Making Sense of Reality: A Mapping of Terminology Related to Virtual Reality, Augmented Reality, Mixed Reality, XR and the Metaverse

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Abstract

The academic research in information systems and neighbouring disciplines has produced multiple terms and concepts relating to media-generated "realities", often called with the umbrella acronym XR denoting either "extended reality", "x-reality" or "cross reality". As new technological solutions and media emerge along with new modalities and forms of interaction, industry and academia come up with new terms, or adopt existing terms (e.g., the metaverse), to describe these concepts. This has resulted in an increase of often partially overlapping terminology and a lack of shared understanding. The aim of this work is twofold: (1) to discover prominent academic XR concepts; and (2) to understand what the concepts describe and how they relate to and differ from each other. We approached these two goals with a bibliometric review technique followed by a narrative review. We discovered 19 unique terms which carried meaning in four areas: as (1) technologies; (2) end user experiences; (3) descriptors of the reality they create; and (4) descriptors of the interactions they afford. Our work offers an overview of the terms currently in circulation and provides a snapshot of the complex space of overlapping definitions and metalanguage.

Keywords: augmented reality, mixed reality, virtual reality, XR, metaverse

1. Introduction

On June 5, 2023, Apple announced the release of the Vision Pro headset. In the marketing description of this device, Apple describes it as "seamlessly blending digital content with your physical space" (AppleInc., 2023). Professional news agencies used a variety of terms to describe it, including: mixed reality (MR) (BusinessInsider, 2023), augmented reality (AR) (BBC, 2023), extended reality (BusinessKorea, 2023), and virtual reality (VR) among others. The fact that a single new device is immediately described with a variety of different terms and acronyms, and that professional news organisations choose so many different concepts to describe the same product, tells something about a the state of messiness (Law, 2004) of the entire field.

It is worth mentioning that, whatever our definition of "reality" might be – an external one as posited by scientific research (Hunt, 2011) or one based on social constructions (Berger and Luckmann, 1967) – none of the mediatic spaces we are discussing belongs to a different reality. The term, instead, is a metaphor, as it is often the case when describing media (Volli, 2005), that answers to an effect of meaning based on a specific form of perception: virtual spaces are experienced as alternatives to our paramount reality, and therefore commonly described as "different" realities. As we seek to observe these digitally mediated experiences of reality, in this work we select the term media-generated reality (MGR) as a working term to describe MR, VR, AR and other similar concepts. The term does not imply that objective reality is technologically mediated, but rather, the user's immediate sensory experience of it is.

This mess around MGR terms has been noted in academia. For example, Dolata and Schwabe, 2023 go as far as claim that the term metaverse has become a moving target and a buzzword that is impossible to conclusively define. Similarly, Speicher et al., 2019 discovered significant differences among how academics and industry experts understood the concept of mixed reality (MR), and provided empirical evidence of six unique ways the term was understood. Major businesses involved in AR and VR often

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provide their own, programmatic, definitions for these terms. IntelCorporation, 2023, for example, provides its own definitions of AR, VR and MR, that again differ from multiple academic ones. Recently, Rauschnabel, Felix, et al., 2022 conducted a literature review on extended reality concepts, followed up by expert interviews and a focus-group study. They similarly discovered discrepancies in how the terms are used and interpreted, and suggested their own conceptualization of how to use terms such as x-reality, AR, MR and VR. While these studies have offered important insights, there remains a research gap in exploring what MGR terms have been established in academia. Indeed, observing recent advances in this field (e.g., Rauschnabel, Babin, et al., 2022; Rauschnabel, Felix, et al., 2022; Speicher et al., 2019; Ziker et al., 2021), there remains a need for a rigorous approach to first of all discover, but also to clarify and systematise this terminology. Thus, we sought to explore what MGR terms have been established in the extant scholarly corpus and how they relate to and differ from each other, and propose the following research questions (RQs):

RQ1: *What MGR terms have been established in the academic literature?*

RQ2: *What do these terms express and how do they conceptually relate to and differ from each other?*

In order to answer the RQs, we used two literature review techniques. First, we ran a bibliometric search to uncover all MGR-related keywords appearing in the academic literature. Second, we performed a narrative review to understand the meanings behind these terms. While this review is not exhaustive, it provides an overview of the academic landscape surrounding terms such as VR, AR and the metaverse, and offers readers a snapshot of how the terms are used and understood.

