Interaction in Situated Learning Does Not Imply Immersion
Virtual Worlds Help to Engage Learners without Immersing Them

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Keywords: Immersion, Situated Learning, Virtual Worlds, OpenSim, Learner Engagement, Interaction, Teaching.

Abstract: Immersion is a central theme when using virtual worlds; the feeling of 'being there' is generally considered a positive attribute of virtual worlds, in particular when these are used for recreation. However, within educational context it may be debatable how far immersion can be expected or is even desirable: if we want students to be reflective and critical on their assignment task, wouldn't it be more important for them to have a critical distance, rather than being immersed? In this paper, we approach this question by examining and discussing how interactions, learner engagement and immersion are linked together when a virtual world is being used in a Hybrid Virtual Learning scenario. Findings from our experiment seem to suggest that even though this learning approach aids positively the educational process, high levels of immersion do not occur. Nevertheless, more research in that direction is highly recommended to be undertaken.

1 INTRODUCTION

Immersion is often considered to be central to Virtual Worlds (VWs) (Bredl et al, 2012; Childs, 2010; Christopoulos, 2013). However, it might be debated how far immersion might help or hinder an education experience within a university assignment. While situated learning (Herrington and Oliver, 2000) is generally considered a futile approach to facilitate practical student experience it may be questioned if 'too much' immersion might hinder students to critically reflect on their learning experience. This is in particular relevant on postgraduate level where this critical reflection is typically a key learning outcome of the course.

In order to shed some light on this issue we draw data from observations from an experiment conducted in the wider context of student interaction and engagement and re-interpret the findings in view of the level of student immersion.

2 RELATED WORK

2.1 Interacting with Virtual Worlds

VWs provide the necessary context for different types of interactions either between the users and the content of the VW or the users themselves. Typical examples of these types of interactions are the object creation and manipulation (Bredl et al, 2012), terrain editing (Allison et al., 2012), and navigating around the world (Hockey et al., 2010). Communication is, indeed, another important factor which increases the opportunities for interaction between the users; be it synchronous or asynchronous, verbal or written or through the use of avatar gestures (Hockey et al., 2010). VWs have been used in various paradigms as they provide fertile ground for the implementation of different learning styles (e.g. Problem Based Learning, Exploratory Learning, and Distance Learning) (Christopoulos, 2013). Vygotsky's (1978) Social Constructivist Learning Theory has great practical application in VWs since it covers issues such as the fact that students become active learners while building, at the same time, their cognitive structures and knowledge through the complex network of interactions that motivate them to engage with the VW and the learning material, by extension. Indeed, as Jones (2013) suggests, learners have the ability to actively affect, alter, and enhance the content of the VW in a manner that will enable them to construct their cognitive schemes and engage with the subject they study. Zhao et al. (2010) further extend the aforementioned claim and also suggest that learning becomes more self-directed and student-centered, whereas educators get the role of

Christopoulos, A., Conrad, M. and Kanamgotov, A.
Interaction in Situated Learning Does Not Imply Immersion - Virtual Worlds Help to Engage Learners without Immersing Them .
DOI: 10.5220/0006316203230330
In *Proceedings of the 9th International Conference on Computer Supported Education (CSEDU 2017) - Volume 1*, pages 323-330
ISBN: 978-989-758-239-4

instructional designers or supporters of activities that aim to engage students in learning (Anasol et al., 2012).

Educators' new role has triggered the conduct of several studies focusing on the interactivity of the VWs and the in-world interactions that can – or need to – be developed in order to cover students' learning needs. Some studies investigate the use of VWs in distance learning scenarios (de Freitas et al., 2009) aiming to identify an evaluation method to measure students' learning experiences, while others cover the skills students acquire when they start using VWs (Childs, 2010). Another group of studies focuses on the elements that affect a VW's interactivity (Steuer, 1992), whereas others attempted to address the aforementioned topic from a different perspective (Chafer and Childs, 2008) as they identified additional parameters. However, most of these studies disregard the perspective of learning in the physical classroom in conjunction with the VW (Camilleri et al., 2013).

