Towards Techno-Psychological Immersion: A Narrative Literature Review of Immersion and Its Related Concepts

Tiina Paananen,[1] Tiina Kemppainen,[2]
Markus Makkonen,[3,1] Matilda Holkkola,[1]
Olli Tyrväinen,[1] Lauri Frank[1]

[1] University of Jyvaskyla, Faculty of Information Technology, Jyvaskyla, Finland
tiina.e.paananen@jyu.fi, markus.v.makkonen@jyu.fi, matilda.i.holkkola@jyu.fi, olli.p.tyrvainen@jyu.fi, lauri.frank@jyu.fi
[2] University of Jyvaskyla, School of Business and Economics, Jyvaskyla, Finland
tikemppa@jyu.fi
[3] Tampere University, Faculty of Management and Business, Tampere, Finland
markus.makkonen@tuni.fi

Immersion is re-trending interdisciplinary topic in academic research due to new digital innovations, such as augmented reality smart glasses. Immersion is, however, still criticized as being a vague concept which should be clarified. For instance, immersion can be analyzed from both psychological and technological perspectives, yet many studies solely focus on one aspect while neglecting the other. Moreover, technological immersion and immersive technologies can be incorrectly used as synonyms. Thus, in this study, we conducted a narrative literature review of selected articles on immersion. As a result, we present our summary, which includes four sense stimulators (visual, auditory, haptic, and olfactory) of technological immersion and three dimensions (spatial, narrative, and strategic) of psychological immersion. Also, we suggest that immersive technologies should be separated from technological immersion. Lastly, we propose a new perspective to immersion: techno-psychological immersion, which combines technological and psychological viewpoints of immersion.

Keywords:
immersion, technological immersion, psychological immersion, immersive technologies, techno-psychological immersion, narrative literature review

University of Maribor Press

DOI https://doi.org/10.18690/um.fov.4.2024.34
ISBN 978-961-286-871-0

1 Introduction

New technology trends are estimated to emerge during the next few years (Pucihar, 2020), enabled by digital transformation (Zimmermann, 2016). One concept experiencing a resurgence in popularity is immersion. Previously, the concept of immersion has been popular particularly in digital games and gaming (Ermi & Mäyrä, 2005). Immersion means deep concentration and attention into something (e.g., a game), where a user relies on their instincts (Brown & Cairns, 2004) and gets closer to being immersed into a virtual world as it would present the real world – blurring boundaries between these two environments (Lee et al., 2013). In immersion, a user becomes part of the experience, physically or virtually (Ermi & Mäyrä, 2005), and immersion can be viewed as stimulating the user's senses via technology – *technological immersion* or as a subjective experience – *psychological immersion* (Nilsson et al., 2016).

The concept of immersion is used across diverse domains, from retail to digital services. Hudson et al. (2019) studied immersive shopping experiences in metaverse environments. Acikgoz and Tasci (2022) found brand immersion interesting in brand community contexts. Also, everyday digital services (e.g., Netflix) are immersing their users (Kemppainen & Paananen, 2024a), with some studies suggesting that this engagement can even resemble a form of relationship (Paananen et al., 2022). Thus, it should be investigated how technology can lead a user to immersion (Soliman et al., 2017) or what are the causes and attributes of psychological immersion (Agrawal et al., 2020). This information could be used to enhance desired customer behavior during the customer journey.

The concept of immersion has been criticized to be widely used but unclear (Brown & Cairns, 2004), and it is still seen as a vague (Agrawal et al., 2020) and diverging (Sun & Botev, 2023) concept. The notion of immersion lacks a standard definition, with interpretations varying across different studies. Immersion can even be left undefined in research as in Tonteri et al.'s (2023) study. Hence, in this work, we aim to clarify the concept of immersion. Our research question is: how has immersion been conceptualized in research literature? We approach this question with a narrative literature review by reviewing both sides of the immersion concept. Previous recent literature reviews of immersion have focused on either technological immersion (e.g., Ambika et al., 2023; Queiroz et al., 2018; Suh & Prophet, 2018) or

psychological immersion (e.g., Agrawal et al., 2020; Nilsson et al., 2016), but not both sides simultaneously – and equally.

The structure of this article is as follows: First, we introduce our methodological approach, followed by the literature review. Next, we present a summary of the main findings of the literature review and discuss these findings in more detail. Finally, the limitations and potential paths for future research conclude this work.

2 Methodological Approach

A narrative literature review provides a summarized overview of selected articles related to the chosen phenomenon. This article seeks to understand immersion and investigates it from a technological and psychological perspective. Related concepts flow, presence, and transportation are included and compared to immersion because these are commonly reflected concepts within immersion (see e.g., Agrawal et al., 2020). This article follows the narrative literature review method by Cook et al. (1997). This method has been previously employed in immersion research in the study by Nilsson et al. (2016), whereas most previous literature reviews of immersion have been conducted either systematically (e.g., Ambika et al., 2023; Cummings & Bailenson, 2016; Queiroz et al., 2018; Suh & Prophet, 2018) or without a clearly described method, such as Agrawal et al.'s (2020) study. The reason for selecting the narrative method is that it provides a more extensive scope to phenomena than the systematic method, which focuses on certain specific questions (Cook et al., 1997). The goal of the narrative method is to summarize prior knowledge. However, it can lead to developing new theoretical perspectives (Paré et al., 2015), such as, by combining previous research into a map form, in other words, 'a greater whole' (Dijkers, 2009).

