Athens Institute for Education and Research
ATINER

ATINER's Conference Paper Series
EDU2016-1945

# Changing Ways for a Better Education: A 3D Gamified Virtual Learning Environment (VLE)

**Luiz Corcini**
**MSc Student**
**UNINTER**
**Brazil**

**Luciano Medeiros**
**Professor**
**UNINTER**
**Brazil**

**Alvino Moser**
**Vice Rector and Professor**
**UNINTER**
**Brazil**

ATINER CONFERENCE PAPER SERIES No: EDU2016-1945

# An Introduction to ATINER's Conference Paper Series

ATINER started to publish this conference papers series in 2012. It includes only the papers submitted for publication after they were presented at one of the conferences organized by our Institute every year. This paper has been peer reviewed by at least two academic members of ATINER.

Dr. Gregory T. Papanikos
President
Athens Institute for Education and Research

This paper should be cited as follows:

**Corcini, F., Medeiros, L. and Mosser, A.** (2016). **"Changing Ways for a Better Education: A 3D Gamified Virtual Learning Environment (VLE)",** Athens: ATINER'S Conference Paper Series, No: **EDU2016-1945.**

Athens Institute for Education and Research
8 Valaoritou Street, Kolonaki, 10671 Athens, Greece
Tel: + 30 210 3634210 Fax: + 30 210 3634209 Email: info@atiner.gr URL: www.atiner.gr
URL Conference Papers Series: www.atiner.gr/papers.htm

ISSN: 2241-2891
24/08/2016

# Changing Ways for a Better Education: A 3D Gamified Virtual Learning Environment (VLE)

**Luiz Corcini**

**Luciano Medeiros**

**Alvino Moser**

## Abstract

It is widely proven that the NICTs (New Information and Communication Technologies) require the educators and teacher's new attitudes and methodologies. Digital youth crave for faster response to their actions; contextualization, objectivity and applicability in the subject matter in the classroom; connectivity and interaction with their peers and they prefer the doing-based learning.

This requires the teacher's accommodation effort, overcoming the assimilation to reinvent and transform before in catalysts and mentors than transmitters, exploiting the full potential of digital media, rather than assimilating them, guided by constructivism, socio-interactionism and connectivism.

These assumptions guide the project of creating a gamified 3D virtual learning environment that uses an open-source server platform for hosting virtual worlds and a meta-verse. An intelligent tutoring system (ITS), developed in PHP language, to guide and monitor the students in the virtual campus in a pedagogical way. The 3D virtual learning environment's interface to the ITS will be done by a web server and a relational database will be used for data storage.

In this 3D Gamified Environment the student will be able to explore a virtual campus, with activity rooms (that follow the curriculum requirements), a library (documents, links, videos, websites, games), a study room, interaction environments and a codesign, they (the students) will be constantly challenged to solve tasks, carry out or complete the surveys and submit proposals, among others tasks.

As a result we expect a better motivation and knowledge retention by the students, because they will be unwittingly monitored, challenged and constantly guided by the ITS that, as a coach does with his players, will monitor and verify performance, stimulate curiosity and drive the resolution of tasks to awaken and maintain students interest in their path in the learning process, overcoming their limitations and reaching goals.

**Keywords**: 3D Virtual World, Education, VLE.

## Introduction

The stages through which humanity has passed in the course of its evolution, such as the stone tool-dependent societies, the bronze and iron Ages, the Great Navigations Period, passing through the Industrial Age, the Information and Knowledge Eras, till the present day, were marked by the search for adaptation and the creation of tools that enhance and facilitate the execution of daily tasks to achieve certain goals. This use of tools and technologies as a way to perform daily tasks such as hunting, eating, protecting yourself, navigating, fighting, storing and manipulating data, distributing information and even learning and educating is called technological mediation.

The concept of mediation is due to Vygotsky (Taille et al. 1992, p.27), where he states:

> "Mediation [...] is the intervention process of an intermediate element in a relationship; the relationship is no longer direct and comes to be mediated by this element".

In this study, we consider technological mediation that supports the teaching and learning process.