2. Materials and methods

2.1. Discovering unique media-generated reality terms from the academic literature

The process of term identification consisted of three steps. First, we selected a seeding concepts based on our existing knowledge on the topic. These were (1) VR; (2) AR; (3) MR; (4) extended reality; and (5) metaverse. We run the initial searches on Scopus, a research database that indexes Elsevier's journals and proceedings and databases such as the ACM Digital Library, the DBLP Computer Science Bibliography, IEEE eXplore, and Springer link among others (Morschheuser et al., 2017; Spors et al., 2023).

Second, we searched for titles, abstracts and keywords with the five keywords in January 2023. We limited the studies to peer-reviewed work. The articles

had to be accessible and written in English. We then downloaded the metadata of all the discovered studies, and used VOSViewer (Van Eck and Waltman, 2017) for bibliometric analysis and investigated the author-given keywords of the studies. The focus on keywords was chosen to simplify the procedure so that it can be carried automatically and systematically with the chosen tool. We went through all the keywords that appeared in at least 3 studies and marked down keywords that somehow related, or had the potential to relate, to MGRs. This process was done by the first author. Below we summarize our inclusion and exclusion criteria for the keywords.

Inclusion criteria:
#1 Describes a digitally constructed, mediated or altered form of "reality", where reality is understood as the user's sensual perception and conception of their surroundings.
#2 Appears in at least 3 peer-reviewed academic studies.

Exclusion criteria:
#1 Terms relating to a specific area such as video gaming or surgery.
#2 Terms that are a mixture of other terms, such as "augmented context-aware reality".
#3 Terms that describe a reality continuum, such as "augmented-mixed reality continuum", which describe how MGR concepts should be organized, not the terms themselves.
#4 Descriptive terms such as "immersive system".
#5 Related concepts that did not aim to describe MGR, such as "remote presence".

Through this process we discovered 16 unique MGR terms. In the third step of the bibliometric approach, we conducted a new, iterative search research on Scopus. We searched for the newly discovered terms, which led to the discovery of three more, and repeated the process again including those three. When the next iteration of this process did not yield any new terms for consideration, we decided that we had reached saturation. We recorded all the 19 terms in a table, with example studies mentioning them. In order to avoid excessive overlapping or diluting the epistemological coherence of the set of terms, we have excluded from the study terms related to specific areas (e.g., "pervasive games" (Kasapakis and Gavalas, 2015), location-based games (Laato et al., 2023), "augmented surgery" (Dubois et al., 1999), "virtual sightseeing" (Lebiedź and Szwoch, 2016) and ambiguous and descriptive terms, such as "remote presence" (Pope et al., 2022), immersive technologies and altered states of consciousness (Jung et al., 2022).

2.2. Finding descriptions and use cases of the terms

Next we conducted a narrative review, an approach particularly suitable for exploring a research topic openly, and suitable in our case due to the convoluted and complex nature of the field (Demiris et al., 2019). We proceeded to run targeted searches with all of the 19 discovered terms for the purpose of discovering what meanings they convey in the academic literature. Our search strings were: *[DISCOVERED CONCEPT HERE] + "definition* OR conceptualisation OR conceptualization" OR "taxonom*"*. In doing so we encountered two issues: First, we found multiple studies producing definitions for more than one concept. Similarly to what was noted by Speicher et al., 2019, we also noted conflicting definitions, or differences in emphasis. Since the focus of this study is to provide an overview of the terms, we did not do any definition comparisons, but rather, opted to uncover how scholars understood and used the terms.