The narrative method does not usually provide a repeatable systematic review (Dijkers, 2009; Paré et al., 2015) but, instead, as a selective approach, it should provide a carefully considered selection of articles on the phenomena (Cook et al., 1997). We wanted to include immersion-related peer-reviewed studies written in English representing either the key studies on the topic or new studies introducing fresh perspectives. The content was sourced through exploration from Google Scholar and databases (e.g., AIS Electronic Library, MIS Quarterly Journal Achieve, Science Direct) and an examination of key studies pertaining to the topic. Key

studies were identified by the number of citations and their frequency in studies when familiarizing themselves with the topic. Furthermore, snowballing tact was utilized to identify newer sources or prominent works that were frequently referenced. We followed Webster's and Watson's (2002) advise to review outside the main field and, thus, included studies also from other fields than information systems (IS). Also, the narrative method gives the possibility to bring new perspectives to immersion research in IS. For example, the immersion-related studies in MIS Quarterly have focused on quantitative data (e.g., Agarwal & Karahanna, 2000; Lee et al., 2012; Nah et al., 2011; Saunders et al., 2011), and immersion is not the main research subject of these studies. This research offers a broader perspective, resulting in a deeper understanding of the phenomenon. Such insights can be valuable in immersion-related concepts like the metaverse, as noted in immersive VR study by Dincelli and Yayla (2022).

3 Immersion and Related Concepts

3.1 Immersion

Merriam-Webster dictionary describes the verb immerse as '*to plunge into something that surrounds or covers*' or '*engross, absorb*'. In turn, Murray (1997) describes immersion in her widely cited book on future cyberspace narratives as follows:

> *'Immersion is a metaphorical term derived from the physical experience of being submerged in water. We seek the same feeling from a psychologically immersive experience that we do from a plunge in the ocean or swimming pool: the sensation of being surrounded by a completely other reality, as different as water is from air, that takes over all of our attention, our whole perceptual apparatus. (Murray, 1997, p. 98)'*

Moreover, Slater and Wilbur (1997) present a technology-related definition to immersion:

> *'Immersion is a description of a technology and describes the extent to which the computer displays are capable of delivering an inclusive, extensive, surrounding, and vivid illusion of reality to the senses of a human participant. (Slater & Wilbur, 1997, p. 3)'*

As these two citations suggest, immersion can be separated into two major perspectives: *technological immersion* (representing the technology's or system's objective property) and *psychological immersion* (representing the individual's psychological state) (Agrawal et al., 2020).

3.2 Technological Immersion

Previous research indicates that studies emphasizing technological immersion primarily examine immersion from a technological standpoint. Sun and Botev (2023) describe technological immersion as a device's capacity to match, represent, and mediate the environment as in the physical world. Ambika et al. (2023) explain the goal is to broaden the user's reality and enable unprecedented experiences. In literature, technological immersion seems to be understood via different technologies and concentrates on two perspectives: 'technology immersion' and 'immersive technologies'. Lee et al. (2013) describe *immersive technology* as a technology that blurs the boundaries between the physical world and the simulated or digital world, leading to a user's sense of immersion, such as, when using an interactive real-time theatre. Daassi and Debbabi (2021) describe immersive technologies as multi-sensory digital environments extending or replacing the natural surroundings of a user. Thus, we separate technological immersion and immersive technologies into two different concepts. First, technological immersion concerns a technology-enabled immersion via sensory experiences. Second, immersive technologies represent the used technologies, such as augmented reality or virtual reality technologies. Immersive technologies are explained in more detail in the next section (3.3.2).

There are different perspectives on the concept of technological immersion, and Sun and Botev (2023) have criticized the immersion concept as diverging in academic research. For example, Agrawal et al. (2020) distinguish system and/or technology from the definition of immersion and propose using Slater's (2003) term 'system immersion' instead, which means technology or system as a facilitator of the experience. Slater (2009) also highlights that the system's physical properties determine the level of immersion. In our work, the emphasis on technological immersion lies in the sensory experience enabled by technology.

The core of technology immersion is the sensory experience where user's senses are stimulated. In a prior research, Slater (2003) have identified different types of technological immersion, which are *visual, auditory, haptic, and olfactory fidelity*. Similarly, in the gaming context, immersion is understood to rely on the player's own senses alongside involvement (Brown & Cairns, 2004). Following this, immersive virtual reality (IVR) has been defined as consisting of visual, auditory, and haptic displays and a tracking system (Slater, 2009). Agrawal et al. (2020) found one reason leading to immersion to be multisensory simulation, even though their paper had more of a psychological immersion perspective. Following the multisensory perspective, in their study, Xu et al. (2018) described that sound is essential with immersive videos and, thus, they combined sound via earphones in their 360° videos. Various sensory experiences seem significant, especially emphasizing visual and auditory sense stimulators.

