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Published in:
Tidsskriftet Læring og Medier (LOM)

Publication date:
2019

Document Version
Publisher's PDF, also known as Version of record

Tidsskriftet Læring og Medier

The Emerging Landscape of Virtual Environments

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Abstract

This paper aims to give an overview of key research of the emerging landscape of virtual environments by looking backwards to identify selected contributions to the field. Focusing on learning potentials and issues, it describes and discusses how virtual environments change the practices within education. Initially, the paper gives a short review trying to define the variety of understandings of the field, especially the terms virtual, virtual environments, presence and immersion. On the occasion of the journal Læring og Medier´s 10th anniversary selected papers form the basis of an overview of the development of especially how Second life has contributed to knowledge in a Danish educational context. SL's potentials for immersion, presence and embodiment, respectively, are illustrated by the results of one case from Aalborg University. Finally, the paper gives a prediction of how virtual environments might change the learning practices in the future.

Introduction

On the occasion of LOM's 10th anniversary, a number of review articles are published on key themes that have contributed to the journal over the last decade. This article is about the landscape of learning potentials of 3D immersive virtual environment (VE) and how especially research and projects in Second Life (SL) has contributed to knowledge and ideas for further research.

Since 2009, eleven papers and one podcast on VE have been published. Common is that they all deal with didactic design of the spaces and remediation of pedagogy using different immersive environments in different learning contexts. Furthermore, the role of the teacher is discussed. The levels of education, which are represented in LOM, are higher education, profession-specific education, and lower secondary school. Most of the cases referenced in the papers use SL as examples of a VE, one is a virtual 2D lab and two are 2D learning environments.

Virtual Environments - Definitions

Acting on the Internet through virtual personifications and representations of oneself has gradually become a natural part of interacting with others. Social media and learning places and spaces with one to one and one too many communications with user-generated content have made it possible to interact and learn across time and space. The notion virtual environment covers a wide variety of definitions, ranging from 2D Internet-mediated places like a bulletin-board or a virtual learning environment (VLE) used for exchanging data and words among a group of people (e.g. Moodle and Blackboard) (Rheingold, 2012, p. 162) to 3D immersive VE like Second Life and the game-based environment World of Warcraft.

Tidsskriftet Læring & Medier (LOM) – nr. 21 - 2019
ISSN: 1903-248X

The terms cyberspace, virtual reality, virtual communities, online learning environments, online worlds, metaverses and 3D virtual worlds are just some examples of community descriptions that, in all their diversity, represent the same thing: namely, a conceptual space or place (most often Internet-driven), in which data, language and interactions are manifested by humans using digital technologies. Virtual refers in general to something imitated or simulated, but it is also related to a variety of situations both in the physical world (e.g. 3D street art) as well as in a simulated environment. According to Merriam-Webster dictionary, virtual means: "very close to being something without actually being it". In this paper, virtual refers to an environment or space mediated by digital technologies. Environment is used synonymously with a community, milieu, world, place and space. In a virtual world, the human representation is called an avatar. Adding the term immersive to the virtual environment means that psychological senses have a possibility to be involved in the experiences in the virtual communities. 3D Immersive Virtual Environment (IVE) thus is the notion of virtual environments that allow the users to be absorbed in the environments (Sanchez-Vives & Slater, 2005, p. 332; Ralph Schroeder, 2010, p. 3; Slater, Usoh, & Steed, 1994)

In recent year the virtual technologies have moved from stationary screens to smaller so-called wearable technologies in the "real" world". Augmented Realities (AR) is a technology that by adding an extra layer of information expands the physical world with graphics, videos and sounds via smart-phones or tablets.