Second, for some concepts it was difficult to find definitions. For example, the term "assisted reality" appeared in some studies, but their source for the definition, (see e.g., Willis et al., 2023) never mentions assisted reality. In these cases, we used Google Scholar to help us find a definition study. When, as in the case of assisted reality, we still could not find an explicit definition, we took the description of the concept from studies using the term. Finally, we detected conceptual clarity issues in the overall extant academic corpus around acronyms. "AR" was used both to refer to assisted reality (Willis et al., 2023) and augmented reality, "XR" for X-reality (Simões et al., 2018), extended reality (Xi et al., 2023) and cross-reality (Ziker et al., 2021) and "MR" for mixed reality, mediated reality and multimediated reality (Mann et al., 2023). To avoid confusion, we opted to only use the acronyms for the three popular terms in our reporting: VR for Virtual Reality, AR for augmented reality, and MR for mixed reality.

3. Findings

The most popular terms in the extant literature for describing MGR concepts were AR, VR, MR, extended reality and the metaverse. These terms are displayed in Table 1.

3.1. The overarching term for "media-generated realities"

We observed an ongoing disconnect in the academic literature regarding what should be the highest level umbrella term for all MGR concepts. Through our systematic search, we discovered five contenders for this. The three "main ones" are confusingly enough are all abbreviated as XR: extended reality, cross reality and X-reality. In addition there are the concepts of mediated reality and multimediated reality (Mann et al., 2023) which in addition to describing concepts such as AR, VR and MR, also include aspects of modifying reality itself. Next we discuss these concepts.

First, regarding X-reality (sometimes written x-reality or xReality) we have scholars such as Leopardi et al., 2021, Rauschnabel, Felix, et al., 2022 and Simões et al., 2018 who make the argument that since new concepts emerge constantly, the umbrella term to describe all of them should include a random variable x in it. This has given rise to the concept of X-reality, which Simões et al., 2018 defines as *"all real-and-virtual combined environments and human–machine interactions generated by computer technology."* and other scholars such as Rauschnabel, Felix, et al., 2022 have followed suit, declaring that x-reality (or xReality) should be the overarching term to describe all MGR concepts.

Second, we have the term extended reality, also often abbreviated XR (Palmas and Klinker, 2020), which is the oldest and most widely used umbrella term. According to an ad hoc search done on Scopus in June 2023, extended reality appears in the title, abstract or keywords of 1575 documents whereas "x-reality OR xReality OR x reality" only results in 77 documents. Extended reality is typically used as simply an umbrella term, with not much more meaning of its own (Cárdenas-Robledo et al., 2022; Xi et al., 2023), and according to Steffen et al., 2019 what makes an activity "extended reality" is virtualization in one form or another.

Third, we have cross reality, also abbreviated as XR, which according Ziker et al., 2021 refers to "technologies and applications that involve combinations of MR, AR, VR and virtual worlds", a description that sounds very similar to the two previous ones. Similarly to extended reality and x-reality, cross reality also does not seem to carry any specific meaning on its own, but is used as an umbrella term.

Here we begin to notice that we have one acronym, three interpretations of which the acronyms come from, but again only one meaning for the acronym. For this reason e.g., the argument in Rauschnabel, Felix, et al., 2022 that it would be "a mistake" to say that XR stands for extended reality seems unnecessary. However, we have two more concepts that are runner ups for the umbrella term, which originate altogether

Table 1. The media-generated reality -related terms discovered in this study, descriptions of them from the extant literature and definition papers, and sources for the descriptions. Note we offer descriptions, not definitions, since for many terms there is no consensus on what the definition should be.