In this study, we included four types of technological immersion stimulating user's senses towards immersion: I) visual, II) auditory, III) haptic, and IV) olfaction. In visual immersion, the amount and type of display screens (Queiroz et al., 2018) and image quality (Cummings & Bailenson, 2016) are essential factors when stimulating the sense of sight. In auditory immersion, Cummings and Bailenson (2016) mentioned that sound quality is essential, and audio can be flat audio or 3D audio (Queiroz et al., 2018) in stimulating the sense of hearing. Haptic immersion concerns haptic features (Cummings & Bailenson, 2016) where immersion is linked to haptic sense via hand, vehicle, or body (Queiroz et al., 2018) and the purpose is to stimulate the sense of touch. Lastly, olfactory fidelity or features (Cummings & Bailenson, 2016; Queiroz et al., 2018) concern olfaction – stimulating the sense of smell – and it can be used in immersive experiences through olfactory displays when the chosen odor (e.g., perfume smell) is released from a device connected to the computer during the use of immersive technology (Herrera & McMahan, 2014). To conclude, a summary of technological immersion is provided in Appendix A.

3.3 Immersive Technologies

In turn, immersive technologies concern immersion-enabling technologies, of which several different technologies have emerged in previous research. According to Lee et al. (2013) immersive technologies refer specifically to the *technology* enabling immersion. Similarly, Slater (2009) characterize technology that provides users with

high-quality sensory information as immersive technology. There are different types of immersive technologies (Daassi & Debbabi, 2021), for example, virtual reality (VR) (Tonteri et al., 2023; Winkler et al., 2020), augmented reality (AR), three-dimensional (3D) views, mixed reality (MR: a combination of AR and VR) (Ambika et al., 2023), extended reality (XR: a combination of AR, VR and MR) (Adams, 2022) , and 360° videos (where users can rotate) (Xu et al., 2018). Several technologies have been examined, but the primary emphasis appears to be on virtual reality and augmented reality.

Immersive technologies have been investigated in the virtuality-reality continuum (Suh & Prophet, 2018) and metaverse environments (Hudson et al., 2019). Compared to the physical world's experience, in immersive technology-mediated experience (e.g., virtual reality), the user must learn to use the technology before using and focusing (Tonteri et al., 2023). Additionally, it is argued that the above listed immersive technologies can be considered as non-immersive if usage does not require special equipment (e.g., a head-mounted display). Thus, for example, web-based environments or Minecraft would be considered as being non-immersive because they are used via a computer, keyboard, and mouse (Suh & Prophet, 2018). The role of immersive technologies is to transport the user to immersion through the users' senses. A summary of immersive technologies and the related studies is presented in Appendix B.

3.4 Psychological Immersion

Agrawal et al. (2020) described psychological immersion as an individual's deep mental state that enables the cognitive process even to dissociate a person from the physical world's awareness. Psychological immersion can also be a subjective experience (Nilsson et al., 2016). In their article, Queiroz et al (2018) use psychological and subjective immersion. On the other hand, Agrawal et al. (2020), raise the concept of subjectivity to the definitions of immersion and use the term psychological immersion. In this study, we employ the term psychological immersion, which is frequently utilized.

Psychological immersion can be further understood as follows. Agrawal et al. (2020) list three reasons leading to immersion: 1) the subjective sense of being surrounded or experiencing the multisensory simulation, 2) absorption in the narrative or the

depiction of the narrative, and, 3) absorption when facing strategic and/or tactical challenges. In this work, multisensory simulation is included in technological immersion. On the other hand, Queiroz et al. (2018) presented four different types of psychological immersion: spatial, strategic, narrative, and tactical. Furthermore, Ermi and Mäyrä (2005) describe that gamers can absorb themselves into a game and become immersed either aesthetically (passively) or escapistically (active participation). Finally, Kim (2013) propose 'context immersion' emphasizing the psychological state of immersion where the user's immersion is embodied through mobile interaction and user experience connecting the user to real life. In this study, we understand psychological immersion as deep mental involvement in the user's cognitive process leading to immersion, following Agrawal et al.'s (2020) definition (cited in Appendix C).

This work uses three dimensions of psychological immersion found in previous research: *spatial, narrative, and strategic*. These dimensions describe the different deep mental involvement styles in the user's cognitive process. First, the spatial dimension is the feeling of being surrounded (Agrawal et al., 2020). Kukkakorpi and Pantti (2021) explained space as transitioning from physical to digital. For example, how a story absorbs the user into another environment. Second, the narrative dimension concerns narrative aspects and the user's imagination, such as how the user relies on the story through imagination (Ermi & Mäyrä, 2005). Third, the strategic dimension concerns strategic, tactical, and challenge-based aspects. For example, the user is immersed when meeting tactical or strategical challenges (Agrawal et al., 2020) or when facing the game's appropriately balanced challenge level (Ermi & Mäyrä, 2005; Nacke & Lindley, 2008). Similarly, Frank et al. (2015) noted in their survey that the game's playfulness increases immersion in the game and effects the user's hedonic motivation. Psychological immersion concepts are summarized in Appendix C.

3.5 Concepts Related to Immersion

In previous research similar concepts are related to immersion, such as flow, presence, and transportation (Agrawal et al., 2020). Flow and immersion are two different concepts but close to each other. Csikszentmihalyi (1990) describes flow as '*the state in which individuals are so involved in an activity that nothing else seems to matter*'. In game studies, attention is central to flow, but in immersion, gamers sense experiences and emotions, and sensory simulation separates the concept of flow

from immersion (Brown & Cairns, 2004). On the contrary, Jennett et al. (2008) describe flow as an '*extreme end of immersion*' because, in their opinion, immersion is not always that strong. Agrawal et al. (2020) describe that flow and immersion might overlap, but these concepts are independent ideas.

