



The Metaverse: Telepresence in 3D Avatar-Driven Digital-Virtual Worlds



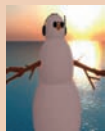
Eliane Schlemmer

Program of Postgraduation in Education. Universidade do Vale do Rio dos Sinos – UNISINOS
elianes@unisinis.br <http://www.unisinis.br/pesquisa/educacao-digital/>



Daiana Trein

Program of Postgraduation in Education. Universidade do Vale do Rio dos Sinos – UNISINOS
daianatrein@hotmail.com <http://www.unisinis.br/pesquisa/educacao-digital/>



Cristoffer Oliveira

Universidade do Vale do Rio dos Sinos – UNISINOS
chris3br@hotmail.com

| **Sended:** 02/05/2009 | **Accepted:** 08/06/2009 | **Published:** 03/07/2009

Resumen

Este artículo reflexiona sobre los conceptos de presencia y telepresencia en el uso de las Tecnologías Digitales-Virtuales emergentes, particularmente en relación a los Mundos Virtuales en 3D. Hace un informe sobre la experiencia de la telepresencia dirigida por avatares diseñados para ser utilizados en procesos de Mundos Virtuales en 3D.

Palabras clave: Metaverso, telepresencia, mundos virtuales

Resum

Aquest article reflexiona sobre els conceptes de presència i telepresència en l'ús de les Tecnologies Digitals-Virtuals emergents, particularment en relació als mons Virtuals en 3D. Fa un informe sobre l'experiència de la telepresència dirigida per avatars dissenyats per a ser utilitzats en processos de Mons Virtuals en 3D.

Paraules clau: Metavers, telepresència, mons virtuals

Abstract

This paper provides a reflection about the concepts of presence and telepresence in the use of emergent Digital-Virtual Technologies (DVTs), particularly concerning 3D Digital-Virtual Worlds - 3D-DVWs. It reports on the experience of telepresence driven by avatars designed to be used in 3D-DVWs processes.

Keywords: The metaverse, telepresence, virtual worlds



1. Introduction

Today we are witnessing the emergence of Digital-Virtual Technologies (DVTs) which foster the creation of three-dimensional online graphic environments, where the subject can be telepresent through an *avatar*, a 3D graphical representation through which s/he is able to interact, thus allowing a kind of *digital-virtual life* to emerge.

This *digital-virtual life* shapes and is being shaped by a human being, who is represented by a *digital-virtual self* in her/his relationships with other digital-virtual selves represented by *technologised bodies* (Lévy 1999). These *technologised bodies* organise in communities in cyberspace, creating digital-virtual social nets, forming and in turn being formed by this culture. Many experts have devoted themselves to conceptualising *life*. Their definitions range from the most traditional to the more paradigmatic, and stem from autopoietic theory, evolutionist biology and biosemiotics.

For Chilean biologists Humberto Maturana and Francisco Varela, “Life is a continuous challenge of facing and learning at every circumstance. Living is learning. As long as there is interaction there is life” (Maturana and Varela 1995). “Los seres humanos somos seres sociales: vivimos nuestro ser cotidiano en continua imbricación con el ser de otro” (Maturana 1999). From this perspective, life is a process of cognition, and the interactions that occur among subjects are always cognitive interactions which are built by living life. It is through living life, by our actions and responses, that we invent our world and are in turn invented by it, so that in the end the subject and her/his world emerge simultaneously. Being *alive* on the web requires interactions and interrelations, so living by necessity means living together. But how does this occur in the Metaverse, a 3D-DVW, which allow subjects to be telepresent through an *avatar* in cyberspace?