#	Concept	General description	Source
1	Extended reality	An umbrella term, similar to X-reality and cross reality, for describing media-generated realities	Cárdenas-Robledo et al., 2022
2	xReality / X-Reality	xReality should replace extended reality as the overarching term where "X should be the placeholder for "all" new reality formats"	Rauschnabel, Felix, et al., 2022
3	Mixed reality	Harnesses technology to alter our perception of the physical world. However, there are multiple ways to understand the concept in circulation with no unified clear meaning.	Skarbez et al., 2021
4	Augmented reality	Integrating virtual content into the user's perception of the physical world	Rauschnabel, Babin, et al., 2022
5	Virtual reality	"Incorporates computer-generated, interactive and highly vivid environments that enable the user to achieve a state of immersion through the ultimate experience of telepresence, and facilitate engagements in human encounters that are multi-sensorial, dynamic and resemble the user's perception and understanding of the real world."	Boyd and Koles, 2019
6	Hybrid reality	A location-aware technology that incorporates aspects of the physical world into the product	De Souza e Silva, 2009
7	Digital reality	"refers to all human–machine interactions in virtual environments using digital technologies including VR, AR and MR"	Lee and Cho, 2023
8	Mediated reality	"Describes the concept of filtering or vision of reality, typically using a head-worn video mixing display" includes the aspect of modifying reality.	Grasset, Gascuel, et al., 2003
9	Multimediated reality	"A multidimensional multisensory mediated reality that includes not just interactive multimedia-based "reality" for our five senses but also includes additional senses (like sensory sonar, sensory radar, etc.), as well as our human actions/actuators"	Mann et al., 2023
10	Holoportation	"Demonstrates high-quality, real-time 3D reconstructions of an entire space, including people, furniture and objects, using a set of new depth cameras."	Orts-Escolano et al., 2016
11	Assisted reality	"Provides an immediate field of vision, hands free, with no virtual component."	Willis et al., 2023
12	Diminished reality	Technologies for creating perceptions of hiding, or visually removing content from the physical world	Mori et al., 2017
13	Virtual world	Inherently "social and collaborative" digitally created perceived spaces	Ziker et al., 2021
14	Digital world	A computer-generated perceived space	Belk, 2013
15	Blended spaces	"A blend of physical and digital space" where cross-domain mappings and conceptual integration between the two occur	Benyon, 2012
16	The metaverse	"a buzz-phrase among tech businesses", a moving target and "a new, continually evolving sociotechnical phenomenon"	Dolata and Schwabe, 2023
17	Telepresence	A transportation of one's physical movements to another place, manifested there by e.g., a robot	Minsky, 1980
18	Cross reality	An umbrella term, similar to X-reality and extended reality, for describing media-generated realities	Ziker et al., 2021
19	Augmented virtuality	"the augmentation of a virtual environment with real-world objects or information"	Vellingiri et al., 2023

from a different stream of research: mediated reality and multimediated reality. According to Mann et al., 2023 these words encompass not only what XR does, but expands this by including the modification of reality. Whereas mediated reality only includes the aspect of modifying a singular reality perception, multimediated reality expands the sensory landscape from the five main senses and involves human actions or actuators. However, these two are more hypothetical at this point.

To conclude, we have an acronym to describe MGR terms: XR, but we seem to disagree about what it stands for. We then have concepts that involve the modification of reality, that expand upon XR: mediated and multimediated reality.

3.2. What meanings do the terms carry?

Understanding the meanings behind the terms is not straightforward, since the extant literature disagrees and provides conflicting definitions and conceptualizations of the meanings of the terms. For example, Boyd and Koles, 2019 showed how the term VR carries meaning in multiple dimensions and has evolved from 1970's when it was first proposed as a concept to more contemporary meanings that are tied to technologies such as VR headsets, ideas such as describing actual virtual spaces, a way to describe interactions and also experiences such as immersion. Similar findings have been reported in definition studies for the other terms as well. In the highly cited work of Mystakidis, 2022, the term metaverse is conceptualized to carry meaning in four dimensions: affordances, technology, principles and challenges. In this work we approached the terms from a perspective of what the terms in their essence describe, and hence chose not to focus on challenges related to the terms, nor the principles upon which they are founded. Thus, we examined meanings of the terms in predominantly four dimensions (e.g., present in Boyd and Koles, 2019): (1) technology; (2) user experience; (3) concept; and (4) interactions. Next we provide examples from the extant literature of each of these dimensions across selected example terms.