Another concept related to immersion is presence (Nilsson et al., 2016), which means, according to Slater (2009), '*being there*' in a virtual place despite being somewhere else in the physical world and being aware of that. Immersion and presence are firmly related but logically separable concepts where presence represents the response to (a certain level of) immersion (Slater, 2003). On the contrary, Queiroz et al. (2018) include presence in immersion, whereas Ambika et al. (2023) define presence as addition to immersion. Additionally, Steuer (1992) distinguish telepresence from presence because telepresence includes '*the mediated perception of an environment*' (e.g., virtual reality), whereas presence is referring environments' natural perceptions. However, previous research note teleoperations or teleconferencing applications to be the primary use of telepresence (Agrawal et al., 2020), not Steuer's (1992) mentioned VR. Moreover, in the study by Mütterlein (2018), telepresence was supported to have a direct positive influence on immersion. Lastly, transportation can be absorbed into the narrative or detached from the environment (Green & Brock, 2000; Van Laer et al., 2014). Agrawal et al. (2020) define narrative immersion as similar to transportation.

4 Summary of the Literature Review

Immersion can be categorized into technological and psychological immersion, where users can become immersed in one or both ways. A summarization of the above reported narrative literature review is visualized in a Figure 1.

Figure 1 shows that in technological immersion can include one or more sense stimulants (visual, auditory, haptic, and odor), for example, how a user experiences a digital environment through sense stimulation. The role of immersive technology is to enable a sense of immersion in the possibilities brought by technology. We understand immersive technology as a technology, such as VR or AR. In addition to previous research, we added new innovations as one of the technologies. For example, the metaverse can bring new immersive technology possibilities. Technological immersion of a user can be simplified as 'how much of the sense is

digitally/virtually covered' enabled by immersive technology. For example, how much augmented reality smart glasses as an immersive technology are covering their user's eyesight (i.e., visual sense), causing the user to experience technological immersion. Lastly, psychological immersion concerns the cognitive elements of immersion. Thus, sensory experience in immersion provided by technology is not mandatory but possible. In our summarization, we include three reasons leading to psychological immersion: spatial, narrative, and strategic. Thus, the user can be immersed, and the user can change from one space to another (spatial) through imagination and story (narrative) or with appropriately balanced challenges (strategic).

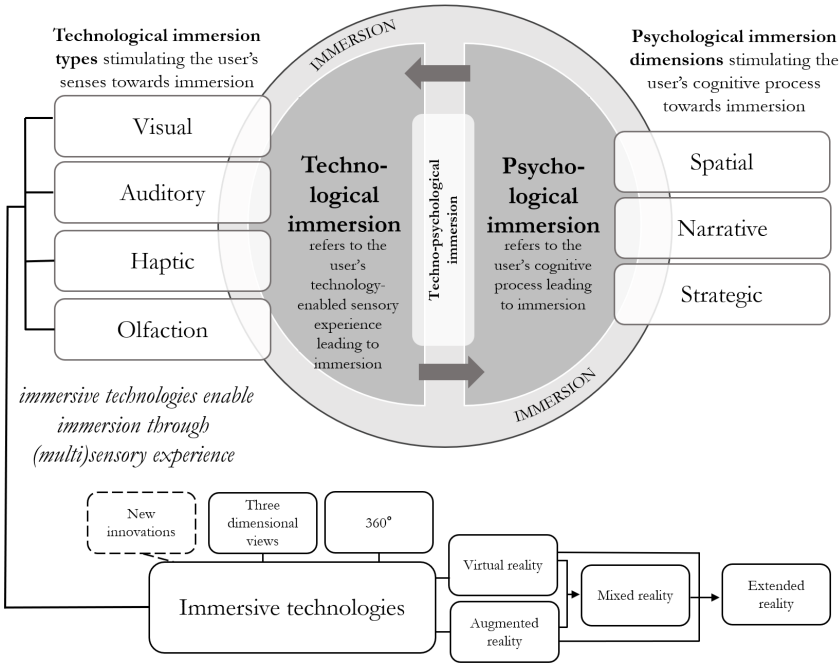

Figure 1: Summary of Immersion
Source: Own

All in all, immersion is not always either technological or psychological, but it can be a combination of both based on our summarization visualized in Figure 1. We call this *techno-psychological immersion*, referring to a situation when aspects from both sides of immersion are realized in the user's immersion experience. Moreover, we

propose the immersion happening only in the physical world (e.g., reading a book) to present non-digital immersion. This immersion can evolve into digital immersion if technology is included, for example, by listening to music via earphones when reading. In contrast, listening to a podcast via earphones can present techno-psychological immersion if a user immerses oneself into the podcast's story (narratively) via the auditory sense. Thus, techno-psychological immersion is an excellent example of the merging of the digital and physical – phygital – worlds because even if we play videogame with all our senses on the computer, our sense of touch still knows the mouse and keyboard of the physical world – unless we use a digital keyboard offered by smart glasses.