With the advent of the Internet and all the ensuing innovations since then, allowed the creation of a new range of possibilities for the development of technological tools that significantly changed the way to communicate, to socialize to perceive the world, to sharing data and information, and in particular, to learn and to teach. These tools or technological devices were called New Information and Communication Technologies (NICT).

In fact, currently, we are surrounded by technological tools that assist us in performing many everyday tasks and we are so familiar that we do not even realize them, but it is certain that many of us could not think of the world without them.

The massive use of NICTs in day-to-day gave rise to a different generation: the hypermedia generation, as defined by Munhoz (2015) or the Digital Natives, as Prensky (2001) prefers, and which, according to the latter one, not only changed the way of dress or speak, not only changed the taste for music or tv series, but also changed the way they learn and assimilates knowledge.

This new generation of learners, characterized by always being on or connected to the Internet are attracted by technology and have not accepted the traditional methods of teaching, which is focused on the teacher as the only source of knowledge and a passive behavior.

NICT has an important role in generating possibilities of tools used to mediate the content to be presented by the teacher to the student. This technological mediation in education can improve the teacher-student relationship and also allow them to put the process of teaching and learning in a technological level never conceived before. Table 1 below shows some examples of these possibilities.

**Table 1.** *Technologic Mediation Examples*

| | |
|---|---|
| **VLE**[1] | A virtual learning environment (VLE) is a set of teaching and learning tools designed to enhance a student's learning experience by including computers and the Internet in the learning process[2]. |
| **E-Learning**[3] | E-learning is electronic learning, and typically this means using a computer to deliver part, or all of a course whether it's in a school, part of your mandatory business training or a full distance learning course[4]. |
| **MOOCs**[5] | MOOCs is an online course aimed at large-scale interactive participation and open access via web[6]. |
| **B-Learning**[7] | The term blended learning is generally applied to the practice of using both online and in-person learning experiences when teaching students[8]. |
| **M- Learning**[9] | Mobile learning is the ability to obtain or provide educational content on personal pocket devices such as smartphones and mobile phones. Educational content refers to digital learning assets which includes any form of content or media made available on a personal device[10]. |
| **Flipped Classroom** | The flipped classroom describes a reversal of traditional teaching where students gain first exposure to new material outside of class, usually via reading or lecture videos, and then class time is used to do the harder work of assimilating that knowledge through strategies such as problem-solving, discussion or debates[11]. |
| **Self-Directed Learning** | "In its broadest meaning, 'self-directed learning' describes a process by which individuals take the initiative, with or without the assistance of others, in diagnosing their learning needs, formulating learning goals, identify human and material resources for learning, choosing and implement appropriate learning strategies, and evaluating learning outcomes[12]. (M. Knowles, Principles of Andragogy, 1972)" |
| **OER**[13] | Open Educational Resources (OERs) are any type of educational materials that are in the public domain or introduced with an open license[14]. |

As we can see, examples of technological mediation listed above can be widely used as different resources for teaching, both in the presence and distance classes.

Besides the available technology and the ease way of assimilation and use by the students of the digital generation, a third factor appears relevant in this

[1] VLE – Virtual Learning Environment.
[2] http://whatis.techtarget.com/definition/virtual-learning-environment-VLE-or-managed-learning-environment-MLE
[3] E-Learning – Electronic Learning
[4] http://www.virtual-college.co.uk/elearning/elearning.aspx
[5] MOOCs – Massive Open Online Courses.
[6] http://desarrolloweb.dlsi.ua.es/moocs/what-is-a-mooc
[7] B-Learning – Blended Learning
[8] http://edglossary.org/blended-learning/
[9] Mobile Learning – Mobile Learning
[10] http://www.mobl21.com/Basics_Of_Mobile_Learning.pdf
[11] http://www.uq.edu.au/teach/flipped-classroom/what-is-fc.html
[12] http://www.selfdirectedlearning.org/sdl-definition-rationale-background-2
[13] OER – Open Educational Resources
[14]http://www.unesco.org/new/en/communication-and-information/access-to-knowledge/open-educational-resources/what-are-open-educational-resources-oers/

process: The teacher's ability to assimilate these technologies so that he can feel comfortable with them long enough to use them in their classes.