3.2.1. Describing a technology
Yoh, 2001 argues that VR specifically is not "a material, such as computer hardware or communication equipment", Boyd and Koles, 2019 define it as incorporating "computer-generated, interactive and highly vivid environments..." and Riva, 2002 explicitly describe it as "a collection of technologies that...". Regardless of whether VR and the other reality-concepts denote a technology, or something created through technology, all these concepts are today used in connection to some specific technologies, architectures or solutions. Berryman, 2012 even opens by stating explicitly: "Augmented reality is a technology that overlays...".

Nowadays we ubiquitously see technology equipment marketed with the VR term specifically, such as "VR headsets" (Dempsey, 2016). Similarly we have AR headsets (Furlan, 2016), which are also sometimes referred to as MR headsets (Al Janabi et al., 2020), and metaverse headsets (Kwok and Tang, 2023) among others. While it is clear that these headsets or other hardware are not the thing itself (e.g. VR), they are the sole means of achieving that thing, and hence cannot be unlinked from it. In fact, the word "computer-generated" appears explicitly in three definitions of VR provided in academic work (Kardong-Edgren et al., 2019) and in definitions of AR (Berryman, 2012) among others.

There exists the question of do all the 19 terms connect to technology in the same way. For example, the three terms that are abbreviated "XR" do not even attempt to describe any specific technological solution, but an umbrella term instead. Furthermore, terms such as "Virtual world" and "digital world" are both computer-generated, but quite clearly refer to virtual spaces, not the technology through which they are constructed.

3.2.2. Describing the user experience
Some scholars defined and understood the terms through the user experience. In particular, the concept of immersion was often mentioned in connection with terms such as VR, MR or the metaverse. In their explicit definition of VR, Boyd and Koles, 2019 argue that VR helps users achieve "a state of immersion". Kardong-Edgren et al., 2019 go as far as advocating that VR definitions should specify the level of immersion and which senses (sight, smell, audio) the system targets.

While immersion was the most highly cited component of any of the media-generated reality keywords, other descriptive words related to the user experience also appeared. Mystakidis, 2022 describes that the metaverse feels embodied and provides a sense of presence. With holoportation the term "remote presence" is mentioned, a feeling of connecting with other people or a place from afar through the technology (Pope et al., 2022).

3.2.3. Describing a concept such as a (socially shared) digitally constructed space
In particular the earlier definitions for VR, telepresence and others were more tied to them as concepts (see e.g., the definition for telepresence by Minsky, 1980) describing a space.

This is understandable, since at the time with the rapid advances made in hardware and software technology it was conceivable that we would at some point reach a specific type of VR, but it was unclear what it would look like as a technical implementation. As recently as in 2001, Yoh, 2001 postulated that VR should be understood as "things, agents and events that exist in cyberspace". However, since then terms such as VR have begun acquiring meaning through solutions such as HTC Vive or Meta Quest. In fact, in recent definitions (e.g., Boyd and Koles, 2019) VR is no longer presented as a concept, but a more specific form of technology-constructed experience.

Besides VR, terms such as "virtual world" are more concepts and less tied to a specific form or type of technology (Ziker et al., 2021), whereas terms such as "the metaverse" have become convoluted concepts and even "moving targets" when it comes to trying to understand them as concepts (Dolata and Schwabe, 2023). Interestingly, some of the more futuristic concepts, such as mediated and multimediated realities, that include the aspect of modification of reality, remain more closely at the level of concept with less technical specifications attached to them (Mann et al., 2023).

3.2.4. Describing interactions In their definition of digital reality, Lee and Cho, 2023 specify that it refers to interactions within virtual environments in particular. According to Boyd and Koles, 2019, VR has "interactive and highly vivid environments" and multimediated reality is "not just interactive multimedia-based reality" Mann et al., 2023. Interactivity can take multiple forms. From hand gestures to voice recognition, newer solutions such as the Apple Vision Pro make use of eye gaze as a mechanism for interacting with the system (AppleInc., 2023).

In Niantic's location-based game Pokémon GO, there is a specific "AR-mode" that uses the mobile device's camera to play Pokémon creatures on top of the camera feed. This has caused players, and occasionally also researchers, to refer to that interaction feature as AR (Laato et al., 2021). Also terms such as "holoportation" contain a link to interactivity, as they are about moving the individual from one room into another through digital capturing and reconstruction (Orts-Escolano et al., 2016).