A digital distributed representation of a person can take a variety of forms, from controlled graphical, digital representations, characters in a videogame, people writing blogs, a Facebook account or embodied avatars. Bailenson & Blascovich (2004) distinguish between the notions *online identities* and *avatars*. Online identities are the distributed digital representations communicating via e-mail, chat rooms, homepages, and other information on the Internet, whereas an avatar can be characterised as a bodily manifestation of a person a "perceptible digital representation whose behaviours reflect those executed, typically in real time, by a specific human being" (Bailenson & Blascovich, 2004). An avatar can take form as an anthropomorphic or an embodied personal representation with high resemblance of oneself (Konnerup, 2015a, p. 97)

The Dawn of Virtual Environments

Historically, the concept *Virtual environment* is a multi-faceted field often linked to Virtual Worlds, Virtual Reality (VR), and associated with science fiction and cyberspace. The author William Gibson in his science fiction/cyberpunk novel, Neuromancer from 1984, coined cyberspace. The novel has had great influence on our subsequent understanding of cyberspace and virtual worlds as futuristic communities (Baym, 2010; Gibson, 1995). However, the concepts do not only relate to futuristic environments. Like Gibson, Bainbridge (2007) characterizes a VE as a 3D environment with inhabitants. People are represented as animated characters, so-called avatars. The user perspective and the possibility to co-create content in communities are central:

> "....an electronic environment that visually mimics complex physical spaces, where people can interact with each other and with virtual objects, and where people are represented by animated characters. The diversity of current virtual worlds can be represented by the creativity-oriented environment Second Life (SL), and the massively multiplayer online role-playing game World of Warcraft (Wow)". (Bainbridge, 2007, p. 472)

Immersion, Presence and Embodiment

The notions immersiveness and presence are often used to describe the habitus, a person behind the avatar might get, when interacting in a VE. Immersion is used in the understanding of absorbing oneself and forgetting the surrounding world (Bailenson & Blascovich, 2004). According Dede (2009, p. 66) immersion is the subjective impression that one is participating in a comprehensive and realistic experience that involves the willing suspension of disbelief. Immersion can lead to presence, which is "a state of consciousness that may be concomitant with immersion and is related to a sense of being in a place" (Slater & Wilbur, 1997, p. 1). Schroeder (2010) noted that, in the context of VEs, "media richness is often called 'co-presence' and that the feeling of "being there" make users feel they are together in the same (virtual) space" (Ralph Schroeder, 2010).

The notion "embodiment" in learning contexts arises from Dewey´s understanding of pragmatism (Dewey, 2005) and phenomenological philosophy (Gallagher & Zahavi, 2012; Merleau-Ponty, 1996; Sheets-Johnstone, 2011) It consider learning as something that happens in interaction between body, brain and the outside world. Virtual embodiment can be defined as the perception of sensory feedback related one´s virtual representation, an avatar, and the effect, it has on the individual´s cognition. It is through a performance of the body, in this case via the avatar, that one is rooted in the VE (Taylor, 2011)

Research have shown that using embodied avatars can lead to increases of the subjective sense of presence inside VE, both the place illusion and the plausibility of the experience and the increase of presence illusion also translates into stronger immersion (Slater, Lotto, Arnold, & Sánchez-Vives, 2009).

In 2003, Bailenson founded Virtual Human Interaction Lab (VHIL), at Stanford University to conduct research on virtual interactions, immersion, behaviour and presence. VHIL integrates technologies that feature equipment for tracking motion, rendering graphics, and displaying visual, aural, and haptic information. It includes a multi-sensory room that allows participants to explore a 20-by-20 ft. space with specialized sounds, floor shakers, and a head-mounted display (Konnerup, 2015, p. 40). The dominant research field at VHIL is social psychology, behaviour and communication. Dominating themes are sustainability and environmental understanding, altruism, empathy, climate change, social anxiety and many more. A major theme in exploring actions in technology-mediated environments is whether the experiences are transformable to "real" life. The research projects have shown encouraging signs that there may be a spillover effect. Trying to study and describe the spill-over effect, Yee and Bailenson (2009) introduced the phenomenon "The Proteus Effect", in the article "The Proteus effect: The effect of transformed self-representation on behaviour". The phenomenon is based on studies showing how short people might achieve more self-confidence by being represented by tall avatars, as well as how people who consider themselves unattractive might boost their confidence by using attractive avatars (Blascovich & Bailenson, 2011; N Yee & Bailenson, 2007, pp. 102–108). Supporting the Proteus Effect, several universities have engaged in further research on the theme. The Obesity Research Centre at The University of Houston, Texas, is using Second Life in a project fighting obesity. A hypothesis is that "individuals with avatars who engage in physical activities in SL are more likely to engage in physical activities in real life" (Dean, Cook, Keating, & Murphy, 2009). Sanchez-Vives and Slater(2005), affiliated to Universität de Barcelona, have conducted interesting studies on phobias and social anxiety. They have experienced that an IVE can be successfully used to make people face their fears. Other key publications is "Being There Together" by Schroeder (2011), that stresses the feeling of presence and of social interactions with others, describing a virtual community as a environment "in which users experience other participants as being present in the same environment and interacting with them – or *being there together*" (Ralph Schroeder, 2010, p. 4).