2. Metaverse and 3D digital-virtual worlds

The word Metaverse comes from science fiction. Neal Stephenson coined the term in his postmodern novel *Snow Crash* (1992), where it represented a fictional virtual world. For the author, the Metaverse is a lifelike private and public utility, because it is an extension of the physical world's real space within an Internet virtual space. The Metaverse is, then, a term that is constituted in cyberspace, and for Lemos (2002: 138) Metaverse “is the technological incarnation of the old daydream of creating a parallel world, a collective memory, the imagery, myths and symbols pursuing man since the ancestral times”, and is *materialised* with the creation of 3D-DVWs, where subjects represented by *avatars* experience immersion through telepresence, by interacting and creating several 3D spaces for living and living together, thus allowing *parallel worlds* to emerge.

3D-DVWs are multimedia environments (Lévy 1999) that permit communication through supporting technologies, 3D representation, computer-graphics modeling, and are used to represent the visual element of a system of virtual. These environments are designed using programming language and VRML (Virtual Reality Modeling Language). A 3D-DVW is *materialised* through 3D graphic representations and requires human actions to *come into being*. Without the acting of e-citizens through their *avatars*, 3D-DVWs would not come about at all. Actions on the part of *avatars* have real-time results; that is, at the very instant the *avatar* acts, the 3D-DVW is modified and updated. A 3D-DVW relies exclusively on e-citizens' imaginations and it may or may not resemble the physical world. Rules in 3D-DVWs

are made by their e-citizens, and they are the result of agreement in living and living together and the relationships among the *avatars*. Interaction in a 3D-DVW may occur synchronously (simultaneously) or asynchronously (in different times and spaces). 3D-DVWs are hybrids, they make use of divergent technologies, such as games, virtual learning environments, instant messaging, and virtual communities, among others. They offer multiple ways to interact, which may be developed by diverse languages: textual, oral, gestural and graphic. This hybridity in 3D-DVWs opens up a novel area of research whose parameters have not yet been clearly defined and whose research processes still find themselves at the earliest stages. For Klastrup (2003: 2): “A virtual world is a persistent online representation, which contains the possibility of synchronous interaction between users and between user and world within the framework of a space designed as a navigable universe. *Virtual worlds* are worlds you can move in, through persistent representation(s) of the user, in contrast to the represented worlds of traditional fictions, which are worlds presented as inhabited by real people, but not actually inhabitable”.

Klastrup (2003) drew attention to the fact that if we understand these virtual worlds (VWs) to be hybrid, then it is from this perspective that they should be investigated. She seeks to develop a poetics of virtual worlds (the systematic study of VWs as VWs), from VWs definition and *worldness* study of such world so that it is which is read with the systematic study of VWs as virtual worlds. Given the particularities that Klastrup (2003) suggests, a whole new definition of VWs should be created to describe the many genres of VWs (to separate social worlds from game worlds) and to determine what distinguishes VWs from virtual environments and virtual communities (with a primary focus on social interaction). This new approach should also place emphasis on the interactional aspects, both user/user and user/world, and illustrate what it distinguishes VWs from other types of imaginary worlds (such as soap operas or films), which are not living spaces. Finally, this formulation must stress the fact that a VW is a world shared by multiple users (synchronous communication) and therefore is also produced by other users.

For Schlemmer (2004), a 3D-DVW may be a relatively faithful facsimile of the physical world, or may in fact be a unique creation that emerges from entirely imaginary representations modeling itself on non-physical spaces for digital-virtual living together. These worlds may have rules of their own, and its inhabitants can make use of their creative powers, since they are not limited to any existent physical rules. One of the key characteristics of 3D-DVWs is that they are dynamic systems that change in real time as subjects interact with it. This interaction may occur to a higher or lower degree, depending on the interface used, because the VWs may be settled by both humans and e-citizens, represented by *avatars* or *virtual humans* (Non-player Characters - NPCs and/or bots and communicative agents). The Metaverse allows the subjects *living* in it to build themselves a 3D-DVW through their *avatars*, their *technologised bodies*.