3.3. How the terms relate to one another

Among the discovered MGR terms, a few directly refer to the mixture of two or more of these terms. These include the umbrella term XR, and MR among others.

One of the first and most highly cited conceptualizations of how the terms relate to each other is the MR continuum of Milgram and Kishino, 1994. In this conceptualization the "real environment", referring to physical space, is placed on one end of the spectrum, and a virtual environment on the other end. Terms such as AR and augmented virtuality are placed on this axis between the two ends, and all terms that are not VR can be labelled as MR. Multiple versions of this conceptualization are in circulation in the academic literature, with some studies drawing a Venn diagram where MR is placed between AR and VR and some placing MR as a technology that penetrates three key layers involved: the human (user), the computer (technology) and the environment (Parveau and Adda, 2020).

Since the seminal paper of Milgram et al., 1995, MR in particular, but also other MGR terms have been conceptualized as continuums. Recently a couple of studies have built on top of this, most notably Skarbez et al., 2021 who proposed a three dimensional taxonomy consisting of three axis: (1) extent of world knowledge contiuum, that goes from an unmodelled real world to a perfectly modelled real world; (2) immersion contiuum, that goes from no virtual content to a system supporting all user actions; and (3) the coherence continuum that also starts from no virtual content but goes towards all virtual behaviors being plausible. This approach has the issue of dimensions 2 and 3 being similar, and there being a mix between the user's experience or state (immersion) and available interactions.

More recently Rauschnabel, Felix, et al., 2022 also accepted the idea of placing the reality terms on a continuum, but instead proposed a dynamic of two continuums: (1) an AR continuum, that goes from assisted reality to mixed reality; and (2) a VR continuum, that goes from atomistic VR to holistic VR. They argue that all technologies can be placed onto one or the other continuum through simply asking the question of whether the user's current physical environment is part of the experience in any way. If yes, it belongs to the AR continuum and if no, it belongs to the VR continuum. This approach challenges the previously established paradigms where MR is positioned a mixture of both AR and VR or in a continuum from reality to virtual reality (Speicher et al., 2019), but supports others such as the idea of MR being a stronger version of AR (McGill et al., 2017).

Several scholars also referred to existing terms to define their new technologies. An example comes from Orts-Escolano et al., 2016 who explain holoportation as an "end-to-end system for AR and VR telepresence". In the study however, instead of

opting for a clean one or two sentence definition for holoportation, Orts-Escolano et al., 2016 describe their system in specific and detailed ways.

4. Discussion

4.1. Key Findings

Our main findings are as follows. First, we systematically searched for the academic peer-reviewed studies for terms describing MGRs, and **discovered 19 unique established terms**. This is not an exhaustive listing, but offers researchers and practitioners a look into what MGR-related terms have been established and are used in academia. Second, we demonstrated that there is **significant overlap in the meanings behind the terms**; i.e., some terms such as cross reality, x-reality and extended reality are almost, or completely interchangeable, and others such as AR and MR are, e.g., in Rauschnabel, Felix, et al., 2022 seen as being part of the same spectrum, while VR remains conceptually different from the two. Third, we showed that there is variance also **within the understandings of individual terms**, with different emphasis regarding what meanings the terms convey and how they fit to the broader taxonomy of MGR concepts. Overall, this creates the need for researchers and practitioners to always define the terms they use in a specific way, as there is a lack of a shared understanding of the nomenclature.

4.2. Implications for research and practice

Our findings echo Speicher et al., 2019 and others in that there are no universally shared understandings of MR, but demonstrate that this lack of shared understanding also exists in almost all MGR concepts. Despite recent attempts to unify the field (e.g. Rauschnabel, Felix, et al., 2022) there remains conceptual confusion in the industry and in academia. Based on our findings, we argue that this confusion stems from the following factors.