The roots in science fiction and cyberpunk have contributed to a view of technology-mediated communication as unreal and different from physically embodied communication and interaction. This is not always the case, however. Today, virtual communication places and spaces are tools that are taken for granted to be on an equal footing with physically embodied communication channel.

Second Life

To understand how VE might influence and enhance learning it is crucial to learn how people act and react psychologically and sociologically in VE activities. In an avatar-mediated 3D environment, sensory information triggers users to forget that they are in a mediated environment, leading them to believe and behave as if they were in the real world (Sanchez-Vives & Slater, 2005, p. 332; Ralph Schroeder, 2010, p. 3; Slater et al., 1994). Within the research field of social psychology, there is an interest in technology-mediated environments and the psychological state in which the individual person perceives himself/herself as being surrounded by, engaging in, and interacting with an environment that provides a continuous flow of stimuli. (Blascovich et al., 2002, p. 105).

SL is internet-driven, and without comparison, the immersive VE (IVE) with the most users and the most frequently referenced IVE in research. SL has also played a dominant role in Danish research projects on VE. Linden Lab in San Francisco founded SL in 2003. By 2014, there were more than one million regular users, “residents”, as they are called (“Second Life,” 2015). It has been important for Linden Lab to stress that SL is not a game, but a society (Carr & Pond, 2007, p. 21). The content is user-generated, which gives the users the possibilities to design and control the content. Furthermore, there are expanded opportunities for buying clothes, furniture and even "land".

Through avatar mediation, VEs, like SL, offer features as embodiment, presence, collaboration, user-centeredness, context-awareness, and cross-real interactions to enhance users’ learning experiences (Konnerup, 2015b, p. 96).

Up through the 00s, as SL, became so advanced and accessible that one could interact meaningfully, the number of users increased with rocket speed. Both large international companies such as IBM and Coca Cola as well as leading universities e.g. Harvard and University of Southern California, saw potentials for collaboration and marketing in the VE (Blok & Christensen, 2009). However, the hype was short, and many users disappeared. Remaining were researchers from the educational practices, who wanted to explore the potential for learning, social interacting, and collaboration across boundaries.

Læring og Medier (Learning and Media)

In Læring og Medier no. 3, 2009 a number on the learning projects in virtual worlds are presented. Five theoretical and empirically based papers and one podcast aim to shed light on potentials and issues. As mentioned, SL was the most advanced VE at that time, but in Denmark relatively new in research and learning contexts. Therefore, Christensen (2009) provides an introductory article with a detailed guide to Second Life posing the questions: What is SL? How to get there? And how to behave? Furthermore, existing projects are introduced in the article to demonstrate the learning possibilities. The following four articles deal with research projects on learning in VEs. 1) visualization of VEs in concrete usage situations in libraries asking, why the VEs often try to reproduce the physical world (Heilesen, 2009); 2) an analysis of the potentials of a virtual learning environments in a multimedia design program (Wiese, 2009); 3) the learning potential in relation to the nursing education (Rasmussen & Hauschildt, 2009) and finally 4) the potentials of virtual learning environments for studying literature (Lindberg, 2009). In LOM no. 4 (2010), one paper contributes to reflections regarding how VEs can support the