Based on the review of the literature that we have conducted, only a few studies attempted to examine interactions both from the inside and from the outside (Levesque and Lelievre, 2011) whereas the authors suggest that great emphasis should be given on the enhancement of interactions both in the VW but also in the physical classroom. De Freitas et al. (2010) also underline the importance and need for further investigation of the potential and the affordances of hybrid spaces with simultaneous student physical and virtual presence. Other researchers (Elliott et al., 2012) highlight the lack of detailed taxonomy of all the interactions related to the educational use of VWs, which would aid in a better understanding of their affordances, in a more expedient design of educational activities, and in a more thorough exploitation of their potential.

2.2 Immersion in Virtual Worlds

Immersion, according to Brown and Cairns (2004), denotes a "sense of being there" or a "Zen-like state where your hands just seem to know what to do, and your mind just seems to carry on with the story". As a phenomenon to describe the immersion experience this is not something new and applicable only to the VW. We can feel immersed while reading books (Nell, 1988), watching films (Bazin, 1967) or doing something else, no matter what but it needs to involve us fully in order we, as "users", could achieve that state of the mind. With the relatively recent advent of VWs, however, the phenomenon described received a new momentum, involving the user through not only observation of the material, but while actively interacting with environment, establishing the cybernetic circuit between the user and the VW. This phenomenon is described as "presence" and "immersion". Though both definitions are widely used and have been discussed for decades, there seems to be a lack of consensus achieved so far (Brown and Cairns, 2004). Nevertheless, the phenomenon these two terms have been enlisted to describe is crucial to our understanding of the relationship between user and VW, as it represents one end of a continuum of intensity of involvement with VWs and addresses the very notion of being in the context of such simulated environments. As Calleja (2014) argues, the main challenge and confusion between two terms is "based on a number of challenges they pose to a clear understanding of the phenomenon they have been employed to describe", since neither of the terms fully and adequately describes the relationship between the user and VW, assuming that the human being interacts with the VW in a unidirectional manner, that there is a certain split between the user in his real world ("here") and the virtual counterpart he interacts with ("there"). Both definitions, "presence" and "immersion", are used frequently and interchangeably, though there is a certain level of contradiction between them. Slater and Wilbur define immersion as a technological feature, an option which belongs to the side of "technicalities", rather than the state of the mind: "A description of a technology […] that describes the extent to which the computer displays are capable of delivering an inclusive, extensive, surrounding and vivid illusion of reality to the sense of a human participant" (Slater and Wilbur, 1997). In contrast, Witmer and Singer (1998) describe the immersion as "a psychological state characterized by perceiving oneself to be enveloped by, included in, and interacting with an environment that provides a continuous stream of stimuli and experiences", which aligns quite closely to Slater and Wilbur's definition of "presence". Moreover, Calleja (2014) introduces a "more productive and precise" definition, where "the VW assimilated into the user's consciousness as a space that affords the exertion of agency and expression of sociality in a manner coextensive with our everyday reality" which he calls "Incorporation".

While the exact definition of 'immersion' is still open to debate we note that it is (in any definition) a central theme and expected outcome when interacting with virtual worlds. The evaluation of which of the definitions describes the phenomenon more precisely lies beyond the scope of this research

and in order to avoid further confusion in the terminology, the term "immersion" is used throughout, denoting the user's involvement into his activities within a virtual environment.

3 MATERIALS & METHODS

To investigate the relationship between interaction and immersion we draw data from an experiment which lasted one month involving postgraduate Computer Science & Technology students participating in the study. Indeed this experiment is part of a wider study on how different types of VWs help or hinder student engagement.

Figure 1: Snapshot of the content of the virtual world which has been developed for the needs of the experiment.

An institutionally hosted OpenSimulator VW was used for students to work with the built-in programming language and design 3D objects. At the end of this assignment, all student groups were expected to present their work, prepare a video about their virtual showcase and submit a report. This class was being held, besides the traditional lecture form, in two-hour practical sessions which ran once a week. Finally, the focus of this experiment was to examine the impact that the educational and leisure games have on interactions, learner's engagement and consequently immersion (see Figure 1).