First, a probable root cause is that the terms emerge as a response to technological evolution, and are influenced by efforts of marketing and advances in engineering, with a limited contribution opportunities by academic research. We have seen this in practice, for example, with the sudden outburst of metaverse-related research in academia after Facebook Inc. changed their name to Meta and shared their vision of a social digital future. This industry- and technology-driven process and the inherent connection to constantly changing and evolving technology has arguably propelled some of the identified reasons for the observed lack of conceptual clarity.

Second, the concepts focus on different types of phenomena, such as technologies (e.g., a VR headset Dempsey, 2016), as experiences (e.g., an immersive VR experience Boyd and Koles, 2019), as concepts (e.g., things and agents in the cyberspace constitute VR Yoh, 2001) and as forms of interaction (e.g., VR offers interactive elements for users Boyd and Koles, 2019). Yet, sometimes the terms are only used to refer to their meaning in one of these dimensions, while perhaps being understood in a broader sense.

Third, confusion may stem from the concepts being studied across different fields. In addition to IS (e.g., Xi et al., 2023), we found examples from medicine and surgery (Dubois et al., 1999), games and playfulness (De Souza e Silva, 2009), education (Ziker et al., 2021), HCI (Pope et al., 2022) and tourism (Lebiedź and Szwoch, 2016) among others. This highlights the interdisciplinary nature of these concepts and technologies which creates an issue of having no shared research tradition to guide the use of these terms. There may also be national cultural differences influencing the understandings and interpretations of these terms (Kordyaka et al., 2023).

Fourth, new technological and engineering innovations constantly take place, and businesses and marketers sometimes wish to differentiate their new products from existing ones. This can lead to them coming up with new terms, further complicating the terminology landscape. Major industry stakeholders are also pushing their own definitions (see e.g., IntelCorporation, 2023) that sometimes differ from academic definitions, leading to a gap in shared understanding.

Together, these four reasons suggest that both academics and practitioners should be precise in describing their systems, since terms such as VR, AR and MR are almost too broad and divided to be useful words without further elaboration. A good example of a company following this approach of avoiding these words and being precise in their description of the system is the marketing of Apple's Vision Pro headset (AppleInc., 2023). We suggest that IS scholars can continue using terms such as XR or the metaverse, but remain mindful of the epistemic roots of the terms and the meanings they carry.

4.3. Limitations and future work

Our approach was suitable at finding those MGR-related terms that are somewhat established appearing in at least 3 peer-reviewed academic studies, and those that are connected to the extant academic

literature of surrounding concepts. Thus, this search was not exhaustive and some novel and off terms may exist beyond what we discovered. Moving forward, we also expect new terms to appear (from the direction of academia, industry or other places such as science fiction novels). Thus, future research should look into understanding whether there really is something new with a new term that emerges, what dimensions (e.g., technology, experience, concept, interaction) it relates to, and to what other concepts it relates to. Equally important is to observe how these terms are discussed in the media, and how the common understandings of the terms might evolve over time.

Another limitation of this work was that while we systematically uncovered 19 media-generated reality concepts, we did not systematically seek to define them. This remains a topic for immediate future research. Past research has provided guidelines for generating conceptually clear definitions (Suddaby, 2010; Wacker, 2004), and having such definitions may further assist in understanding the linkages between the concepts, and what meaning they convey.

5. Conclusion

Even rigorous analyses of just one MGR concept (e.g. MR or XR) have yielded that there is no single accepted definition for the concept (Rauschnabel, Felix, et al., 2022; Speicher et al., 2019). As a remedy, we encourage both researchers and practitioners to create a common ground by offering explicit definitions for the terms they use and possibly to indicate concrete products such as HTC Vive or Holo Lens as reference points.

In conclusion, we argue that as a field that throughout its history has operated at the intersection of computer science and business, and which draws from theories from other neighboring disciplines such as psychology, IS has the potential to contribute interdisciplinary knowledge here and serve as the wayfarer for also other disciplines in providing accurate and unified nomenclature regarding MGR terms. Once we are able to align our understanding and formulate shared precise meanings for MGR terms, we are then able to meaningfully and more effectively discuss emerging topics such as the metaverse.

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