5 Discussion

This study contributes to an understanding of the immersion concept. The prior literature on the immersion concept reveals two sides of immersion: technological and psychological. Also, immersive technologies are more commonly represented in the research but are sometimes used as a synonym with technological immersion such as in Lee et al.'s (2013) study. Some of the literature investigates immersive technologies through a technological approach rather than as a sensory experience or actual immersion, such as Suh and Prophet (2018) as well as Fan et al. (2022). Thus, our clarification of immersive technologies followed previous research ideas, but we clarified the concepts by separating the concepts of immersive technologies (e.g., VR and AR) and technological immersion (i.e., multisensory experience that leading to immersion). We also created a framework (Figure 1) in which we present immersion as an entity consisting of psychological and technological immersion, which can lead to techno-psychological immersion where both sides of immersion are realized.

Different technologies are integrating into various aspects of people's lives, from school to entertainment, and thus, customers might expect more immersive experiences, service providers, and products. Our techno-psychological immersion framework can be utilized as inspiration or the discussion stimulator for product design to determine ways to enhance user immersion, such as what aspects should be considered related to enabling or enhancing immersion. For example, designing IT devices covering the user's face (e.g., Dyson's air-purifying headphones) could be further developed to enhance all sense experiences mentioned in our framework,

significantly improving the simulation of the sense of smell. Otherwise, there is potential for augmenting the factors that contribute to psychological immersion within VR headsets and other increasingly prevalent immersive technologies. For example, by bringing more robust storytelling to the space between the user and the service with interactive communication or the depth of the narrative. A more detailed product design model should be developed in future research, and our framework will provide the first ideas.

Due to possibilities provided by technological innovations, people are also integrated to use everyday digital services (e.g., Spotify), essential in people's daily routines, as noted in the study by Kemppainen and Paananen (2024a). Service designers should consider our framework's elements leading to techno-psychological immersion. This can mean, for example, helping a user transfer spatially (e.g., while waiting transfer for a more exciting digital environment) and providing appropriate sensory stimuli (e.g., improving concentration at work with suitable digital content – music or podcast), Thus, this can enhance positive digital well-being as in study by Kemppainen & Paananen (2024b). This approach can also enhance spatial psychological immersion, as seen in platforms like Instagram reels, where users can feel detached from the outside world while scrolling.

Lastly, immersion is essential for companies pursuing metaverse opportunities. Immersion in metaverse is trending research topic right now in various fields (e.g., Dincelli & Yayla, 2022; Tang et al., 2022; Song et al., 2020). As commerce has evolved from electronic commerce to multichannel retailing, and onwards to omnichannel retailing (Brynjolfsson et al., 2013; Mali et al., 2022), the next step in this evolution seems to be the metaverse (Mystakidis, 2022), which emphasizes immersion (Hudson et al., 2019). As an example, Roblox is a metaverse VR game (Rospigliosi, 2022) where, in addition to playing and interacting with other players, the user can purchase branded clothing items in the game, which can be digital replicas of the physical world's products. Thus, a company can use the same designs to sell products in new ways in the metaverse, which highlights the importance of understanding the user's techno-psychological immersion.

6 Limitations and Future Research Suggestions

Due to the narrative literature review method, this study only gives a greater scope of understanding of the phenomena. Thus, it does not provide the reproducibility of retrieving sources or research processes. However, the study presents a summarization of carefully selected articles. Narrative review maps previous research into a new form (Dijkers, 2009), which can lead to new theoretical perspectives (Paré et al., 2015) and, thus, our framework can be utilized as a discussion stimulator to inspire future research related to immersion. Hence, empirical and experimental research of techno-psychological immersion could be conducted using different methods. Also, immersion is trending in retail and, thus, further research should be conducted on how customers experience techno-psychological immersion in different contexts (e.g., omnichannel, brick-and-mortar stores, metaverse, or showrooms). Also, retail immersion barriers would be an exciting topic, as, for example, QR code usage barriers have been noticed during brick-and-mortar shopping, and people are not utilizing digital opportunities (see Paananen et al., 2023). Lastly, experimental studies of customer's techno-psychological immersion with different immersion technologies (e.g., VR, AR) would be interesting in different retail contexts.

References

Acikgoz, F., & Tasci, A. D. A. (2022). Brand cocreation and immersion: The link between sense of brand community and attitude toward a brand. Journal of Hospitality and Tourism Insights, 5(2), 465-500.

Adams, D. (2022). Virtual Retail in the Metaverse: Customer Behavior Analytics, Extended Reality Technologies, and Immersive Visualization Systems. Linguistic and Philosophical Investigations, 21, 73-88.

Agarwal, R., & Karahanna, E. (2000). Time Flies When You're Having Fun: Cognitive Absorption and Beliefs about Information Technology Usage. MIS Quarterly, 24(4), 665.

Agrawal, S., Simon, A., Bech, S., Bærentsen, K., & Forchhammer, S. (2020). Defining Immersion: Literature Review and Implications for Research on Audiovisual Experiences. Journal of the Audio Engineering Society, 68(6), 404-417.

Ambika, A., Shin, H., & Jain, V. (2023). Immersive technologies and consumer behavior: A systematic review of two decades of research. Australian Journal of Management. 03128962231181429.

Brown, E., & Cairns, P. (2004). A grounded investigation of game immersion. CHI '04 Extended Abstracts on Human Factors in Computing Systems, 1297-1300.