3. Avatar

As with the Metaverse, Neal Stephenson first used the term *avatar* in 1992 to refer to a human representation in cyberspace. For Schlemmer and Trein (2008), *avatar* is an indian word used to depict a body manifestation of an immortal being, or a manifestation of a being belonging to a parallel world, sometimes even a Supreme Being, in this world. It

derives from Sanskrit *Avatāra*, which means *descent* or *incarnation*. In the technological context, the term *avatar* is used to refer to the graphical representation of a subject in a virtual world. Depending on the technology, it can range from a simple image, a two-dimensional model, all the way to a sophisticated, predefined, personalized 3D model. It may resemble the physical appearance of the human or may instead be a figment of one's imagination. Creating an *avatar* allows the user to construct an entirely new identity.

In Metaverse Second Life - SL (e.g., *Second Life (SL)*), the term *avatar* refers to e-residents' graphic representation within the 3D-DVW (see Figure 1 and 2 for different types of representations). It is possible to edit many parts of the body of *avatars* with scroll bars that can range from values of 0 to 100 (Figure 3 shows a polygon mesh). These bars manipulate a polygon mesh that changes the appearance of the *avatar*. The bars work as gauges, determining the higher and lower dimension of the *avatar's* body. All movements have been previously calculated, so there are many but still a finite number of possibilities.

Besides creating a *technologised body*, it is also possible to assemble different items of clothing. Some clothes are based on existing ones in the physical world, and some are invented and exist only in the VW. Both are possible by shaping *prims* (basic building blocks such as spheres, cubes, etc.) and textures (e.g., Figure 4 shows a T-shirt texture), thereby increasing the degree of realism through the imitation of the colours and textures of varying fabrics. There is also clothing designed in image edition programmes such as GIMP (Figure 5 shows editing in GIMP) and Photoshop, which are then imported into SL. The profusion of details allows users to dress *avatars* like humans in the physical world. If the user wants to further increase the sensation of realism, SL allows the creation of special effects for clothing, such as the movement of fabric when the *avatar* walks, runs, or flies, or when there is wind in the virtual world (Figure 6 shows the creation of movement in Poser). In addition to clothes, there is also the potential for establishing other characteristics for the *avatar* through the construction of meaningful objects. Some users add wings (Figure 7 shows

an *avatar* with Wings), tails, tattoos and other ornaments to the *avatar's* body. Hair of various shapes, movement, and colours can also be added.

The *avatar's* movement is another key characteristic that can be edited in SL; every movement of the *avatar* and the way s/he interacts with the world can be personalised. Editing movements and gestures occurs outside of SL, with the aid of software programmes such as Poser. After editing, the user imports gestures or movements into SL, via files that contain data about the *avatar's* movement and actions.

All these possibilities for personalising *avatars* enhance the degree of realism, and permit the subject to immerse her/himself in the 3D-DVW, thereby promoting the feeling of telepresence, which allows the subject to experience a sensation of belonging within the VW. Constructing *avatars* is a process of virtualising the physical world and giving birth to an entirely new world. Before our *virtual birth*, we have already chosen our names, sexes, skin colours, weights, etc. We decide whether we are a human being, an animal or even half animal, half human. Subjects living in and living together in the 3D-DVWs are the ones who establish all the rules, patterns, shapes, and parameters.

4. Presence and telepresence

When we speak of presence we refer to mental models we have built during our lives. In 3D-DVWs we discard our learned understanding of being present as we have experienced it thus far, and we come to experience a telepresence that can be understood as a *digital-virtual being with*. For Schlemmer (2008) *being present* is no longer limited to physical presence as determined by the limits of the physical body, since our new technologised, *digital-virtual bodies* can be here and there at the same time permit us to construct and explore fresh realities, experiences, and feelings. The study of presence and telepresence in the context of Digital Virtual Technologies - DVTs is at an early stage; we know very little about the perception of presence and feeling as experienced through *avatar* interaction in 3D-DVW, for example (Schlemmer 2008).