The development of this project has identified a singular relationship between learners and teachers, in which the first ones are master in the use of new technologies in day-to-day activities, but not about the content of the subject and the latter ones dominate the content to be taught, but not the new technology devices or programs to enable a truly productive mediation.

Based on this, the purpose of this work is to create a Virtual and Immersive 3D Environment using a set of several features listed in table 1, always emphasizing the importance of teacher-student relationship as mentioned by teachers Soares, Valentini and Rech (2011, p.43):

> "The source for the creation of a dynamic learning environments is the communication between students and teachers that make the interaction flows, which support the development of learning contexts. Such interaction flows are the basis of coexistence network that can arise in these environments, through coordination of recursive conduct"

Thus, this project aims to support both the student and the teacher.

With respect to the student, the process of discovery of contents to be learned will be through a contextualized and meaningful learning using gaming features, such as storytelling, quests and puzzles, points and badges. For the teachers a friendly environment will be developed, in order to facilitate the process of adapting to this new technological scenario by the use of an Intelligent Tutoring System.

We should formally define the central object of the project, the Virtual Learning Environment, and consider to this work the following definition:

> "Virtual Learning Environments are spaces that are established by digital technologies, going beyond the limits of the classroom or the interface of a portal, so that the relevant are the interactions and dialogues that arise among the process of the actors involved the environment: Teachers and Students" (Soares, Valentini, and Rech, 2011, p. 40)

Educational activities implemented in Virtual and Immersive 3D Environments, according to Gomes (2014, p.2), can take many forms:

- Acquiring practical knowledge;
- Collaboration, group work and distance learning;
- Discovery, investigation and discussion;
- Simulation and Problem Solving;
- Motivation;
- Creating interactive and hypermedia learning environments ;

As mentioned by Soares (2011, p.43), the enhancement of knowledge construction takes place by the insertion and use of different media for

communication flows within the virtual environment. This fact is explained by the perception that it is natural that we have within the same class different types of learners and, consequently, different ways of learning. The focus is not the interface itself, but how the interface proposes and accepts the pedagogical communication.

It is also important to consider what is mentioned by Carlos Cela (2012), when he observes that living in cyberspace cannot compare, nor, above all, replace the real acquaintanceship. This way, the expected results should aim for a better engagement and greater retention of knowledge by the student and a better class control by the teacher, who will thus have time to manage their classes and the development of the skills of their students.

*Objective*

The goal is to identify how effective the use of an immersive 3D virtual environment is in the retention of knowledge and commitment to student learning

## Literature Review

*Virtual and Immersive Learning 3D Environment*

3D virtual worlds are environments in which the real world can be simulated. Users can move using virtual representations called avatar and they can interact with each other and with the environment objects in a synchronous way. (Kapp & Driscoll, 2010 *apud* Yilmaz, 2013, p.1).

The use of 3D Immersive Virtual Worlds provides a rich educational experience in detail, sense of immersion and the possibility of interaction with various educational resources. (Moura, Mendes, & Souza, 2012, p. 1).

Yilmaz (2013, p.1) also points out that 3D virtual worlds differ from other learning environments in their similarity to the real world, providing opportunities for more effective interaction and communication.

The teaching-learning immersive environments denote a possibility for the learner's development differently, by immersion in environments that recreate classrooms, laboratories, conferences and different contexts to explore.

Virtualization environments, according to Oliveira et al. (2014, p.3) is an alternative that brings numerous innovative possibilities and can modify parameters, such as: differentiation and student motivation; possibility for the learning process occurs with individuals geographically spaced; the collective construction of knowledge in specific environments for such purposes, among others.

An important factor is mentioned by Moura et.al (2012, p.1), which warns that the use of virtual worlds for learning cannot take into account individual and contextual characteristics of learners.

Another crucial point when it comes to developing interactive 3D content or a learning object is the organization of how the content is presented to the learner because, as described Munhoz (2015), the script and the storytelling of a given scenario is as or more important than the content that you want to teach. It means that, it's an engaging story and a consistent script that calls the student's attention and motivates for learning and not the opposite.

Thus, we believe that the development and use of digital roadmap for logic modeling immersive content, contextualizing the content to be learned, and the way they are treated is extremely important to the success and effectiveness of 3D immersive content. (Oliveira et al., 2014, p. 2).