Brynjolfsson, E., Hu, Y. J., & Rahman, M. S. (2013). As technology blurs the distinctions between physical and online retailing, retailers and their supply-chain partners will need to rethink their competitive strategies. Digital transformation, 9.

Cook, D. J., Mulrow, C., & Haynes, R. (1997). Systematic Reviews: Synthesis of Best Evidence for Clinical Decisions. Annals of Internal Medicine, 126(5), 376-380.

Csikszentmihalyi, M., 1990. Flow: The Psychology of Optimal Experience. Harper and Row, New York.

Cummings, J. J., & Bailenson, J. N. (2016). How Immersive Is Enough? A Meta-Analysis of the Effect of Immersive Technology on User Presence. Media Psychology, 19(2), 272-309.

Daassi, M., & Debbabi, S. (2021). Intention to reuse AR-based apps: The combined role of the sense of immersion, product presence and perceived realism. Information & Management, 58(4), 103453.

Dijkers, M. P. J. M. (2009). The Value of "Traditional" Reviews in the Era of Systematic Reviewing. American Journal of Physical Medicine & Rehabilitation, 88(5), 423-430.

Dincelli, E., & Yayla, A. (2022). Immersive virtual reality in the age of the Metaverse: A hybrid-narrative review based on the technology affordance perspective. The Journal of Strategic Information Systems, 31(2), 101717.

Ermi, L., & Mäyrä, F. (2005). Fundamental Components of the Gameplay Experience: Analysing Immersion. In DeCastell S., Jenson J. (Eds.), Proceedings of DiGRA 2005 conference: Changing Views—Worlds in Play. 15-27. Vancouver, British Columbia, Canada: Simon Fraser University.

Fan, X., Jiang, X., & Deng, N. (2022). Immersive technology: A meta-analysis of augmented/virtual reality applications and their impact on tourism experience. Tourism Management, 91, 104534.

Frank, L., Salo, M. & Toivakka, A. (2015). Why Buy Virtual Helmets and Weapons? Introducing a Typology of Gamers. In the Proceedings of the 25th Bled eConference, 502-519.

Green, M. C., & Brock, T. C. (2000). The role of transportation in the persuasiveness of public narratives. Journal of Personality and Social Psychology, 79(5), 701-721.

Haywood, N., & Cairns, P. (2006). Engagement with an Interactive Museum Exhibit. In T. McEwan, J. Gulliksen, & D. Benyon (Eds.), People and Computers XIX — The Bigger Picture. Proceedings of HCI2005, 113-129.

Herrera, N. S., & McMahan, R. P. (2014). Development of a Simple and Low-Cost Olfactory Display for Immersive Media Experiences. Proceedings of the 2nd ACM International Workshop on Immersive Media Experiences, 1-6.

Hudson, S., Matson-Barkat, S., Pallamin, N., & Jegou, G. (2019). With or without you? Interaction and immersion in a virtual reality experience. Journal of Business Research, 100, 459-468.

Jennett, C., Cox, A. L., Cairns, P., Dhoparee, S., Epps, A., Tijs, T., & Walton, A. (2008). Measuring and defining the experience of immersion in games. International Journal of Human-Computer Studies, 66(9), 641-661.

Kemppainen, T., & Paananen, T. E. (2024a). Dualities of digital services: Everyday digital services as positive and negative contributors to customer well-being. Journal of Service Theory and Practice, A-Head-of-Print.

Kemppainen, T., & Paananen, T. (2024b). How Can Favorite Digital Services Enhance Users' Digital Well-Being? A Qualitative Study. In M. Papadaki, M. Themistocleous, K. Al Marri, & M. Al Zarouni (Eds.), Information Systems: 20th European, Mediterranean, and Middle Eastern Conference, EMCIS 2023 (pp. 65-76). Springer. Lecture Notes in Business Information Processing.

Kim, M. J. (2013). A framework for context immersion in mobile augmented reality. Automation in Construction, 33, 79-85.

Kukkakorpi, M., & Pantti, M. (2021). A Sense of Place: VR Journalism and Emotional Engagement. Journalism Practice, 15(6), 785-802.

Lee, Y., Chen, A. N., & Ilie, V. (2012). Can Online Wait Be Managed? The Effect of Filler Interfaces and Presentation Modes on Perceived Waiting Time Online. MIS Quarterly, 36(2), 365-394.

Lee, Y.-C. N., Shan, L.-T., & Chen, C.-H. (2013). System development of immersive technology theatre in museum. In Proceedings of International Conference on Virtual, Augmented and Mixed reality, 400-408.

Mali, E., Paananen, T., Frank, L., & Makkonen, M. (2022). A Customer Perspective on Omnichannel Customer Journey and Channel Usage : A Qualitative Study. In P. Bednar, A. S. Islind, H. Vallo-Hult, A. Nolte, M. Rajanen, F. Zaghloul, A. Ravarini, & A. M. Braccini (Eds.), Proceedings of the 8th International Workshop on Socio-Technical Perspective in Information Systems Development (STPIS 2022), 299-310. RWTH Aachen. CEUR Workshop Proceedings, 3239.

Murray, J. B. (1997). Hamlet on the holodeck: The future of narrative in cyberspace. New York, NY, USA: Free Press.