3.1 Research Methodology

Research through observation may have several strengths but three were the main aspects that indicated observation as the most suitable method for this study. Firstly, as described in Cohen et al. (2011), that led to the emergence of unique primary data, the most essential advantage of observation is considered to be the principles of 'immediate awareness' and 'direct cognition' — i.e. the opportunity given to a researcher to have a 'direct look' at the actions that take place without having to rely on second-hand accounts. Secondly, observation is a very flexible form of data collection that allows researchers to alter their focus, depending on the observed actions and behaviours. Finally, the method of observation allows the researcher to gather any necessary data, while the participants unimpededly follow their own agenda and priorities.

Nevertheless, when conducting observation research, there are unavoidably – as with most methods – certain disadvantages in the data collection process. Even though a great effort was made to eliminate them as much as possible, they cannot be disregarded. In particular, the main challenge, when collecting primary data through observation, is the 'selective attention of the observer'. In addition, the 'reactivity' of the sample can also run the risk of bias. Finally, observations are recording only what happens in a given period of time or what can be seen in a given interface.

4 LEARNER ENGAGEMENT, INTERACTIONS & IMMERSION

In order to identify the impact that different types of interactions have on users – or in this case students – while being (physically) present in a university laboratory and also in the VW, we developed our own observation checklist (see Tables 1 and 2). The focus points – though not all of them are presented in this paper as we are focusing exclusively on those who have impact on immersion – were developed after using the findings of a research conducted by one of the authors (Christopoulos, 2013), under the principles and guidelines of the Grounded Theory (Strauss and Corbin, 1998) and the suggestion of pedagogists on how to make these observation checklists effective (Cohen et al., 2011).

Consequently, we correlated these focus points in accordance with the framework related to the factors affecting immersion as presented by Witmer and Signer's (1998), and namely are:

- *Control Factors*: such as 'degree of control', immediacy of control', 'anticipation of events', 'mode of control', 'physical environment modifiability'
- *Sensory Factors*: such as sensory modality, environmental richness, multimodal presentation, consistency of multimodal information, degree of

movement perception, active search
- *Distraction Factors*: such as isolation, selective attention, interface awareness
- *Realism Factors*: scene realism, information consistent with objective world, meaningfulness of experience, separation anxiety / disorientation.

Table 1: Observation checklist (actions & interactions in the physical classroom) and linkage to level of immersion.

Type of interaction	Immersion
Student seems focused on his/her project	High (meaningfulness of experience)
Student seems "absent-minded"	Inconclusive
Student seems to enjoy the project	
Student seems unpleased using the VW	
Student makes positive/negative comments about the technology or emotional experience.	Low (detached from the VW to interact in the real)
Student refers to avatar in the first person/ identifies with avatar (avatar as 'I')	High (embodiment)
Student refers to avatar in the second person/ addresses avatar directly ('you'), third person ('him', 'her' or as an object ('it')	Low (demonstrates distance)

Table 2: Observation checklist (actions & interactions in the VW) and linkage to immersion.

Type of interaction	Immersion
Student works on project (building/scripting)	High (physical environment modifiability)
Student refers to avatar within VW.	High (indicates interaction)
Student modifies his/her avatar's appearance	Inconclusive (might indicate distance)
Student uses avatar gestures	High (as it happens in-world, rather than direct interaction with classmates)
Student uses existing content, in-world tools, his/her own virtual creations, explores classmates' virtual artifacts	

5 REFLECTION ON THE OBSERVED DATA

In this Section we will discuss the actions that students performed during their practical sessions as they have been observed by the researcher, both in the physical classroom and the VW, during the course of this experiment. In order to observe all the participants for an equal amount of time, students' actions were logged in rotation for approximately 30 seconds (per student or pair of students) until the completion of the practical session. In total, 18 students participated in our study among which fifteen (15) were males and 3 (females).