In this study, the resource used to treat the problem of lack of context or identifying the individual characteristics of learners is the use of intelligent agents and intelligent tutoring systems (ITS) or called intelligent agents with pedagogical features described later in this document.

One of the features that attract many teachers, researchers and even educational institutions to develop projects using the Virtual Worlds is the ability to recreate reality and to test conditions with minimal budget constraints compared to a test performed in the real world. Beyond that recreation or simulation of the real world, there is also the possibility of creating scenarios, scripts and stories in fictional worlds where the limit is the creativity of its developers.

The Virtual World 3D Immersive proposed by this paper aims to aggregate all these considerations, so that the student can actually use it without losing the reference of the institution and its teachers in real life.

## Virtual Coexistence

In proposing the study of 3D virtual learning, you need to analyze what constitutes this virtual coexistence.

The coexistence within the meaning of Maturana, implies a living relationship in which exchanges are regulated by relations in which everyone is respected and there is no coercion. Emotions are based on respect for the other, it is essential that there is a transcendence of hierarchical relationships, because for Maturana (2001, p. 69), these are based on mutual denial, the requirement of obedience and a power relationship. "The power comes with obedience, and obedience is the power as mutual denial relationship" .

### *Intelligent Tutoring System (ITS)*

The use of intelligent agents has increased over the years, due to the distributed intelligence and mutual interactions that may emerge in a system composed of a number of agents. An agent is any system which can be considered able to perceive its environment via sensors and act upon this environment (Russel and Norvig, 2004). Intelligent agents were first mentioned in the pandemonium of Oliver Selfridge: instead of having a single program responsible for implementation, a number of small programs would be charged

with carrying out reconnaissance tasks collaboratively standards (Teixeira, 2008). The agent use strategy is also aligned with the design of Minsky on the mind consists of simple agents that cooperate and compete in a kind of society, in the genesis of the complexity of the human mind (Minsky, 1989).

In a line with the educational area perspective, intelligent tutoring systems (ITS) are programs that aim to apprentice teaching, aligned to a teaching process that is well directed and restricted scope of the knowledge domain which is part of the ITS . A software is considered an ITS if it has these three characteristics (Burns and Capps, 1988):

- Contains the knowledge domain to act as a human expert;
- Is able to assess the stage of the student's knowledge;
- Should perform a teaching strategy that minimizes the difference between the knowledge of the expert and the novice.

Thus, the ITS are instructional computer-based systems with instructional content models that specify "what" teach, and teaching strategies that specify "how" to teach. (Wenger, 1987 apud Gavidia and Andrade, 2003, p.7).

Intelligent Tutors Systems (ITS) originate in Artificial Intelligence (IA) in the late 1950s. The idea was to build computers that could "think" like humans and perform any task that were associated with human thought (Gavidia and Andrade, 2003, p. 3), such as the instruction.

Soliman and Ghetto (2010) point out that there has been an effort to employ the ITS in traditional learning because they have the potential to provide learning environments with greater wealth of resources and exploitation of contextualized social aspects of learners. (Moura, Mendes and Souza, 2012, p. 5).

The main features of ITS, in Vizcaya (2001) apud Gavidia and Andrade (2003'p.7) are:

- The knowledge domain;
- Know the student reality, allowing to direct and adapt education;
- The sequence of teaching is not predetermined by the instructional designer;
- performing best suited and more detailed student's diagnostic procedures ;
- A better teacher-student communication improves, allowing the student to perform questions to the teacher;

Following the above, the Intelligent Agents and Intelligent Tutoring Systems can perform various tasks in a VLE to assist the teacher in evaluating the performance of their students face the difficulties encountered on the path of emancipation. We can cite as an example the following tasks: monitoring the activities of apprentices, capturing your contextual information automatically, such as a preference for a particular type of content, the difficulty in resolving certain activity and the frequency of use of resources, in

addition to performing the learner's direction on the recommendation of educational content. (Silva, 2011 apud Moura, 2012, p.5).