Figure 1 shows the graphical representation of a web chat



Figure 2 shows a 3D graphical representation



Figure 3 shows a polygon mesh that manipulates the avatar's appearance



Figure 4 shows a T-shirt texture

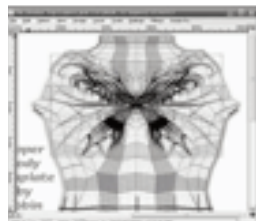


Figure 5 shows editing in GIMP



Figure 6 shows editing in Poser



Figure 7 shows an avatar with wings appearance

Technology	Communication	Level of Telepresence
3D-DVWs, Virtual Worlds, Virtual Reality, Online MMPORPGs	Multidirectional	High
Videoconference, Chat, Telephone, Virtual Communities, Simulators	Two-directional	Average
Television, Radio, Print, Cinema, Web, Mail	Unidirectional	Low

Table 1. Technologies and level of telepresence achieved

In a comprehensive review of knowledge production about presence, Lombard and Ditton (1997) have found six interconnected but distinct conceptions:

- Presence as social information that shapes socialisation among subjects
- Presence as realism, or the feeling of reality the subject experiences, the sensation that the *thing is true*
- Presence as transport, which enables the subject's movement and provides the following variations:

- ♦ *You are there* — the subject is shifted to another place (this concept is often used in discussions of virtual reality)

- ♦ *There is here* — the other place and its objects are shifted closer to the subject

- ♦ *We are together* — where two or more subjects are shifted together into a place they share. Subjects share the same virtual space

- ♦ *You are around* — the earliest version of presence. The oral tradition of the earliest human beings involved a storyteller, which allowed the subject to be shifted to the time and place where the events occurred (Biocca & Lévy 1995, in Lombard and Ditton 1997)

- Presence as immersion introduces the idea of perceptual and psychological immersion (Biocca & Lévy 1995, in Lombard and Ditton 1997), such as Virtual Reality - RV, IMAX Film, planetariums and simulations, where experiences and feelings are imbedded in the digital-virtual world. Perceptual immersion is the “degree to which a virtual environment submerges the perceptual system of the user” (Biocca & Delaney 1995: 57, in Lombard and Ditton 1997). Presence as immersion also includes also a psychological dimension. Presence as immersion occurs when subjects feel they are involved (Palmer 1995), absorbed (Quarrick 1989, in Lombard and Ditton 1997), engrossed, or engaged
- Presence as social actor in the environment; the subject is involved in an Virtual Reality - VR experience where it is possible to act/interact and experience a situation
- The presence of the environment as a social actor involves feedback during interaction provided by the environment itself, and the use of computer programmes to enact social roles, such as the use of agents. Marvin Minsky first used the term telepresence in 1980 in a

tele-operation system involving the remote manipulation of objects. For Minsky, “telepresence is the feeling that he or she is really there in the remote environment, while virtual presence is feeling as if you were present in the environment the computer created” (1980: 120).












According to Walker and Sheppard in Hu (2006), telepresence is a way of communicating that allows the subject to act and interact with other subjects and objects at a distance and while experiencing the feeling of *being there*, *being here* and *being together*. It is used to assign digital-virtual presence to one or more subjects in another place that may be physically distant or inaccessible. Lévy (1996) says that the projection of the virtual image of a body is usually associated with the notion of telepresence, but telepresence is always more than the mere projection of virtual images, since it is not associated with digital technologies but rather with 3D digital-virtual technologies. We have experienced telepresence in simple telephone calls. For Lévy (1990), the telephone is the primary medium for telepresence, because it passes through electromagnetic waves and allows us to feel our interlocutor's presence (see Table 1).

For Lévy (1999), virtual worlds possess two discrete modes: immersion and browsing. Immersion provides the subject with a representation and allows him/her to interact with other users and the environment, and his/her actions directly affect the environment. Browsing occurs when the virtual world guides the individual along a path.