rehabilitation of people with communication disabilities after a brain injury (Konnerup, 2015, p. 177). The same year, a paper identifies the phenomenon "SL" by remediating a master course to a VE based on Wenger´s pedagogical philosophy "community of practice" (Riis, 2010). Dahl, Hedegaard and Musaus (2013) contribute with a paper to LOM explaining how a Virtual Lab (VL) might support pharmacology students` learning. In this context, the VL serves as a substitute for the physical Lab. The last two papers to be mentioned represent newer digital technologies, namely the wearables that combine the physical and the virtual world. Both are from 2015, LOM no. 14. The first accounts for 5th grade students´ participation in three-dimensional modelling by transforming physical models into Virtual Reality (VR) using a virtual headset. The focus is on the design processes and learning experience. Finally, Buhl & Rahn (2015) present a project on the design and implementation of AR as a digital wearable in teaching lung anatomy in nursing education. The aim of this project was to study whether AR might enhance learning.

Case

Some of the significant parameters for learning in 3D VEs are the possibilities of immersion, presence and embodiment. In the following, these parameters will be illustrated through one of the articles published in LOM no. 4 (2010).

From 2010 to 2014, a research project regarding virtual communicative rehabilitation following a brain injury was conducted as a collaboration between The Institute for Speech, Language, and Brain Disorders in Aalborg, DK and Aalborg University. The target group was people with aphasia[1]. Communication is crucial prerequisite for learning and identity formation (Duchan, Linda, Garcia, Lyon, & Simmons-Mackie, 2001). The overall research objective was to investigate, whether and how a 3D VE had the potential to renegotiate identity through avatar-mediated interaction.

The empirical work comprised workshops, interviews, and two virtual pilot courses I SL. Pilot 1 was a pedagogical course for speech therapists. The primary goal was to remediate the pedagogical designs from physical speech therapy to virtual avatar mediated speech therapy. Pilot 2 was a six-week rehabilitation course for people with aphasia. In this pilot, the aim was to investigate the potentials of avatar-mediated communicative rehabilitation and learning.

Overall, the study demonstrated that avatar-mediated interaction in immersive VEs might contribute to strengthen renegotiation of identity and to facilitate learning possibilities through among other things immersion, presence and bodily and social interactions (Konnerup, 2015, pp. 183–184)

In the analysis of the course in SL, the feeling of immersion is demonstrated multiple times. Michael´s speech is fluid and in longer sentences, though he has and tendency to paraphrase and use neologisms and agrammatism. In an interview with Michael, he vividly describes an incident in SL like this:

> "Yes, a trolley ... tram on the rails. Yes, the tram, on the rails. Then, I say to my wife: Watch out... I had better hurry across the road before I am hit, before the tram gets here. Suddenly it is close... I think it is awesome... hahahaha, that it suddenly..."

[1] Loosing communication competencies after a brain injury

Another incident take place one evening Michael is exploring places in SL, he is taking a walk on the harbour (in SL). He fells in the water and cannot get up again. He must have spoken loudly to himself, because his wife shouted from another room asking what had happened, and he shouted back that he had fallen into the harbour. "We laughed and laughed, hahahahaha", he said. The incidents demonstrate how Michael absorbing oneself and forgetting the surrounding world become immerse the situations and the scenarios he experiences in SL, and in such an extent that he spontaneously finds the correct words.

As mentioned, immersion can lead to presence. The interviews revealed many examples of the participants having a feeling of presence and concrete bodily experiences. Here are some quotes:

> "...when I'm practicing jumping, my whole body tightens, and I find myself quite physically stretched upwards and onwards the moment I jump, and a relaxation when I'm well down to earth on the other side."
>
> "...and I felt both thirst and taste when I looked at Lauren drinking her coca cola."
>
> "When I am walking, I cannot feel anything, but when I fly - then I get butterflies in my stomach. It is fantastic. Normally, I am afraid of heights..."
>
> "I was out dancing one day, and suddenly I was dancing myself ... I really like to dance in here, but only when I am with some of you! Otherwise, I do not really know what to do with myself!"
>
> "A little annoying thing - I get carsick / seasick when I move around in SL"

These quotes and scenes demonstrate that SL affords a high degree of a sense of presence, and, with Schroeder's words, a sense of "Being there".

The project participant demonstrated that they in their presence in SL did not simply roam through the VE as "mind" but find themselves grounded in the practice of the body, and thus in the world (here SL).