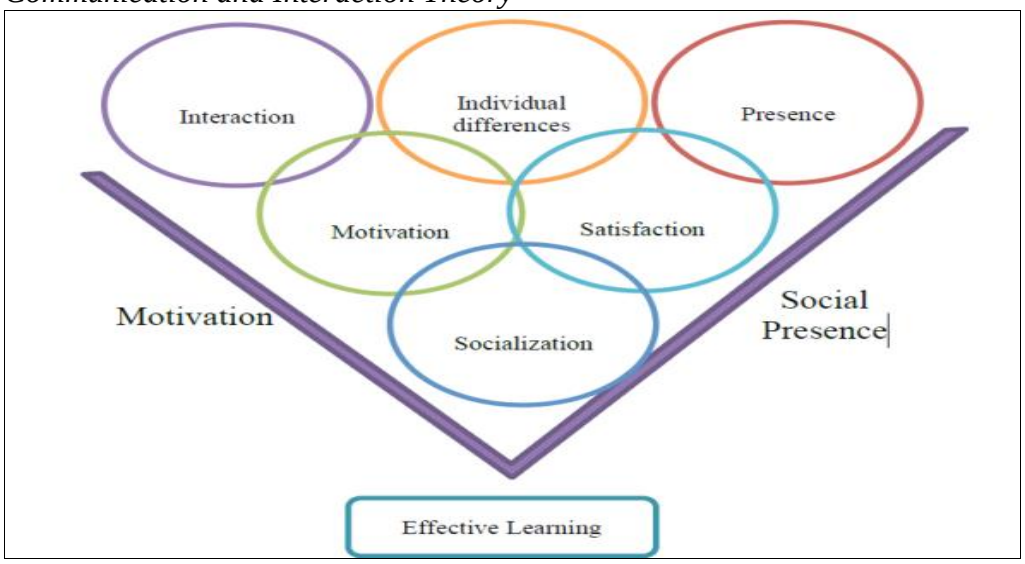
## Methodological Framework

In this project, we followed the steps determined by Oliveira et al. (2014, p.5-6) in creating a methodological framework for a 3D Virtual World, which consists of the following steps:

1. Conceptual Definition of the environment;
2. Description of the actions of objects;
3. Definition of the navigation flow and interaction between objects for sequential environmental class;
4. Insert multimedia content;

For this project, necessary characteristics for effective learning were also considered, defined by the Holmberg's Theory of Motivation and Interaction: Interaction, Identification of individual characteristics, sense of presence and belonging, satisfaction, motivation and socialization, as shown in the Figure 1.

**Figure 1.** *The Relationship between Motivation and Social Presence in the Communication and Interaction Theory*




*Source*: Holmberg's Theory (1983, 1997, 2003) *apud* Yilmaz (2013, p.2).

Where we highlight the terms because they are the basis of the methodological framework developed in this project. So we have:

- Interaction: The Interaction between the avatar and the objects;
- Motivation: several factors can contribute to the student's motivation to participate in the process. The Self-Determination Theory of Deci and Ryan (1985) is one of them. Others are points and badges, depending

on the student's profile. This profile is determined by the Bartle's prototypes.

- Socialization: The student needs to feel part of a group. By identifying the characteristics of a particular group and socialize with him, the student begins to feel motivated; you realize that it makes a difference.
- Satisfaction: The satisfaction for the task well done, to feel himself useful for the group
- Individual Differences: Each student has a unique cognitive trait, a way to learn and a way to respond to each unique mission or task proposed task during the teaching-learning process.

*Samples of the Framework's Importance*

As a sample of this methodological framework we can present Ronan's article (Ferreira, 2014, p. 1) that points out that even with a great number of Virtual Learning Environments available, it is notable as they lack satisfactory solutions with greater interactivity and sense of presence in the virtual activities.

Another example is about (Oliveira, et al. 2014, p. 2)… where they explain that the development and use of a digital roadmap for logic modeling immersive content, contextualizing the materials and how they will be treated in an immersive VLE, is of paramount importance to the success and effectiveness of the use of immersive 3D content.

Moura et al. (2012) points out that even in the face of so many features, researchers conclude that a VLE cannot replace the interaction between student and teachers. A problem that occurs in most VLEs is that the content is passed to all students in the same way and does not change according to the need of each.