The immersion to which Lévy (1999) refers occurs in the 3D-DVW, which directly speaks to our loss of spatial references while we are telepresent in another world. Similarly, we lose the perception of the movement of our own physical bodies when we gain new bodies via our *avatars*. We have to learn to talk, run, jump, fly and make gestures with our technologised bodies. There are no limits on our technologised bodies; we gain a technological digital-virtual body that can simultaneously be here and there, and therefore we are able to construct new realities, experiences, and sensations.

5. Avatar Telepresence- Preliminary Analysis

Below we have provided some graphic and textual representations about the sensation of telepresence provided by various *avatars*. Subjects participating in this experiment are 20-35 years old, eleven are female and four are male, and there are a total of fifteen subjects with differing levels of approach and technological fluency (see Table 2).

Avatar Graphic representation	Textual representation
Janilse Smith 	The experience of becoming an avatar in the 3D virtual worlds means to be immersed in the environment interacting with a virtual body; so we are really involved in what we're doing.
Eder Parisi 	For me, being represented by an avatar means having a self similar to me in the 3D-DVW. It is an image representation, which is different, for example, from being represented by my contributions to a forum. In a 3D-DVW I'm there and can express myself even by text, but also by gestures, look, clothes, etc.
Gasper Blanco 	The difference of experiencing telepresence in a 3D-DVW ... is basically the representation you make of your digital-virtual self ... the 3D-DVW allows you to use gestures, movements, speech, the very representation of your self (body, accessories), I think it touches me because it allows me to see the other as a representation, an avatar as a subject, that individual behind ... After engaging in meetings and chats in a 3D-DVW, there's a sensation there's no limits in time and space while we are there, discussing and interacting through avatars, as if we were addressing physical subjects in the flesh ...
Saiyen Eerie 	The biggest difference is in managing to interact ... in the 3D-DVW it's you that is talking, but under any id, it's nice, you can interact with more than 20 individuals at the same time, while through Virtual Learning Environment there's no sensation of interacting with people, but rather with software, which is tiring and boring.
ItaK 	I noticed that through the virtual world you can interact differently from chat, because at this moment, I'm represented by an avatar and at the same time I can move throughout Unisinos and communicate with colleagues in different ways. It would be different if I'm represented by an avatar, since I can communicate and move at the same time, instead of only typing.
Solh Magic 	It was interesting approaching other avatars, talking and trying to discover who is who. Listening to the teacher's voice without having her physical presence in the classroom was also different, telepresence opens up the ability to communicate, interact and interchange experiences and knowledge. The 3D-DVW allows for an approach to objects, people and spaces similar to the real world, creating situations only our second self can realise, such as flying.
Joice Patzlaff 	Nice, because there you can be as you sometimes imagine yourself, or even if you're frustrated with yourself, your body, there you can open your heart and make it true in no time at all, but unfortunately not in reality ... in 3D it is a way of communicating more similar to actually being present, it is as if we were all together in the same space and communication was presential.
Angeline Ragu 	I found it very interesting to listen to the teacher's voice when she wasn't present, it's really a very useful resource, I also believe that classes could be conducted in this way, using telepresence ... I think participation is more direct, that is, I'm there represented by a character that expresses my opinions and has contact with other colleagues.
Agriebler Andel 	The feeling is one of freedom, it would be very good if everyone could choose their names, but we need them when we are born and as we have no choice, our parents' choice is not always what we would prefer. I'm used to msn, but with a simultaneous image, even when it's 3D, it is very different, you can have an idea of reality, indeed a virtual reality, but I love it, much more than ever.
Juliap Paule 	Great! My first reaction was to show to everyone that I could teleport. The feeling is that of a child discovering something spectacular! For sure! We would use not only a written language, but notice how our colleagues perceive, see the world around them, act in particular situations, express their ideas, feelings and wishes through various languages (written, oral, gestural, etc.), a lot of knowledge and glances in real time on VW.
Abigails Footman 	This novel experience is funny as I can change my avatar, easily and quickly moving into other places. ... 3D-DVWs are more interactive than virtual communities. While I listen to a piece of information I can explore the world in which I am, and I can also communicate by way of chats. Moreover, it is less tiring as I can see, to talk, gesture.



