thesis or university papers, webinars, reviews, duplicate papers, and workshop • Irrelevant literature reviews or short ones, general technical papers, articles that do not relate Metaverse to education

Some of the selected articles and studies with descriptions

Title	Year	Publisher/Journal	Key Findings
Evaluation for students' learning manner using eye blinking system in Metaverse.	2015	*Procedia Computer Science*	New avatar-blinking technology was introduced for a virtual problem-based learning (PBL) class in the Metaverse. With the blink system, teachers may thoroughly examine students' reactions to get better results.
Towards data justice? The ambiguity of anti-surveillance resistance in political activism.	2016	*Big Data and Society*	- There is uncertainty around this type of anti-surveillance resistance in connection to more significant activist behaviors - (re)conceptualized on terms that may address the consequences of this data-driven form of governance in connection -Towards more comprehensive social justice agendas - Transition to surveillance capitalism
The geography of Pokémon go Beneficial and problematic effects on places and movement.	2017	*In Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems, New York*	- The design of Pokémon G.O. reinforces pre-existing geographically linked biases - Pokémon G.O. has geographically-related safety risks - Geographic design considerations
Cyber-syndrome and its formation, classification, recovery, and prevention	2018	*IEEE Access*	- Nomophobia - Genesis stages, categorization, treatment, and prevention of cyber-syndrome - How cyber-syndrome influences physical, social, and cognitive environments
Distributed Metaverse: Creating Decentralized Blockchain-based Model for peer-to-peer Sharing of Virtual Spaces for Mixed Reality Applications.	2018	*In Proceedings of Augmented Human International Conference (A.H.)*	- Mixed reality: Social and collaborative applications - Decentralized peer-to-peer distribution paradigm

Copyrights in higher education: motivating a research agenda.	2019	*Journal of Technology Transfer*	- I.P. ownership, copyrights, intellectual property in universities - Fundamental legal and policy investigations
The ethics of Smart City (EoSC): Moral implications of hyper-connectivity, algorithmization, and the datafication of urban digital society	2020	*Ethics and Information Technology*	- Potential strategies for addressing the underlying moral issues by demonstrating the effects and implications of digital connectedness, algorithmization, and the datafication.
Identity Reshaping and Manipulation In Cyberspace	2020	*Anthropological Research And Studies*	- Personal Privacy - Privacy of behavior and decisions - Privacy of communication in an online medium - A.I. driven decisions
The virtual world is a resource for hybrid education.	2020	*iJET*	- Metaverse as a complementary digital tool to the teaching-learning process in the university - Freedom of access to synchronous and asynchronous information - The issue of the design, development, and implementation of a virtual or metaverse world in an educational environment - how mobile and hybrid learning models for collaborative class.
Public Policy for the Metaverse: Key Takeaways from the 2021 AR/VR Policy Conference	2021	2021 AR/VR Policy Conference.	- Building an immersive future - Innovation through accessibility and inclusion - Utilizing a solid knowledge base as individuals, communities, and policy makers

Netiquette: ethic, education, and behavior on the internet	2021	*International journal of environmental research and public health,*	- Cultural changes due to the information and communication technologies (ICT) - Netiquette in the age of social network
Metaverse for social good: A university campus prototype.	2021	*In Proceedings of the 29th ACM International Conference on Multimedia.*	- Technology for social benefit - Macro view, a three-layer metaverse design: infrastructure, interaction, and ecology. - Transcending toward a historical and a fictional metaverse - A blockchain-driven metaverse prototype of a university campus
A complete survey on technological singularity, virtual ecosystem, and research agenda.	2021	Cornell University	- Accelerated digital transformation through "Metaverse - Metaverse ecosystem
Hidden town in 3d: Teaching and reinterpreting slavery virtually at a living history museum	2021	*J Comput Cult Herit*	- Collaborative digital humanities education, including - Multidisciplinary project-based learning,
Immersive Virtual Reality in K-12 and Higher Education	2021	*Virtual Real*	- Immersive Virtual Reality (V.R.) applications in Higher education - Virtual instructional design approaches
Big Data, Antitrust, and Monopolistic Power over Human Behavior	2021	*UCDavisLaw Review*	- Theory of antitrust - Monopolistic hold on biopower to attain biosupremacy and control over human behavior
Ready teacher one: Virtual and augmented reality online professional development for K-12 schoolteachers	2021	Computers	- Virtual reality (V.R.) and augmented reality (A.R.) stimulate students' episodic memories - Educational advantages of A.R. and V.R. - inquiry-based learning and digital storytelling
A content analysis of	2021	*Journal of Metaverse*	- Gaming businesses