But according to Silva (2011 apud Moura 2012, p.5), intelligent agents or Intelligent Tutorial System [1](ITS), can perform various tasks in a VLE such as monitoring the activities of users, capture automatic so its contextual information, such as preference for a particular type of content and frequency of use of resources, in addition to realize the personalized recommendation of educational content.

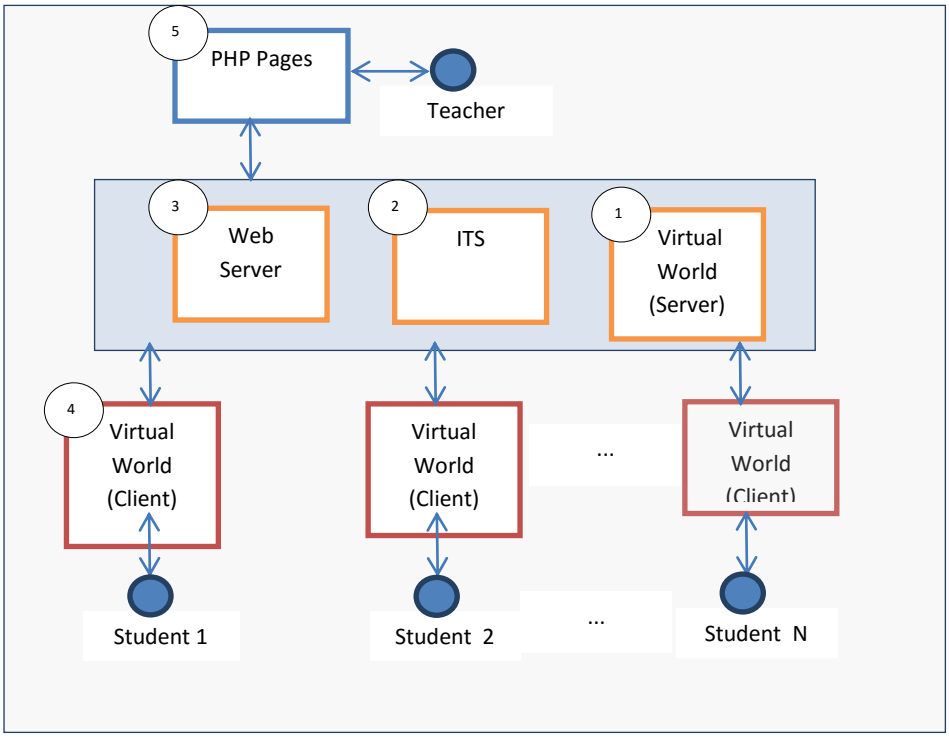
## The Designing Project

This project refers to the creation and development of 3D Virtual World for students of Epistemological Foundations of Technological Mediation, which is a discipline of the Master's Degree in Education and New Technologies in order to propose an alternative methodology for the learning.

The figure below schematically represents the general project proposal as well as its parts.

[1] The position of the ITS in the diagram's project is shown in Figure 2.

**Figure 2.** *Project's Diagram*




In Figure 2, we have some items to explain:

(1) 3D Virtual World (Server):

The 3D Virtual Environment's Server. This server is responsible for centralizing the implementation of certain programs (more general and complex) that enable the delivery and implementation of a virtual environment on client machines.

The Virtual Worlds Server we chose to use in this project is OpenSimulator1, also known as OpenSim.

The OpenSim is an open source application server, multi-platform and multi-user. It can be used to create customized virtual environments (3D worlds) that can be accessed through a variety of clients in multiple protocols.

Written in C # language, runs on both Windows operating system (.NET framework), as the Unix operating system (Mono framework). The source code is released under the BSD license.

Characteristics:

- Supports 3D environments, online and multi-user;
- Supports multiple clients and protocols;
- Supports physical simulations in real time;
- Supports customers who create 3D content in real time;

[1] OpenSimulator: 3D Virtual World Simulator. Available in: http://opensimulator.org/ - accessed at: 04/12/2016)

- Supports scripts;
- Provides unlimited ability to customize the virtual world applications;
- Can be run on a unique machine or on the same machine that will run a client viewer.