<p>Amandal</p> 	<p>It is great, very interesting, because you can shape, create yourself in the way you wish, make clothes as you wish, the colour you like, it's as if you were a creator ... Telepresence makes us closer, for example, in the class we can see, talk, it seems real, each avatar with his/her own characteristics.</p>
<p>Tamaregina Parx</p> 	<p>I felt comfortable and interacted well though I didn't know enough about this metaverse to use all the resources, but it's the free interaction that makes people feel comfortable without the pressure to talk, like in a chat or in a presential class.</p>
<p>Gchiefelbein Samtanko</p>	<p>As for the telepresence with the avatar, it's much better than the Virtual Learning Environment, the class is not as tiring, it's more interactive, easier to follow ...</p>

Table 2: Telepresence: graphical and textual representation

Analysing the accounts above, we have found that all subjects creating their *avatars* have maintained their gender, and most of them have retained features similar to their appearance or *physical identity*. Concerning representations about the feeling of telepresence, we have found:

- the linkage between the sensation of telepresence and a feeling of being immersed is made viable by interaction with a virtual body, which allows for more involvement with what is being developed
- the connection between the feeling of telepresence and the possibility of representing a *digital-virtual self* through an *avatar* that may or may not be similar to one's physical shape, marks a differentiation between a representational image or a textual representation in a forum, for example, and highlights the possibility to express oneself through gestures, movements, speech, and appearance, among other factors. These multiple modes of expression move with and express feelings and perceptions since one can *see* the other through his or her representation.
- the assurance of a certain degree of privacy since it is possible to create *fakes* or *aliases*, which could certainly resemble physical world identities, but would not show who the person really is, thus allowing more comfort.
- freedom for subjects to be the way they imagine themselves to be, through telepresence, so that they can open their heart and “make it real” in a collapsed period of time, unlike most situations in physical reality. Some subjects found similarities between the presential in the physical world and the telepresential, commenting that the modes of communication are similar to those employed in the presential, as if everyone were actually in the same space.
- another issue concerns the possibility for a different type of interaction, to be able to converse with many people at the same time and through any identity, allowing a new kind of communicative approach.
- subjects noted that the class is not as “boring and tiresome”, it is more interactive, and allows one to see, talk and gesture. The connection between the feeling of telepresence in physical meetings and talking in 3D-DVW includes the sensation that there is no limit in time and space because while it is possible “to be there”, discussing and interacting through the *avatar*, it is also possible to refer to physical subjects.
- the sensation of telepresence sensation is unique because of the *avatar's* representation and the simultaneity

of communication and movement in space, unlike mere typing. Some subjects commented on the discovery of “who is who” in 3D-DVW, and on how it was “different to listen to the teacher’s voice, separated from her physical presence in the classroom.”

- some subjects are optimistic about telepresence’s possibility for improving communication skills and for the exchange of experience and knowledge. The 3D virtual world enables an approach with objects, people, and spaces that are similar to those in the real world, and at the same time creates situations that only our second *self* can do, such as flying.
- telepresence allows more direct participation through the representation of a character that gives opinions and comes into contact with other people. It is also possible to see how colleagues perceive, see the world, act in particular situations, express their ideas, feelings and wishes in different languages. There is “a lot of knowledge and glances in real time on VW”.
- other subject claim telepresence provides freedom through the *avatar*, because everyone can choose names, interaction is free, and there is no pressure to talk, as in a chat or in a presential class.
- when speaking of telepresence in 3D-DVWs, some subjects make distinctions with other technologies such as AVAs, MSN and virtual communities, highlighting aspects such as interactivity and simultaneity of action (listening to information, exploring the world, communicating via chat).
- telepresence also appears to be related to teleporting, the ability to move quickly into other places. It is still associated with the pleasure of discovery, of feeling comfortable, considering the experience as nice, very interesting, and fun because one could change the *avatar*.
- a final issue is the feeling of authorship because there was the possibility “to create in the way they wished, make clothes as they wished, the colour they liked, it’s as if you were a creator” Telepresence is also seen as a way of getting closer in a “distance class context, as we can see, talk, it seems real, each avatar with his/her own characteristics”.