Mütterlein, J. (2018). The Three Pillars of Virtual Reality? Investigating the Roles of Immersion, Presence, and Interactivity. . In T. X. Bui (Ed.), the Proceedings of 51st Annual Hawaii International Conference on System Sciences. 1407-1415.

Mystakidis, S. (2022). Metaverse. Encyclopedia, 2(1), 486-497.

Nacke, L., & Lindley, C. (2008). Boredom, Immersion, Flow—A pilot study investigating player experience. In Proceedings of the 2008 IADIS International Conference Gaming 2008: Design for Engaging Experience and Social Interaction, 103-107.

Nah, Eschenbrenner, & DeWester. (2011). Enhancing Brand Equity Through Flow and Telepresence: A Comparison of 2D and 3D Virtual Worlds. MIS Quarterly, 35(3), 731-747.

Nilsson, N. C., Nordahl, R., & Serafin, S. (2016). Immersion Revisited: A review of existing definitions of immersion and their relation to different theories of presence. Human Technology, 12(2), 108-134.

Paananen, T., Frank, L., & Kemppainen, T. (2022). Customer-Brand Relationships in the Context of Digital Brands. In A. Pucihar, M. Kljajić Borštnar, R. Bons, A. Sheombar, G. Ongena, & D. Vidmar (Eds.), 35th Bled eConference : Digital Restructuring and Human (Re)action, 495-510. University of Maribor.

Paananen, T., Holkkola, M., Makkonen, M., Frank, L. & Kemppainen, T. (2023). Customers' QR Code Usage Barriers in a Brick-and-Mortar Store : A Qualitative Study. In A. Pucihar, M. Kljajić Borštnar, R. Bons, G. Ongena, M. Heikkilä, & D. Vidmar (Eds.), 36th Bled eConference : Digital Economy and Society : The Balancing Act for Digital Innovation in Times of Instability, 171-188. University of Maribor.

Paré, G., Trudel, M.-C., Jaana, M., & Kitsiou, S. (2015). Synthesizing information systems knowledge: A typology of literature reviews. Information & Management, 52(2), 183-199.

Pucihar, A. (2020). The digital transformation journey: Content analysis of Electronic Markets articles and Bled eConference proceedings from 2012 to 2019. Electronic Markets, 30(1), 29-37.

Queiroz, A. C. M., Nascimento, A. M., Alejandro, T. B., Tori, R. de Melo, V., de Souza Meirelles, F., & da Silva Leme, M. I. (2018). Virtual Reality in Marketing: Technological and Psychological immersion. In Proceedings of the 24th Americas Conference on Information Systems.

Rospigliosi, P. A. (2022). Metaverse or Simulacra? Roblox, Minecraft, Meta and the turn to virtual reality for education, socialisation and work. Interactive Learning Environments, 30(1), 1-3.

Saunders, Rutkowski, Genuchten Van, Vogel, & Orrego. (2011). Virtual Space and Place: Theory And Test. MIS Quarterly, 35(4), 1079-1098.

Slater, M. (2003). A Note on Presence Terminology. Presence Connect, 3(3), 1-5.

Slater, M. (2009). Place illusion and plausibility can lead to realistic behaviour in immersive virtual environments. Philosophical Transactions of the Royal Society B: Biological Sciences, 364(1535), 3549-3557.

Slater, M., & Wilbur, S. (1997). A Framework for Immersive Virtual Environments (FIVE): Speculations on the Role of Presence in Virtual Environments. Presence: Teleoperators and Virtual Environments, 6(6), 603-616.

Soliman, M., Peetz, J., & Davydenko, M. (2017). The Impact of Immersive Technology on Nature Relatedness and Pro-Environmental Behavior. Journal of Media Psychology, 29(1), 8-17.

Song, H. K., Baek, E., & Choo, H. J. (2020). Try-on experience with augmented reality comforts your decision: Focusing on the roles of immersion and psychological ownership. Information Technology & People, 33(4), 1214-1234.

Steuer, J. (1992). Defining Virtual Reality: Dimensions Determining Telepresence. Journal of Communication, 42(2), 73-93.

Suh, A., & Prophet, J. (2018). The state of immersive technology research: A literature analysis. Computers in Human Behavior, 86, 77-90.

Sun, N., & Botev, J. (2023). Technological Immersion and Delegation to Virtual Agents. Multimodal Technologies and Interaction, 7(11), 106.

Tang, Y. M., Chau, K. Y., Kwok, A. P. K., Zhu, T., & Ma, X. (2022). A systematic review of immersive technology applications for medical practice and education-trends, application areas, recipients, teaching contents, evaluation methods, and performance. Educational Research Review, 35, 100429.

Tonteri, T., Holopainen, J., Lumivalo, J., Tuunanen, T., Parvinen, P., & Laukkanen, T. (2023). Immersive Virtual Reality in Experiential Learning—A Value Co-creation and Co-destruction Approach. In T. X. Bui (Ed.), the Proceedings of 56th Annual Hawaii International Conference on System Sciences. 1313-1322.

Van Laer, T., De Ruyter, K., Visconti, L. M., & Wetzels, M. (2014). The Extended Transportation-Imagery Model: A Meta-Analysis of the Antecedents and Consequences of Consumers' Narrative Transportation. Journal of Consumer Research, 40(5), 797-817.