In SL, you can choose between different perspectives. First person or third person viewed from front, side or rear. For some people, it is difficult to imagine an avatar being them when they see the avatar in third person. First person perspective, however, might give a feeling of being an outside observer, risking that the users forget that they are able to act as part of the scene. This perspective feels like watching a movie or a TV show. Immersion and presence require that the participants have an idea of how their avatars look. The first time Michael switches the perspective so that he sees himself from the front, he exclaims surprised and enthusiastically, "Wow, this is me! It really is!"

By analysing which personal pronouns the participants use about themselves, you get an indicator of their degree of immersiveness and presence and whether they are grounded in their avatar or n

It is significant that most of the participants in the very beginning of the course call the avatar "it" or "mine", but they soon switch to "I" and "me". It is also significant that it is in active action that" I" and" me" are most commonly used. When it comes to discussing the interface or technical obstacles, the users continue to say" it" and" the avatar".

In the very first session, two participants are occupied with their appearance and how the avatars move. They exchange experiences and learn from each other:

Patricia: "Well, when I make a right-click on **mine**... **mine** is sitting now. Do you see?"

Later, at the same session, they are learning how to dress and undress. Patricia is now more familiar with her avatar, and she asks Pia:

Patricia: "I'm not sure; do you see that **I'm** wearing it? Do you see **me**, Pia?"

On several occasions, the participants move around on their own, small talking and speaking aloud to themselves. Vivianne has just learned to fly, and she is happy about it:

Vivianne: "Excuse **me**, **I** will fly a little."

Karen: "Oops, where are **you**? Who is flying there?"

Vivianne: "It´s **me.**"

Persons with aphasia have demonstrated to be capable of immersing themselves in the interactions and scenarios of SL to great extent, leading them to experience a high degree of presence. Being in a VE, in which they move, behave and live with others, bodily existence may turn actions into meaning, which can lead to learning (Konnerup, 2015, p. 99). Parameters as embodiment and a sense of presence have demonstrated creating positive effects for learning tasks (Konnerup, 2015, p. 103)

Implications for Learning Practices

Generally, the LOM papers conclude that VE do have learning potentials. They agree that our learning practices are changing with the development of new VE technologies. However, there seems to be a broad consensus that despite the virtual opportunities, it not only demand to put know pedagogy "into new technologies" but calls for remediating the learning design. Heilesen (2009) wonders why VE learning designs are often replicates of the physical world. He acknowledges that the use of well-known metaphors might enhance the sense of a safe environment, but at the same time, he calls for more creativity and innovation that can bring out new learning possibilities.

A common denominator is an agreement that VE might enable learners to personalise and co-design the learning environment, facilitate high engagement, active and social learning, authentic assessment, and link between education and life. Given the task to explore SL´s potentials for communication, socialisation, collaboration, and knowledge sharing, students at the multi-media-designer education conclude that the environment must have a welcoming design and afford interaction and communication. They prefer a recognisable frame with both open and private spaces, since as a beginner, you need to explore and learn without feeling insecure. The identification with the avatar affects your emotional attachment in the environment and influences engagement and learning (Wiese, 2009). However, if there is no identification with the avatar it can foster a resistance to participation and thus influence the learning potential (Riis, 2010).

Potentially, VE contain opportunities for a variety of pedagogical approaches based on learning theories from behaviourism over cognitivism to constructivism (Riis, 2010). However, Riis (2010) and (Konnerup, 2010) agree that VE like SL have special potentials for learning and teaching building on social learning methodologies e.g. situated learning and learning in communities of practice. Lave & Wenger (1991), and Wenger (1999) describe learning as a process in which the learner becomes involved