the metaverse articles.			- Creating consumer's distinctive experiences and learning journey
The future of online trust (and why Deepfake is advancing it).	2021	A.I. Ethics	- Trustworthy A.I. -Deepfake risk posed by unreliable A.I. -Democracy and internet trust. - Social trust challenges of the digital era
A Survey on Metaverse: the State-of-the-art, Technologies, Applications, and Challenges.	2021	Cornell University	- Technological architecture of the Metaverse - Network Infrastructure - Management technology
Will Metaverse be NextG Internet? Vision, Hype, and Reality	2022	Cornell University	- Essential prerequisites for the Metaverse. - Possibilities and potential future areas for more innovation.
Definition, roles, and potential research issues of the Metaverse in education: An artificial intelligence perspective.	2022	*Computers and Education: Artificial Intelligence, Elsevier*	- Characteristics of the Metaverse and potential uses - Metaverse definition - Challenges in academic environments - Functions of A.I. in the Metaverse and metaverse-based schooling
Advancing Education Through Extended Reality and Internet of Everything Enabled Metaverses: Applications, Challenges, and Open Issues	2022	Cornell University	- Metaverse paradigm - Meta technology educational applications - Ethical issues of using the Metaverse in education
An Exploratory Study on the Production of Metaverse Ethics Education Contents for Adolescents	2022	*EasyChair.*	- Virtual reality evolution during Covid-19 - Social and ethical issues - Cybercrimes - "Metaverse Ethical Principles"

A Metaverse: Taxonomy, components, applications, and open challenges	2022	*IEEE Access*	- The social value of Generation Z - Connectedness with reality - Deep learning in the Metaverse
The Metaverse as a Virtual Form of Data-Driven Smart Urbanism: On Post-Pandemic Governance through the Prism of the Logic of Surveillance Capitalism.	2022	*Smart Cities*	Challenges of the Metaverse have via the social and economic logic of surveillance capitalism - Evaluating the effects of Metaverse's widespread adoption as well as users in making decisions about its use in daily activities
Avatars in the Metaverse: potential legal issues and remedies	2022	International Cybersecurity Law Review	This article discusses problems with a real-life person's avatar in the Metaverse. - What does the anticipated rise of the Metaverse entail - Avatar's copyrights - Methods for giving legal personality to avatars in the metaverse \ - Imposing accountability on a real-life person - Possible legal problems in the Metaverse - Potential for statutory remedies and judicial interpretation to address avatar-related wrongdoing.

Educational implications of the four elements of the Metaverse

Augmented reality	Lifelogging	Mirror world	Virtual reality
- Accurately solve problems using virtual digital information to teach invisible portions graphically - Deep grasp of subject matter	- Reviewing and reflecting on one's daily activities -Capacity to present and use the information correctly -Retrieving feedback from others on social media sites results in reinforcement and incentives - Use collective intelligence to recreate the information learned - Examine knowledge understanding and make improvements based on learning analytics data - Data-driven decision for teachers for personalized learning and guidance	- Learning beyond physical borders - Conducting collaborative real-time online classes - Students can achieve "learning by making, real-life experience - Engaging with their digital heritage.	- Practice can be done through virtual simulation - learning beyond time - Improving strategic and comprehensive problem-solving skills