(2) ITS – Intelligent Tutoring System:

Developed in LSL (Linden Scripting Language), a language script available in OpenSim Viewer itself, containing:

- Logical and operating strategies and direction as the performance and reactions of learners;
- The read access and write data to the relational database (MySQL);
- And the access to sending and receiving messages to the Web page. These pages are developed in PHP Language.

(3) Web Server:

Web servers are computers with special software that allows the acceptance of client computer requests and return responses to those requests. Web servers let you share information over the Internet or an intranet or extranet. In this project the Web Server will be simulated by WampServer application, which is a web development environment for Windows operating system that allows you to create web applications with Apache 2, PHP and MySql database.

(4) 3D Virtual World (Client):

As Client for OpenSimulator, we choose the Viewer called Imprudence, an open source metaverse viewer project based on the Second Life Viewer source. The goal of Imprudence is to greatly improve the usability of the Viewer through community involvement, thoughtful design, modern development methods, and a pro-change atmosphere. The Viewer Imprudence[1] has limitations with respect a: mesh e a put media on a prim. So, we began to use the Viewer FireStorm[2], which proved much better and no heavier (computationally talking) than the previous.

Here are some photos that present an overview of immersive 3D virtual environment of this project.

[1] Imprudence Viewer. URL: http://blog.kokuaviewer.org/ -accessed at: 04/12/2016
[2] FireStorm Viewer. URL: http://www.firestormviewer.org/ - accessed at: 04/12/2016

**Figure 3.** *Identification Area.*


**Figure 4.** *North view of the Scenario*

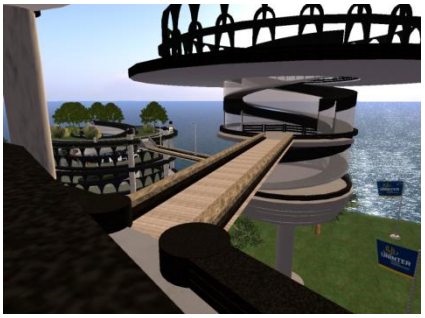


**Figure 5.** *Another Scenario's View.*

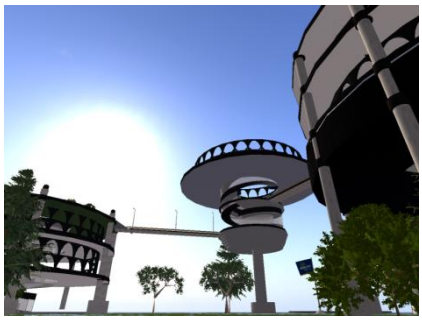
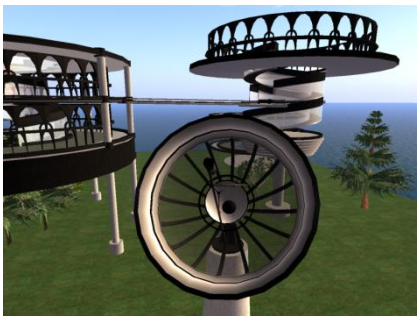


**Figure 6.** *Another Scenario's View*



(5) PHP Web Pages:

Web pages developed in PHP Language will be responsible to create the interface between the teachers and the Intelligent Tutoring System (ITS) in the Virtual World. As mentioned in this document, the ITS will help the teacher or tutor in verification and analysis of student's performance in the Virtual World. The data collected by the ITS will be stored in MySQL database and/or Notecards within objects. In this kind of web pages, the teachers can have a friendly interface to understand this data and may issue reports as well as change settings and instructional designer's pre-defined strategies.

*The Stages*

According to what was described in the methodology, this project follows the following instructional design:

Stage 1

The first step was to define a scenario and script - a story - which has the function to engage the student and attract to the content to be learned.

Stage 2

Definition, along with the teacher responsible for the course (Professor Alvino Moser and Professor Rodrigo dos Santos), what are the themes or topics covered.

At this stage the condition or situation that the avatars of students could contact them was also defined.

Stage 3

Description of the appearance and behavior of every object that the Avatar learner can interact within the virtual environment scenario.

Stage 4

This stage treats the scriptwriting the virtual environment. Descriptions of sequences interaction that can occur between the avatar and the objects of the scene so that the learning process is effective.