6. Concluding Comments

Metaverse technology, 3D-DVWs, with the possibility of telepresence via the creation of *avatars*, has an existence, a reality, but of another nature, one associated with virtuality. So we cannot accept the claim that *avatar* telepresence via *technologised bodies* living in these worlds and allowing exist-

tence of a digital-virtual life is not real, as Castells (1999) states when he calls it *Real Virtuality*. When we take learning as something that occurs when the subject interacts with the object of knowledge and other subjects, which characterises interaction as the key element in an educational process, we can imagine 3D-DVWs and *avatar* telepresence raising what we now call Distance Education to new standards, since currently it takes place almost exclusively via textual language.

However, we need to remember that merely using 3D-DVWs since they are a novelty does not necessarily mean innovation in the educational context. For that to happen we need teachers/researchers who appropriate this technology to understand it in the context of its specific nature, which demands new methodologies, teaching practices, and mediating processes that are in tune with the potential 3D-DVWs offers.

References

- Castells, M. (1999). *A Sociedade em Rede*. São Paulo: Paz e Terra.
- Hu, R. T. O. (2007). *Contribuições ao desenvolvimento de um sistema de telepresença por meio da aquisição, transmissão e projeção em ambientes imersivos de vídeos panorâmicos*. USP.
- Klastrup, L. (2003). *A Poetics of Virtual Worlds. Proceedings of MelbourneDAC2003*. Melbourne. Available at <http://hypertext.rmit.edu.au/dac/papers>. Accessed in 10.08.2008.
- Lemos, A. (2007). *Cibercultura. Tecnologia e vida social na cultura contemporânea*. Porto Alegre: Sulina, 3rd ed.
- Lévy, P. (1996). *O que é o Virtual?* Rio de Janeiro: Editora 34.
- Lévy, P. (1999). *Cibercultura*. Rio de Janeiro: Editora 34.
- Lombard, M. & Ditton, T. (1997). At the heart of it all: The concept of presence. *Journal of Computer Mediated-Communication*. Available in <http://jcmc.indiana.edu/vol3/issue2/lombard.html>. Accessed in 10.08.2008.
- Maturana, H. (1999). *Transformación en la Convivencia*. Santiago: DolmenEdiciones.
- Maturana, H.; Varela, F. (1995). *A árvore do conhecimento - As Bases Biológicas do Conhecimento Humano*. Campinas: Ed. Psy.
- Minsky, M. (1980) *Telepresence*. Omni, pp. 45-51.
- Schlemmer, E. (2004). AWSINOS: Construção de um Mundo Virtual. In: *VIII Congresso Íbero-Americano de Gráfica Digital*: Sigradi, São Leopoldo- RS.
- Schlemmer, E. (2008). ECODI - A criação de espaços de convivência digital virtual no contexto dos processos de ensino e aprendizagem em metaverso. *Revista IHU*.
- Schlemmer, E. Trein, D. (2008). Criação de Identidades Digitais Virtuais para Interação em Mundos Digitais Virtuais em 3D. In: CIAED (eds.). *Congresso Internacional de EaD*, São Paulo.

| How to cite this article:

Schlemmer, Eliane; Trein, Daiana and Oliveira, Cristoffer (2009). The Metaverse: Telepresence in 3D Avatar-Driven Digital-Virtual Worlds. *@tic. revista d'Innovació educativa*. (nº 2) [Articles] <http://ojs.uv.es/index.php/attic/article/view/98/88>. Accessed: month/day/year