5.1 Actions & Interactions in the Physical Classroom

5.1.1 Student Attitude towards the Use of the VW

Week 1. Most of the students dedicated their time to explore the content of the VW, play with the games (amusement park, lake, café, maze), discover and familiarise themselves with the tools of the VW, and only a few of them – almost at the end of the practical session – were observed being at their team's workspace in order to discuss, plan and make some initial design of their project's infrastructure. Indeed, as it was as introductory session and most of the students were not familiar with the building and scripting tools of the environment, they were not expected to be either working right away or to be focused on their project. A couple of students were quite often observed being absent-minded or completely detached from the VW, as they were on their phones or staring at their friends without actively engaging or participating in the conversations. The main source of disappointment or displeasure was the difficulty some students had in understanding the tools of the VW (even the navigational ones). As a general note, it is worth mentioning that all of them acknowledged the importance of having pre-existing content in place, as it provided them with the opportunity to get a taste of what their simulation or showcase should contain or look like.

Week 2. Almost all the students (including some of them who were responsible for the development of the virtual showcase) spent a considerable amount of time (in total duration) working or helping their teammates with the documentation needs of their project. However, most of the developers were usually interacting more with the VW and less with their team members who were working on other aspects of the project. Nevertheless, as most of them (the developers) were still not comfortable with the building and scripting tools of the technology, very few of them, and only for a few times, were observed working 'focused' on their project. Indeed, the difficulty most of the students had manipulating the tools of the VW was undoubtedly a good reason to be displeased or even frustrated (in some cases). Likewise, very few times were students observed

being happy or enjoying the process, as they were not directly engaged with the actual development process, but, instead, they were trying to deal and familiarise with the tools of the VW.

Week 3. All the teams but one (infancy stage) had shown some actual effort to work and develop parts of their virtual showcase as they had now reached the middle-end stage of their projects. During the course of the practical session, all of the developers were most of the time located at their teams' workspaces, working on their projects. However, very few times were students observed working focused on their task, as they were often distracted by other matters (talking, helping, searching on the web). Likewise, no great levels of enjoyment were observed, as the students were trying to do some serious work without losing time in playing or entertaining themselves along the way. A couple of students were observed a few times being absent-minded or actually completely detached from the VW (use of mobile phone), while some more students were quite displeased, as they were still struggling a lot to understand the tools of the VW. As these students were part of the aforementioned team that was still in an infancy stage, their disappointment turned into frustration and anger towards the use of the VW, leaving no space for other students or the teaching team to help them out.

Week 4. Even though all the students were working on the finalisation of their virtual showcase, very few times were they observed working focused on their projects. In fact, quite often their attention was being distracted by other matters such as the documentation process. Apart from not being focused on their task, a group of three students were observed being several times completely detached from the VW, as they were browsing the news on the web, staring at other students or using their phones. Not very obvious levels of enjoyment were observed either. Most of the students were rushing to finish off the development of their showcase or to make some 'last-minute' modifications on their objects, while also offering some help to other team members that were working on other matters.

5.1.2 Student Identity and Avatar Identity

Week 1. Students that managed to familiarise themselves with the VW faster than others were quite keen to help their fellow students to perform some, at least, basic changes in their avatars' appearance editing, and, thus, a large portion of the session's time was centred around this process. Indeed, several comments were made by most of the students, such as 'why am I a lady?', 'I want to be a man, how do I change my gender?!', 'he is very ugly, how we can fix it?', 'can I make it black like me?', 'get a brush and start painting it bro! haha!'. A fairly common and often repeated action was the observation of students pushing their avatars to go far beyond the VW's 'invisible' borders, something which caused their avatars to seem stuck or gave the illusion of flying to 'nowhere'. As expected, help requests to 'unstuck' the avatars were made to the teaching team 'he lost his way [referring to his own avatar]! Can you help me get back to ground?'. Interestingly, one of the students lost his way out while visiting one of the workspaces and asked the lab demonstrator to help him find his way out 'sir, I got myself in this room, how can I go out?'.

Week 2. Very few students were observed modifying their avatars' appearance for a fairly short period of time, whereas equally rare were the references made in relation to them. A quote worth mentioning was the one made by one of the students asking his life-partner, and eventually fellow student, to modify his own avatar as he was struggling to do so '[partner's name] can you make it look like me?'. Another interesting comment was made by the only student who slightly 'drifted' from the mainstream attitude that most students had towards their avatars, i.e. mirroring their physical identity in the VW, and differentiated himself by modifying his avatar's body shape in a completely different way, completely opposed to his physical identity (overweight-underweight) 'guess I need to start training! Lol'.