Webster, J., & Watson, R. T. (2002). Analyzing the Past to Prepare for the Future: Writing a Literature Review. MIS Quarterly, 26(2), xiii–xxiii.

Winkler, N., Röthke, K., Siegfried, N. & Benlian, A. (2020). Lose Yourself in VR: Exploring the Effects of Virtual Reality on Individuals' Immersion. In the Proceedings of 54th Annual Hawaii International Conference on System Sciences. 1510-1519.

Xu, Y., Dong, Y., Wu, J., Sun, Z., Shi, Z., Yu, J., & Gao, S. (2018). Gaze Prediction in Dynamic 360° Immersive Videos. In the Proceedings of 2018 IEEE/CVF Conference on Computer Vision and Pattern Recognition, 5333–5342.

Zimmermann, H.-D. (2016). Digital Transformation—The Emerging Digital Economy. In Proceedings of International Conference: Liberec Informatics Forum: ICT in the Role of Services: State of the art and perspectives. 138–146.

Appendix A: Summary of Technological Immersion and Senses

Concept	Explanation
Technological immersion System immersion	'The capacity of a media device to mediate and represent an environment in a way that matches human perception of the physical world' (Sun & Botev, 2023) 'Let's reserve the term 'immersion' to stand simply for what the technology delivers from an objective point of view. The more that a system delivers displays (in all sensory modalities) and tracking that preserves fidelity in relation to their equivalent real-world sensory modalities, the more that it is 'immersive'.' (Slater, 2003)
Sensory immersion	- Sensory immersion: 'Large screens close to player's face and powerful sounds easily overpower the sensory information coming from the real world, and the player becomes entirely focused on the game world and its stimuli.' (Ermi & Mäyrä, 2005) - Experience of multisensory simulation (Agrawal et al., 2020) - System-focused immersion (i.e., sensory immersion, based on media features) (Daassi & Debbabi, 2021)
Visual	- Visual immersion (single screen, multiple screens, videowall, cavern automatic virtual environment) (Queiroz et al., 2018) - Stereoscopic vision, image quality, field of view, update rate overall high versus low, (Cummings & Bailenson, 2016) - 'Audiovisual implementation has something to do with immersive experiences, but it is by no means the only or even the most significant factor.' (Ermi & Mäyrä, 2005)
Auditory	- Auditory immersion (flat audio, 3D audio) (Queiroz et al., 2018) - Sound quality (Cummings & Bailenson, 2016)
Haptic	- Haptic immersion (hand, vehicle, body) (Queiroz et al., 2018) - Haptic features (Cummings & Bailenson, 2016)
Olfaction	- Olfactory fidelity (odor) (Queiroz et al., 2018), - Olfactory features (Cummings & Bailenson, 2016) - Olfaction is sense of smell, which is described as an important perceptual function and olfactory display enable using odorants (e.g., the smell of orange) during immersive technology usage (Herrera & McMahan, 2014)

Appendix B: Summary of Immersive Technologies

Concept	Explanation
Immersive technologies Equipment perspective	'Immersive technology refers to technology that blurs the line between the physical world and digital or simulated world, thereby creating a sense of immersion.' (Lee et al., 2013) Immersion requires equipment (e.g., head-mounted display) from an user (Suh & Prophet, 2018)
Enabling immersive technologies	- Augmented reality (AR) (Ambika et al., 2023; Daassi & Debbabi, 2021; Fan et al., 2022), mobile AR (Kim, 2013) - Virtual reality (VR) (Ambika et al., 2023; Kukkakorpi & Pantti, 2021; Queiroz et al., 2018; Tonteri et al., 2023; Winkler et al., 2020) - Mixed reality (MR) (Ambika et al., 2023) - Extended reality (XR) (Adams, 2022) - Three dimensional views (3D) (Ambika et al., 2023) - 360° videos (Xu et al., 2018)

Appendix C: Summary of Psychological Immersion and Dimensions

Concept	Explanation
Psychological immersion	'Immersion is a phenomenon experienced by an individual when they are in a state of deep mental involvement in which their cognitive processes (with or without sensory stimulation) cause a shift in their attentional state such that one may experience disassociation from the awareness of the physical world.' (Agrawal et al., 2020)
Spatial	- Spatial dimension (Queiroz et al., 2018) - 'Place refers to factual and inter-textual qualities, whereas space alludes to the digital environment in which the user is immersed.' (Kukkakorpi & Pantti, 2021) - Subjective sense of being surrounded (Agrawal et al., 2020)
Narrative	- Absorption in the narrative or the depiction of the narrative (Agrawal et al., 2020) - Imaginative immersion: 'The game offers the player a chance to use her imagination, empathize with the characters, or just enjoy the fantasy of the game.' (Ermi & Mäyrä, 2005) - Children create narratives, which allow for the use of fantasy while still following the linear structure (in the museum context) (Haywood & Cairns, 2006)
Strategic	- Absorption when facing strategic and/or tactical challenges (Agrawal et al., 2020) - Challenge-based immersion: 'This is the feeling of immersion that is at its most powerful when one is able to achieve a satisfying balance of challenges and abilities.' (Ermi & Mäyrä, 2005) - Immersion is more closely achieved with appropriately challenging game tasks (Nacke & Lindley, 2008)