in a community of practice representing his/her beliefs and behaviours. Learning in social VE extends beyond the pedagogical structuring and context through interaction, interplaying and communication among the learners. Several of the LOM papers conclude that VE has the potential to stimulate, engage, collaborate, stimulate, use different personas, and thus the desire to learn (Riis, 2010; Wiese, 2009; (Konnerup, 2015b). Furthermore, VE offer possibilities for multi-modal communication, which is central to the learning process (Konnerup, 2010). Therefore, even though the spaces are similar to the real-world environment, digital features offer a whole range of new activities, ways of interacting and communicating. The embodied personal representation constitutes the potential for having a strong influence on the learning experiences. Being represented by an avatar allows the learner to be bodily absorbed in a learning space and give a sense of being in a place together with people exploring other cultures and historic episodes. The virtual methods have been used for years in other contexts than the institutional education system. E.g. digital technologies and virtual activities have transformed the museum experiences for years (Rudloff, 2013). Experiences from museums and other cultural experiences can be transferred to education. One recent example is the Danish Refugee Council´s interactive virtual reality experience: "See the world in the light of a refugee". Through a pair of VR glasses, you get the experience of being a refugee child in Jordan yourself, and with the help of interactive choices, you decide what you want to experience. Such an experience has the potential to bring the learner closer to, even immerse him/her in the historic event and bring the learner to a higher degree of realisation. Wearables like VR glasses and AR are not avatar-mediated but brings the user IN the space, combining the virtual and the physical world.

Mobile augmented reality games, as Pokémon GO demonstrates how a digital game world can run parallel with game activities in physical reality. This changes the realities from binary modes to a heterogeneous space of being engaged in all kinds of places interacting with friends, acquaintances, and strangers. Thereby, it is possible to reshape and expand the learning formations of communities (Majgaard & Larsen, 2017),

VE facilitate open-ended, student-directed learning that changes the role of both teachers and students. Student must take the responsibility for their own learning, and teaching can take place independently of time and place, with or without the presence of a teacher. The teacher´s role is to design the framework, facilitate activities, and motivate to engage.

Through avatar mediation, VEs, like SL, offer features as embodiment, presence, collaboration, user-centeredness, context-awareness, and cross-real interactions to enhance users' learning experiences

New practises

New media give rise to new practises. When new technologies are offered, it is natural to be excited about the functions and features of the technology. In educational contexts, the pedagogical approaches are often of secondary importance to the digital technologies, which do not carry with them reflections on learning theory and philosophy. Furthermore, the notion of VE refers to a very diverse range of different spaces, places, and realities with disparate features and affordances. Based on research projects, the LOM-papers present virtual learning practises and pedagogical approaches in a variety of educational contexts. Many potentials are suggested. Although VE exceed physical limits, expand the world and offer situational activities, there is no evidence of enhanced learning. What we do find is increased learning through experience and through transformation of the experience (Majgaard & Lyk, 2015). The tendency to simply replicate physical spaces in virtual spaces is an issue. On the one hand, the sense of being safe in recognizable spaces might give students better conditions for experiencing, being and learning (Wiese, 2009). On the other hand, the question is, whether it makes a difference to the learning processes and the learning experiences if the physical and the virtual spaces are similar

(Heilesen, 2009). To make a difference, the pedagogy must be re-designed. In order to not just replicate classroom teaching, the educator's responsibility is to have focus on activities that qualify the teaching, provide opportunities to use more modalities, and offer experiences and new realizations.

Research at the VHIL team has revealed that avatar-mediated interactions and digital identities can change the ways in which we see ourselves. Our real character can, so to speak, be transformed by mirroring our avatars. (Blascovich & Bailenson, 2011). Potentially, this makes manipulation possible.

Does the definition that was given initially hold in this paper? One major change over the past 10 years is that virtual technologies are about to change from being mediated by screens to involving AR operated by wearable smart technologies. Learning is increasingly moving from the traditional classroom to virtual spaces, to urban spaces and into the nature. The environment is not "another" world or a Second Life, but an extension of the environment and people's lives and perceptions.

LOM`s papers on VE reflect a variety of research projects and their outcomes. By reading the publications from the last decades, you learn that LOM mirrors international and national research, from VE on computer screens over virtual labs to wearable augmented and virtual reality. The learning designs and pedagogical approaches change as the digital possibility change. Several educators and researcher are continuing their enthusiastic explorations of new technologies to enhance learning experiences. However, it also reveals that many possibilities are still to be uncovered. The immersive interfaces are evolving significantly. The whole field is changing rapidly. So are the pedagogical implications.

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Forfattere

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