Week 3. Only two students were observed modifying their avatars' appearance. However, both of them performed minor changes for an overall short period of time. In particular, one of them was observed making modifications mainly for his own favour and desire, whereas the second one was performing changes that were required for the needs of his team's showcase (demonstration of smart devices attached to human body or, in this case, the avatar's body). In any case, very few references related to avatars were observed mainly during the natural talk-flow, and, interestingly, all of them in the second person 'poseballs can help you do it', 'You need to attach it in your left shoulder otherwise it is not going to work', 'Where are you going?'.

Week 4. None of the students was observed making direct reference or mention to avatars at any point during the practical session. However, one student was observed editing his avatar's appearance for a couple of minutes, for the needs of the

showcase demonstration.

5.2 Actions & Interactions in the VW

5.2.1 Student Identity and Avatar Identity

Observation week 1. Almost all the students were observed modifying their avatars' appearance for a considerable amount of time. Some of them performed basic changes, such as hair and body style, whereas others made some more detailed and intensive one, such as clothing and accessories. Interestingly, none of the students were observed role-playing (opposite gender than their real one or converting their avatar into something unrealistic e.g. robot, animal). However, several students modified their avatars' appearance according to their desire, without mirroring their real identity (physical condition). As the use of the chat tool was quite intense, several times students were observed referring to avatars through it.

Week 2. As the use of the chat tool was almost non-existent, no comments about avatars were observed. Likewise, only a few students were observed modifying their avatars' appearance, with the most striking examples being the appearance editing made by one of the students on behalf of her friend, and the student that slightly role-played by modifying his avatar's body shape to look differently than his physical one.

Week 3. Only two students were observed modifying their avatars' appearance. However, none of them performed extreme or unrealistic modifications. In particular, one of them made some basic changes whereas, the other one, who was performing modifications on the avatar's appearance in order to be used as part of the showcase demonstration, spent a considerable amount of time carefully editing body parts as the project of his team was dealing with the development of a smart/security vest for cyclists. In any case, none of the students was observed using the chat tool to make references or mentions to avatars at any given time.

Week 4. Only one student was observed working on the modification of his avatar's appearance in order to attach and correctly position the finalised scripted objects that were meant to be used for the demonstration of this team's showcase. As regards the chat tool, some very inappropriate comments (considering the university context) were observed being made by two students while commenting on the avatars of other students. It is, however, quite interesting to know and ponder on the fact that even though students were aware of being observed in real-time as well as of the existence of chat-logs, they still decided to use the in-world chat tool to make a rather inappropriate conversation.

5.2.2 Interactions with the World

Week 1. Only a few students were observed working or, more precisely, making some preliminary work related to their project for a couple of minutes just before the end of the practical session. Instead, students' attention almost monopolised by the content exploration and use (developed by other students/the researcher), the modification of their avatars' appearance, and the exploration of the in-world building tools. Indeed, most of the students spent a considerable amount of time exploring the content that had been developed by other students, visited and played with the games located at the amusement park, the mini lake and the café, though only one student was observed going through the maze. In any case, none of the students/teams was observed using or even being at the racing game. As to the exploration of the in-world tools, almost all the students exchanged friend requests both with their team members and their fellow students, and used the chat tool including the Instant Messages option. After being suggested by the lecturer, all the teams were observed setting up their own group (using the in-world function) and some students further explored the tools of the VW (e.g. weather settings, gestures). As far as the building tools are concerned, nearly all the students were observed using and editing some of the default library prims in order to better understand their capabilities, without, however, spending a considerable amount of time modifying them in a meaningful way. On the other hand, none of the students was observed exploring the programming language even though a mention was made by the lecturer.