Stage 5

This stage treats the distribution of multimedia content within the environment. What multimedia content must be entered and where they should be inserted.

Stage 6

This stage treats the definition of the learning strategies used by ITS and current development of the Intelligent Agents as well as the design and structuring of database.

Stage 7

This stage treats the definition of web page layout, report type and available settings for the teacher in order to allow the course management.

## Conclusion

As part of a larger study on the topic (thesis) this article cannot have, in this moment, all the data it needs to generate conclusions on the subject.

The following steps, namely: insertion of the completion of multimedia contents in the 3D virtual environment and testing with a group of students will allow an expected analysis on the retention of knowledge.

## References


Burns, H. L.; Capps, C. G. (1988) *Foundations of Intelligent Tutoring System: A Introduction*. Hillsdale, N.J.: Lawrence Erlbaum Associates.

Cella, C. (2012) *Angry Young Postmodernism* 3. ed. Lisboa: Lulu Enterprises.

Ferreira, R. L. R. (2014) *Aprendizagem com Tecnologia 3D em Educação a Distância* [*Learning with 3D Technology in Distance Education*]. 20 Congresso Internacional ABED de Educação a Distância. Curitiba: ABED.

Gavidia, J. J. Z.; Andrade, C. V. D. (2003) *Sistemas Tutores Inteligentes* [*Intelligent Tutoring System*.]. Universidade Federal do Rio de Janeiro. Rio de Janeiro, p. 24. Retrieved from http://cos.ufrj.br/~ines/courses/cos740/leila/cos740/STImono.pdf. [Accessed 02/04/2016].

Maturana, H.; Varela, F. (2001) *A Árvore do Conhecimento: As bases biológicas do entendimento humano* [*The Tree of Knowledge: The biological basis of human understanding*]. Campinas: Editorial Psy II.

Minsky, M. (1989) *A Sociedade da Mente* [*The Society of Mind*]. Rio de Janeiro: Francisco Alves.

Moura, Í.; Mendes, F.; Souza, P. (2012) *Utilização do Framework JADE no Desenvolvimento de um Mundo Virtual* [*Using the Framework JADE in the Development of a Virtual World*]. Exacta, BH. Retrieved from www.unibh.br/revistas/exacta. [Accessed 28/10/2015].

Oliveira, L. D. et al. (2014) Proposta de uma Arcabouço Metodológico para a Autoria de Conteúdo em Ambiente Imersivo de Ensino [Proposal of a Methodological Framework for Content Authored in Immersive Environment Education]. *RENOTE - Novas Tecnologias na Educação,* 12(19). Retrieved from http://seer.ufrgs.br/index.php/renote/article/view/50354 - [Accessed 28/10/2015].

Russel, S.; Norwig, P. (2004) Inteligência Artificial [Artificial intelligence] 2. ed. Rio de Janeiro: Elsevier.

Soares, E. M. D. S.; Valentini, C. B.; Rech, J. (2011) Convicência e Aprendizagem em Ambientes Viortuais: Uma Reflexão a partir da Biologia do Conhecer [Coexistence and Learning in Virtual Environments: A Reflection from the Biology of Knowledge]. *Educação em Revista, Belo Horizonte*, 27, p. 39-60, dez.. Retrieved from http://www.scielo.br/scielo.php?pid=S0102-46982011000300003&script=sci_abstract&tlng=pt. [Accessed 07/01/2016].

Taille, D. L.; Oliveira, M. K. D.; Dantas, H. (1992*) Piaget, Vygotsky, Wallon: Teorias Psicogenéticas Em Discussão [Piaget, Vygotsky, Wallon psychogenetic Theories In Discussion]*. São Paulo: Summus.

Teixeira, J. D. F. (2008*) A mente segundo Dennet* [*The Mind by Dennet*]. São Paulo: Perspectiva,.

YILMAZ, R. et al. Social Presence and Motivation in a three-dimensional virtual world: A explanatory study. *Australasian Journal of Education Technology*, Ataturk, v. 29, p. 823-839, 2013. Retrieved from http://ajet.org.au/index.php/AJET/article/view/425/778. [Accessed 28/10/2015].