Week 2. At the starting point of the practical session, most of the students were observed wandering around the showcases developed by others, in order to observe and discuss their functionality and get some ideas for their own work. However, all of them were quite sceptical and uncertain regarding the development process of their own showcases, due to the fact that they were still very unfamiliar with the development tools of the VW. Thus, a considerable amount of time, during the practical session, was dedicated for experimentation with the primitives that could be found in the in-world library, the importing process of textures and objects and, in some cases, even of

scripts (mostly premade ones that can be found on the web). After reaching half-way of the practical session, some students became keener to use objects developed by their class or team mates, to request some feedback or help from others and to teach others what they had discovered (peer-tutoring/peer-learning). It is worth mentioning that none of the students was observed approaching, visiting or using the content developed by the instructional designer at all, or performing in-world actions irrelevant to their project, other than some avatar appearance modification. Finally, a couple of students that were observed roaming quite often to other workspaces discovered and used the landmark tool, which allowed them to 'mark' several locations on the virtual map and, so, they could instantly teleport back and forth.

Week 3. Overall, it was a fairly 'silent' in-world observation as students were working focused on their task without being disrupted too often. This can be justified by the fact that only one week had been left prior to the submission of their assignment and, by extension, the completion of their virtual showcase and, thus, all of them had to hurry towards the final implementation and development of their showcases. The relatively few times during which students were observed performing actions irrelevant to their project, included visits to other workspaces and use of the scripted objects developed by others. It is worth mentioning that none of the students was observed visiting the content developed by the researcher at any time.

As far as the tools of the VW are concerned, the group function was proved to be quite helpful and handy for most of the developers, as they could edit and/or remove objects that other team members had created during the past days. In addition, even though a notable mention regarding poseballs was made in the physical classroom, only one team showed intense interest to use them in order to animate their avatars.

Week 4. Very few times were students observed performing in-world actions irrelevant to their project, such as visiting the workspaces of other students, or using the content developed by the researcher (actually, the latter was never observed). Indeed, very few students and for a small period of time were observed wandering around the workspaces of their virtual neighbours, though without using anything located there but only observing. Instead, most of them were usually located at their own workspaces, finalising their showcases by adding cosmetic primitives or scripts.

Only one group was observed missing important elements from their showcase, as they were fairly behind the schedule and a considerable amount of work had to done for its completion.

6 DISCUSSION & CONCLUSIONS

The main advantage of the Hybrid Virtual Learning approach is that it eliminates the drawbacks and the disadvantages that each one of the two educational methods, i.e. the virtual and the traditional classroom learning, have. However, this has a critical effect on the levels of immersion that students can reach due to the different types of stimuli they get from the physical classroom, the online (outside of the VW) available resources (as part of their research for their assignment) or even aspects related to their personal life and are completely unrelated to university (social media, phone-calls and texts).

Even though students had quite intense interaction with the content of the VW and its tools, especially during their first contact with the world, the levels of immersion were almost non-existent due to the often breaks they have had to discuss their in-world actions with their fellow-students in the physical classroom. Likewise, the parallel actions that most of the students were usually performing be it to help their fellow-students with other tasks or to provide some help (demonstrate) to those who were struggling to cope with the VW and its tools were also decreased the levels of immersion.

Finally, the fact that students were working over-focused on their task during the final stages of their assignment, can also not be considered as an indication of high levels of immersion given that most – if not all – of them were stressed and anxious to complete their in-world task so that they could get all the bits and pieces of their assignment together and submit their work.

We may therefore conclude that immersion does not seem to have much – if any – relevance when it comes to educational practices as opposed to virtual games. Even though in both cases in-world goals and targets are to be achieved (students want to complete their assignment in order to get 'real' marks and gamers want to complete a set of tasks in order to get the feeling of completion or joy), using a VW – even with game-like content – as an extension of the physical university does not lead students to encounter high levels of immersion.

Counterintuitively, this lack of immersion might well be a plus. It may lead to a useful distance between the student and their in-world task and

might even foster critical thinking and reflection on their actions. Educators and instructional/content designers should be aware of this when designing educational games: factors that help to support an immersive experience not necessarily correlate with factors that foster a situated learning experience. In any case we highly recommend that further research is needed to shed more light on this occurrence.

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